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Abstract

This paper tries to answer the question how taxation of corporate and individual income affects competition among firms for highly-skilled human resources like CEOs. It shows that individual income taxes can perform a substantial impact on the outcome of such a competition if marginal tax rates are different like in an international labor market. Additionally, it presents the surprising result that in a local labor market for CEOs observed gross fixed salaries should decline in the individual income tax rate. The effects of taxation in a market for CEOs is in particular an interesting topic because recent developments with respect to compensation practices of top-level managers have opened a public debate about the use of instruments for regulating compensation of those managers. The investigation follows an analytical economics-based approach by extending an LEN type model of moral hazard with elements of competition and income taxation. It investigates the impact of differential taxation on the competition between two firms for the exclusive service of a unique, highly-skilled CEO.

Keywords: CEO, taxes, competition for talents, skilled human resources.

JEL Classification: D82, H24, H25, J31, J33, L13

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1 Introduction

In general, due to the enormous consequences of their decisions CEOs can have a fundamental impact on a firm's financial success. For this reason many companies seem to provide an extraordinary high effort on the hiring decision of their top level management and try to attract the most talented person for this important job by offering wage payments which appear to be far beyond the compensation levels of the remaining management.[1] In fact, various studies suggest that firms are in a competition for scarce human resources including talented CEOs where the intensity and outcome of this competition are determined by various factors including firm sizes and the marginal productivity of the CEOs involved. For instance, Gabaix / Landier (2008) show that in a market for talented CEOs the most productive CEO is hired by the biggest firm and the remaining managers become assigned by descending size and productivity as well.

However, recent developments of compensation practices of top-level managers have not only stimulated academic research on these issues but also opened an ongoing public debate about whether and how to regulate payments made by firms to their CEOs. One instrument which has been in favor by governments recently in order to perform regulating effects in this context is the use of the tax system.[2] Individual income taxes in the shape of wage taxes are common in most countries of the world do not only seem to be able to impact the contracts between firms and CEOs but can also perform a substantial influence on the market for talented CEOs. On the one hand, those taxes drive a wedge between the payment the firm offers the CEO and the payment he finally receives and therefore as a direct effect they tend to create the need for a higher gross compensation in order to preserve working incentives. On the other hand, wage taxes can have an indirect effect on compensation levels and the competition for CEOs as well since they may affect all competing firms differently (e.g. due to existing pre-tax distinctions like CEO productivity or different wage tax rates). However, by now the effects of taxes on the market for scarce human resources has not been addressed in academic literature.

To the best of my knowledge, this is the first paper to undertake an investigation integrating the fields of managerial incentive design, competition for talents and taxation while providing a strong focus on wage taxes at the CEO level. The central contribution of this paper is to obtain a richer picture on how taxes impact the competition for CEOs. Therefore it examines the following research questions: What impact do taxes have on firms' competition for CEOs? How are compensation levels of CEOs affected by taxes? How do expected utility levels of CEOs and expected profit of firms change under (differential) taxation?

The research questions are addressed by using an LEN type agency model of moral hazard with two identical, risk neutral firms (principals) competing with each other in order to hire a single CEO (agent).

[1] Mishel / Davis (2014) document that the CEO-to-worker compensation increased from 20-to-1 in 1965 to 510.7-to-1 in 2013 with an average CEO pay of $ 24.8 million.

[2] For instance, in 2013 the Austrian government introduced a progressive tax system for bonus payments which have been subject to a very generous preferential tax treatment formerly. Current plans of a tax reform scheduled for 2016 include a temporary increase of the marginal tax rate for people who earn more than € 1 million a year.

This CEO represents an effort averse 'superstar manager' with a unique ability to increase the expected profit of the hiring firm by performing a non-observable task. As this makes the manager desirable for both firms, each of them offers a compensation contract that (i) uses incentive pay in order to ensure a desired effort level in case the CEO can be hired and (ii) tries to outperform the contract offered by the competitor and hence to attract the CEO. However, in this model the expected utility the manager can receive from an agreement with either firm crucially depends on the obligated amount of wage tax to pay and the compatibility of the CEO with the competing firms. Wage taxes might vary substantially among the firms because in international setting the firms may be located in different tax jurisdictions with different individual income tax rates. Further, the manager's compatibility can be different among the firms due to different organizational structures or culture.

In order to present the impact differential taxation within this setting in a meaningful way, the paper compares the situation of different marginal tax rates applied at both firms to a setting where all contracting parties are subject to a uniform linear wage and corporate income tax. A central finding of this paper is that individual income taxes become an important determinant of the competition outcome if wages are taxed at different rates. The paper illustrates that a sufficiently large tax rate differential is able to offset an existing pre-tax disadvantage due to different compatibility and therefore the competition outcome under uniform taxation might be changed by differential taxation. However, I show that this tax effect can be moderated in a situation of non-observable effort due to an additional effect the tax rate difference has on the compensation risk of the CEO. Additionally, under differential taxation a marginal increase of the individual income tax rate applied at the successful firm has an ambiguous effect on the offered fixed salary.

In contrast to this observation, we can find quite unexpected effects of a uniform wage tax on the observed gross wages received by the CEO. In a competition setting, an increase of the uniform wage tax rate reduces the fixed salary offered by both competitors. Even though this result seems to be paradox at first glance, the intuition behind it can be found in the fact that wage taxes do not only reduce the expected utility the CEO can gain from working for one firm but also reduce his reservation utility which in turn tends to lower the compensation needed in order to attract him. The paper shows that this second indirect effect of wage taxes on the gross compensation dominates the direct tax effect and hence observed fixed salaries decline under uniform taxation. Therefore, the paper indicates that assumptions concerning the taxation of an agent's reservation utility can be crucial when assessing the effects of taxes in agency models. By explicitly modeling the agent's alternative working opportunity it presents a possible way to address this issue.

The paper proceeds as follows. Section 2 provides a brief review of the literature investigating the field of competition for scarce human resources and the effects of taxation in agency relationships. Section 3 explains the basic model setup and section 4 derives results for a competition among firms in a situation of observable effort. Section 5 provides the competition equilibrium with non-observable effort and section 6 outlines the impact of marginal changes in tax rates. Finally, section 7 concludes and discusses limitations of this investigation.

2 Related Literature

This paper tries to combine different topics that have been investigated only partially together by now and therefore it adds to several streams of literature. The aim of this section is to provide a brief overview about publications within these separate fields which are closely related to this paper.

First, this paper extends prior contributions concerning corporate governance and optimal design of incentives for top-level managers. In particular, it considers an agency problem of moral hazard, which among others has been described analytically in the seminal work of Holmström (1979). He investigates optimal sharing rules between two contracting parties in a setting of delegation and finds that optimal risk allocation cannot be achieved under imperfect information due to the need of providing working incentives for the better informed party. The LEN model dates back to Spremann (1987) and represents a special case of the general problem of moral hazard. Holmstrom / Milgrom (1987) provide further details on the underlying assumptions which justify the application of linear compensation contracts.

Second, this paper adds to a considerable amount of publications investigating the role of taxation on executive compensation and instruments of corporate governance. Among others, Halperin / Kwon / Rhoades-Catanach (2001), Katuscak (2005) and Niemann (2008) find for different agency models of moral hazard that a corporate income tax (without any limits of deductibility) does not affect pre-tax incentives. Further, the latter two papers show that a wage tax reduces the effort exerted by the agent and therefore tends to increase compensation costs for the firm. However, both admit that taxes might lead to additional effects, if the perspective of the manager's alternative working opportunity is taken into consideration. Katuscak (2009) provides empirical evidence for the impact of wage taxes on executive compensation and shows that an increasing tax rate implies a decrease in the pre-tax pay-to-performance sensitivity generated by stock option grants. In contrast to this result, Frydman / Molloy (2011) indicate that a negative association between executive compensation and wage taxes exists only in the long run. They find total compensation as well as the structure of compensation to be unresponsive to major changes in tax rates. However, they use a sample of U.S. firms and therefore lack the ability to exploit another source of variation in wage tax rates which occurs in an international job market for CEOs. Martini / Niemann (2014) provide insights into tax issues which arise in an situation of international labor mobility of managers. In particular, they investigate the impact of taxation on assignment decisions of human resources under different methods for avoiding double taxation using an LEN model of moral hazard. They find that the optimal assignment decision depends on both corporate and wage taxation. Further, the impact of the variation in the wage tax rate on the optimal assignment decision is ambiguous and depends on the method for avoiding double taxation.

Finally, this contribution relates to several publications which provide an explanation for recent trends in CEO compensation practices. Murphy / Zabojnik (2004) document among others that CEO compensation has increased substantially over the last decades and explain this trend by an increase of competition

among firms for highly skilled CEOs.[3,4] Murphy / Zabojnik (2007) show analytically that the firms' increasing demand for general management skills (in contrast to firm-specific knowledge) is consistent with the observation of high compensation levels and hiring external CEOs from the market more frequently. Terviö (2008) uses an assignment model approach in order to analyze the market for talented CEOs.[5] He finds that in a competitive market the most talented CEOs are hired by the firms with the biggest scale. Further, he concludes that the firms' different scale is more important for variations in the CEOs' compensation than the dispersion of their abilities. Gabaix / Landier (2008) extend this result and provide empirical evidence for a proportional connection between CEO compensation firms' market value.[6] Edmans / Gabaix / Landier (2009) develop a model which combines competition for talented CEOs with a problem of moral hazard. They show that the low level of fractional ownership observed in practice is consistent with optimal contracting if a multiplicative specification of the CEO's utility function and the production function is used. Additionally, the paper concludes that the high levels in total pay are driven by the firms' competition for scarce talented CEOs and are not affected by the firms' problem to provide working incentives.

3 Model Design

In order to address the question how competition and contract design for talented CEOs are affected by taxation I develop a partial equilibrium model, which extends an LEN type agency model with elements of competition for scarce workforce and taxes. In particular, I consider a situation of two firms (principals) which have the opportunity to hire a unique CEO (agent) for a single period. The risk-averse CEO represents a superstar manager who is able to cause a positive impact on the realization of the uncertain cash flow of the firm $\widetilde{x}$ via his privately known effort e. The realized cash flow of firm $i \in \{1,2\}$ when hiring the CEO equals $\widetilde{x}_i = \mu_i e_i + \widetilde{\theta}_i$. The random noise term $\widetilde{\theta}_i$ which is not observable for the firm represents all kinds of uncertainty associated with the generation of the cash flow and follows a normal distribution with zero mean and variance σ_i^2.[7] For the ease of exposition it is assumed that both firms face the same business risk and hence $\sigma_1^2 = \sigma_2^2 = \sigma^2$. Further, the marginal impact of the agent's effort

[3] Bebchuk / Fried (2004) also investigate those trends. However, they attribute the strong increase of compensation to the managers' ability to capture the board and therefore to influence the pay setting process.

[4] Other trends include for instance relatively high insensitivity of CEO compensation to firm performance and reward for luck. For a brief review on these trends and alternative explanations for them see e.g. Conyon (2006) and Edmans / Gabaix (2009). Frydman / Saks (2010) analyze the development of executive compensation in the U.S. from 1936 to 2005 and conclude that recent trends can not be explained by a single theory on their own.

[5] He bases his analysis on Rosen (1981) who was one of the first to provide an economic view on so-called superstars (meaning a small number of peoples earning an enormous amount of money).

[6] More recently, Cremers / Grinstein (2014) challenge the market based explanation for the increase of CEO compensation. Their empirical investigation suggests that the industry based variation in firm size does not have a significant impact on compensation levels.

[7] The random shocks affecting the cash flow of either firm $\widetilde{\theta}_1$ and $\widetilde{\theta}_2$ might be correlated with each other in any arbitrary direction. However, as the further analysis will show it is not necessary to make an assumption regarding their association because the respective cash flows can only be used separately within this model.

on the realized cash flow is equal for each firm with $\mu_1 = \mu_2 = 1$. These assumptions can be justified especially for those cases where two firms of the same industry and with similar size are competing for the exclusive service of the CEO.

When firm i is able to hire the superstar manager S it has to pay him a gross compensation of s_i. As the effort the CEO exerts can not be observed by either of both firms, each of them makes the offered compensation dependent on the realized cash flow in order to provide working incentives for the agent. Hence, in this case the firm's gross profit equals $\widetilde{\pi}_i|S = \widetilde{x}_i - s_i(\widetilde{x}_i)$. On the other hand, if firm i is not able to attract the talented CEO it has to hire some 'ordinary' manager O from the market which has no special ability for increasing the firm's cash flow and therefore generates a profit equal to $\widetilde{\pi}_i|O = \widetilde{\theta}_i$.[8]

As the paper aims to analyze competition among firms on a highly integrated international job market for scarce human resources it is assumed that both firms can be located in different tax jurisdictions with different tax systems. Such a market seems to be a very plausible one for CEOs which are hired by very large multinational enterprises. However, the competitors do not necessarily have to be in different nations as there also exist many countries in the world with income tax rates varying locally among states, districts or municipals.[9] I consider the taxable base for corporate taxation being uniform among firms and equal to the realized profit $\widetilde{\pi}_i$. However, this profit is subject to a proportional corporate tax rate τ_i with $0 \leq \tau_i < 1$ which can be different for both competing firms.[10] Under these assumptions, the realized after-tax profit of firm i is equal to $\widetilde{\pi}_{i,t} = (1 - \tau_i)\widetilde{\pi}_i$.[11]

The CEO's utility depends on his after-tax compensation $s_{i,t}$ he receives from being hired by firm i and the costs $c_i(e_i)$ of exerting effort for this firm. His utility function has an exponential form with

$$U(s_{i,t}, e_i) = -exp\{-r\left[s_{i,t} - c_i(e_i)\right]\}. \tag{1}$$

The parameter $r > 0$ represents the coefficient of constant absolute risk aversion of the agent. It is assumed that both firms offer only linear gross compensation contracts with $s_i(\widetilde{x}_i) = F_i + b_i(1 - \tau_i)\widetilde{x}_i$ consisting of a fixed salary F_i and a bonus coefficient b_i.[12] The CEO's realized gross compensation $s_i(\widetilde{x}_i)$ is subject to a proportional individual tax at the rate of t_i with $0 \leq t_i < 1$.[13] Therefore, his after-tax

[8] It is assumed that the ordinary manager would not exert any additional effort ($e_i = 0$). Further, his gross compensation equals a salary which is determined in a competitive market and normalized to zero here.

[9] For instance in 2013 in the U.S. the individual income tax rate varied on a state level from 0% to 12.3% additional to national taxes. Other examples for divergent income taxes are the sovereign cantonal tax regimes in Switzerland or municipal income taxes in Denmark and Finland. Schellekens (2013) provides a thorough overview on the income tax systems of many countries.

[10] Although different tax systems might imply differences in the tax rates and the taxable bases at the same time, the conjunction of these differences is approximated in this model by different tax rates only.

[11] Subscript t indicates the corresponding after-tax expressions for all variables.

[12] It should be noted that the agent's gross compensation s_i is based on the after-tax cash-flow $(1 - \tau_i)\widetilde{x}_i$. Another possible performance measure could be the firms after-tax profit which would incur a recursive relationship between the agent's compensation and the performance measure, because s_i serves as a tax shield on the firm level. However, I abstract from this consideration as it complicates the analysis without adding additional insights. See for instance Ewert / Niemann (2012) who provide a short description of this alternative scenario.

[13] Please note that the CEO's compensation might become negative if the realization of $\widetilde{x}_i$ is sufficiently low. As we do abstract from issues of limited liability and the existence of loss offset restrictions these negative tax payments lead to a

compensation is equal to $s_{i,t} = (1-t_i)s_i = (1-t_i)\left[F_i + b_i(1-\tau_i)\widetilde{x}_i\right]$. For the purpose of explicit solutions the agent's effort costs are considered to be quadratic with $c_i(e_i) = k_i\frac{e_i^2}{2}$. Without loss of generality it can be assumed that $k_2 \geq k_1 > 0$ and therefore one extra unit of effort is more costly for the agent when providing it for firm 2 in comparison to firm 1. The different marginal cost parameters k_i can be interpreted as different compatibility (higher values indicate lower 'fit') the CEO actually has for the competing firms which might be caused by various reasons. One explanation for this assumption could be the existence of different organizational structures or culture within the firms.

Provided the assumptions of a normally distributed wage payment and the negative exponential utility function with constant absolute risk aversion the expected utility of the CEO can be expressed by the utility of his certainty equivalent:

$$E\left[U(s_{i,t}, e_i)\right] = U(CE_i) \tag{2}$$

$$\text{with } CE_i = (1-t_i)\left[F_i + b_i(1-\tau_i)e_i\right] - \frac{r}{2}(1-t_i)^2(1-\tau_i)^2 b_i^2\sigma^2 - k_i\frac{e_i^2}{2} \tag{3}$$

It is assumed that both firms are able to offer a contract which the manager strictly prefers to any other of his outside options (including possible unemployment). Hence, the CEO decides to work for the firm which offers the higher certainty equivalent and randomizes with equal probability if both firms offer an equal amount. Put differently, from the perspective of contracting firm i the CEO's reservation utility is represented by the certainty equivalent offered by rival firm j.

As both firms are considered to be risk neutral they want to maximize their expected after-tax profits. Conditional on being able to hire the CEO the expected after-tax profit of firm i equals $E\left[\widetilde{\pi}_{i,t}|S\right] = (1-\tau_i)\left[(1-b_i)e_i - F_i\right]$. However, if firm i has to hire an ordinary manager the expected after-tax profit is equal to $E\left[\widetilde{\pi}_{i,t}|O\right] = 0$. Provided the CEO's decision rule for selecting his employer, firm i can choose the certainty equivalent it wants to offer the agent strategically by setting CE_i equal to an amount of u_i. The ex-ante expected after-tax profit of firm i is then dependent on the strategies u_i and u_j of both firms and has the following form:

$$E\left[\widetilde{\pi}_{i,t}\right] = \begin{cases} (1-\tau_i)\left[e_i - b_i(1-\tau_i)e_i - F_i\right] & \text{if } u_i > u_j \\ \frac{1}{2}\{(1-\tau_i)\left[e_i - b_i(1-\tau_i)e_i - F_i\right]\} & \text{if } u_i = u_j \\ 0 & \text{if } u_i < u_j \end{cases}$$

$$\text{with } i,j \in \{1,2\},\ i \neq j,\ u_i = CE_i \text{ and } u_j = CE_j$$

To summarize, each firm faces two interrelated problems. First, it wants to provide sufficient working incentives in order to maximize its profit conditional on hiring the superstar manager (contracting problem). Second, it has choose strategically a certainty equivalent offer which ensures that the manager gets attracted (competition game). Figure 1 depicts the timing of the game. In stage 1 both principals simultaneously choose a certainty equivalent u_i and u_j they want to offer the agent and provide a contract

full tax reimbursement to the agent. The same applies to negative profits of both firms.

offer $s_{i,t}$ and $s_{j,t}$ to the CEO. In stage 2 the CEO decides to work for one of the two firms and exerts effort. In the final stage the cash flows are realized, the CEO receives his compensation and taxes are paid.

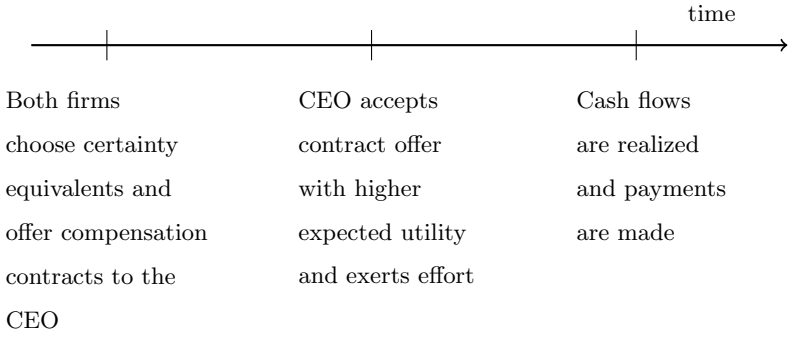

Figure 1: Timeline

4 Equilibrium With Observable Effort

In the first-best case the effort exerted by the manager can be verified by each firm. Even though this case occurs not very often in reality it should serve as a benchmark in order to evaluate the consequences of private information on the competition game among firms. As each firm can directly control the amount of effort exerted by the CEO no variable pay is needed in order to provide working incentives for the agent. For any given strategy in the competition game the contracting problem of firm i conditional on hiring the CEO is the following:

$$\max_{e_i, F_i} (1 - \tau_i)(e_i - F_i) \tag{4}$$

$$\text{s.t. } (1 - t_i)F_i - k_i \frac{e_i^2}{2} = u_i \tag{5}$$

In contrast to the standard agency problem u_i represents the strategy firm i chooses in the competition stage and not the agent's reservation utility (the certainty equivalent offered by the rival firm) per se. The optimal contract parameters can be calculated by using the Lagrangian approach and take the following values:

$$F_i^{fb} = \frac{u_i}{1 - t_i} + \frac{1 - t_i}{2k_i} \tag{6}$$

$$e_i^{fb} = \frac{1 - t_i}{k_i} \tag{7}$$

It is easy to observe that the corporate income tax does not have any influence on the optimal contracting parameters whereas the individual income tax has a direct proportional negative impact on the contracted effort level.[14] However, t_i has two opposing direct effects on the fixed remuneration. On the one hand,

[14] These results are in line with other papers investigating the role of taxes in a non-competition setting. See e.g. Niemann (2008)

due to the reduction of exerted effort it tends to reduce gross compensation. On the other hand, it creates the need for grossing up the offered amount of utility, because the tax reduces the net wage received by the agent. Further, t_i could also have a pontential impact on firm i's strategy u_i in the competition game.

For deriving explicit solutions of the competition game it is necessary to calculate the expected after-tax profit of firm i conditional on hiring the CEO by using the parameters of the optimal contract:

$$E\left[\widetilde{\pi}_{i,t}^{fb}|S\right] = (1-\tau_i)\left(\frac{1-t_i}{2k_i} - \frac{u_i}{1-t_i}\right) \tag{8}$$

In order to provide a better understanding how differential taxation impacts the competition for the CEO among the firms, Proposition 1 presents the equilibrium of the competition game under uniform taxation, hereby assuming that $t_i = t_j = t$ and $\tau_i = \tau_j = \tau$.[15]

Proposition 1 (Equilibrium of the competition game in the first-best case with uniform taxation)**.** [16]

1. *In a situation of uniform taxation, if the CEO is equally compatible with each firm ($k_1 = k_2 = k$), the equilibrium outcome of the competition game is $u_1^{fb,h} = u_2^{fb,h} = \frac{(1-t)^2}{2k}$ and the expected profits of both firms equal zero.*

2. *Assume ε to be the smallest currency unit available with the property defined in Assumption 1 (see Appendix).*[17] *If the CEO is more compatible with firm 1 ($k_2 > k_1$), the equilibrium outcome of the competition game is $u_2^{fb,h} = \frac{(1-t)^2}{2k_2}$ and $u_1^{fb,h} = \frac{(1-t)^2}{2k_2} + \varepsilon$. In this equilibrium the expected profits of the firms are $E\left[\widetilde{\pi}_{2,t}^{fb,h}\right] = 0$ and $E\left[\widetilde{\pi}_{1,t}^{fb,h}\right] = (1-\tau)(1-t)\left(\frac{1}{2k_1} - \frac{1}{2k_2} - \frac{\varepsilon}{1-t}\right) > 0$*

Proof. See Appendix. □

Proposition 1 shows that both firms are in a horse race to the top in order to attract valuable employees like the talented CEO. Under uniform taxation and perfect information about the agent's effort choice the equilibrium outcome of the competition is determined only by the compatibility of the manager with either firm. In a situation of different compatibility ($k_2 > k_1$) the inferior firm is willing to give up any economic rents from hiring the agent and hence earns an expected profit equal to zero. On the other hand, the successful firm can earn an economic rent which is increasing in the compatibility differential. However, in equilibrium uniform individual income taxes lower the amount of u_i and u_j offered by both competing firms. As this amount represents the expected utility the CEO receives in equilibrium, a uniform individual taxation has a negative impact on his rents in this competition setting. Further, assuming $\varepsilon \approx 0$ the expected profit of the successful firm is reduced trough uniform taxation by a multiple of $(1-\tau)(1-t)$.

[15] As the competition game is similar to a game with a Bertrand market most of the analysis which is done here is in line with this literature on industrial organization. See for instance Tirole (1989), Shy (1995) or Wolfstetter (1999) who provide insights on the equilibria of a Bertrand price competition.

[16] All equilibrium values associated with the situation of uniform (homogeneous) taxation a denoted by a subscript h.

[17] Assumptions 1–6 are necessary in order to ensure from a technical perspective that all illustrated equilibria can constitute under discrete currencies. Without those assumptions the possibility of overbidding the competitor by a 'small' amount is limited and hence this would lead to distorted solutions.

Finally, under uniform taxation the equilibrium values of the offered fixed salaries are:

$$F_1^{fb,h} = (1-t)\left(\frac{1}{2k_1} + \frac{1}{2k_2}\right) + \frac{\varepsilon}{1-t} \qquad F_2^{fb,h} = \frac{1-t}{k_2} \tag{9}$$

An examination of (9) with respect to marginal changes in t provides us with Corollary 1.

Corollary 1. *In a situation of uniform taxation and observable effort, individual income taxes reduce the gross salaries offered by both competing firms.*

The surprising result of Corollary 1 appears to contradict prior findings of theoretical literature about tax effects on managerial compensation and therefore calls for further explanation. If both firms are in a competition, the CEO has the power to extract all economic rents which (hypothetically) could be generated by working for firm 2, leaving firm 2 with an expected profit equal to zero. In this situation, an increasing individual income tax rate reduces these economic rents due to its negative effect on the CEO's optimal effort level (see (7)). This effect, however, exerts pressure on firm 2 to reduce the offered gross salary in order avoid a negative profit. As a result, the reduction of expected utility the CEO could receive from firm 2 has also a softening effect on the competition between the two firms and enables firm 1 to reduce the offered gross salary as a response.

The results in Proposition 1 illustrate that uniform taxation has no impact on the constitution of the competition equilibria. We now explicitly allow for differences in tax rates and therefore investigate the situation of competition in an international setting. Proposition 2 summarizes the equilibria and outcome of the competition game for this case.[18]

Proposition 2 (Equilibrium of the competition game in the first-best case with differential taxation)**.** [19]

1. *Assume ε to be the smallest currency unit available with the property defined in Assumption 2 (see Appendix). In a situation of differential taxation, if the CEO is equally competible with either firm ($k_1 = k_2 = k$), the equilibrium outcome of the competition game is dependent on the relation between the individual tax rates t_1 and t_2 only. More precisely, the following equilibria constitute:*

   (a) *If $t_1 > t_2$, in equilibrium $u_1^{fb,d} = \frac{(1-t_1)^2}{2k}$ and $u_2^{fb,d} = \frac{(1-t_1)^2}{2k} + \varepsilon$. The corresponding expected profits are $E\left[\widetilde{\pi}_{1,t}^{fb,d}\right] = 0$ and $E\left[\widetilde{\pi}_{2,t}^{fb,d}\right] = \frac{1-\tau_2}{1-t_2}\left[\frac{(t_1-t_2)[(1-t_1)+(1-t_2)]}{2k} - \varepsilon\right] > 0$.*

   (b) *If $t_1 < t_2$, in equilibrium $u_1^{fb,d} = \frac{(1-t_2)^2}{2k} + \varepsilon$ and $u_2^{fb,d} = \frac{(1-t_2)^2}{2k}$. The corresponding expected profits are $E\left[\widetilde{\pi}_{1,t}^{fb,d}\right] = \frac{1-\tau_1}{1-t_1}\left[\frac{(t_2-t_1)[(1-t_1)+(1-t_2)]}{2k} - \varepsilon\right] > 0$ and $E\left[\widetilde{\pi}_{2,t}^{fb,d}\right] = 0$.*

2. *Assume ε to be the smallest currency unit available with the property defined in Assumption 3 (see Appendix). If the CEO is more compatible with firm 1 ($k_2 > k_1$), the equilibrium outcome of the competition game is dependent on the relation between the compatibility parameters and the individual income tax rates t_1 and t_2. More precisely, the following equilibria constitute:*

[18] The proofs are similar to those in Proposition 1 and therefore omitted for brevity. This is also done for the remaining propositions in this paper for the same reason.

[19] All equilibrium values associated with the situation of differential taxation a denoted by a subscript d.

(a) *If* $t_1 < t_2$ *or* $t_1 > t_2 \geq 1-(1-t_1)\sqrt{\frac{k_2}{k_1}}$*: In equilibrium,* $u_2^{fb,d} = \frac{(1-t_2)^2}{2k_2}$ *and* $u_1^{fb,d} = \frac{(1-t_2)^2}{2k_2} + \varepsilon$*. The corresponding expected profits are* $E\left[\widetilde{\pi}_{1,t}^{fb,d}\right] = \frac{1-\tau_1}{1-t_1}\left[\frac{k_2(1-t_1)^2 - k_1(1-t_2)^2}{2k_1k_2} - \varepsilon\right] > 0$ *and* $E\left[\widetilde{\pi}_{2,t}^{fb,d}\right] = 0$*.*

(b) *If* $t_1 > t_2$ *and* $t_2 \leq 1-(1-t_1)\sqrt{\frac{k_2}{k_1}}$*: In equilibrium,* $u_1^{fb,d} = \frac{(1-t_1)^2}{2k_1}$ *and* $u_2^{fb,d} = \frac{(1-t_1)^2}{2k_1} + \varepsilon$*. The corresponding expected profits are* $E\left[\widetilde{\pi}_{1,t}^{fb,d}\right] = 0$ *and* $E\left[\widetilde{\pi}_{2,t}^{fb,d}\right] = \frac{1-\tau_2}{1-t_2}\left[\frac{k_1(1-t_2)^2 - k_2(1-t_1)^2}{2k_1k_2} - \varepsilon\right] > 0$.

The results of proposition 2 indicate that differential taxation at level of the CEO can have a substantial impact on the firms' competition for him. In the (degenerate) case of equal compatibility (part 1), the different individual income tax rates become the only force determining the outcome of the competition by providing the firm with the lower tax rate a competitive advantage. However, with different compatibility ($k_2 > k_1$, part 2) the impact of different individual income tax rates becomes more subtle. Whenever t_2 is greater than t_1, differential taxation has no impact on which firm wins the competition, because the effect of different compatibility is even enforced by the tax effect. On the other hand, if t_2 is smaller than t_1, the CEO faces a relatively smaller tax burden when working for firm 2. This effect moderates the disadvantage of different compatibility among the firms. As a result, if t_2 is sufficiently low ($t_2 \leq 1-(1-t_1)\sqrt{\frac{k_2}{k_1}}$) the tax advantage outweighs the compatibility effect and an equilibrium constitutes, where firm 2 wins the competition. It seems worth to notice that even under differential taxation, corporate income taxes have no influence on the competition for CEOs. This observation can be explained by the fact that τ_i simply scales the expected profits of either firm and hence is irrelevant for the firms' decision on which utility level to provide to the CEO.[20]

Consequently, the offered fixed salaries are dependent on the constituting equilibrium. If firm 1 wins the competition (equilibrium 2.a), the following values apply:

$$F_1^{fb,d} = \frac{1-t_1}{2k_1} + \frac{(1-t_2)^2}{(1-t_1)2k_2} + \frac{\varepsilon}{1-t_1} \qquad F_2^{fb,d} = \frac{1-t_2}{k_2} \tag{10}$$

In the equilibrium where firm 2 is successful (equilibrium 2.b), the offered fixed salaries are as follows:

$$F_1^{fb,d} = \frac{1-t_1}{k_1} \qquad F_2^{fb,d} = \frac{(1-t_1)^2}{(1-t_2)2k_1} + \frac{1-t_2}{2k_2} + \frac{\varepsilon}{1-t_2} \tag{11}$$

5 Equilibrium With Non-observable Effort

In the second-best case the effort exerted by the manager cannot be verified by any of the firms. Therefore, in order to provide working incentives for the CEO both firms need to make his compensation dependent on the realized cash flow $\widetilde{x}_i$ by granting him a share $b_i \in [0,1]$. Assuming the first-order approach being

[20] This result might change, if parts of the CEO's compensation are non-deductible for the firm. Halperin / Kwon / Rhoades-Catanach (2001) and Gök (2008) provide an extensive analysis of this issue in the context without competition.

valid, the contracting problem of firm i can be characterized as follows:

$$\max_{b_i,F_i} (1-\tau_i)\left[e_i - b_i(1-\tau_i)e_i - F_i\right] \tag{12}$$

$$\text{s.t. } (1-t_i)F_i + (1-t_i)(1-\tau_i)b_i e_i - \frac{r}{2}(1-t_i)^2(1-\tau_i)^2 b_i^2\sigma^2 - k_i\frac{e_i^2}{2} = u_i \tag{13}$$

$$e_i = \underset{e_i'}{\text{argmax}}\ (1-t_i)F_i + (1-t_i)(1-\tau_i)b_i e_i' - \frac{r}{2}(1-t_i)^2(1-\tau_i)^2 b_i^2\sigma^2 - k_i\frac{e_i'^2}{2} \tag{14}$$

As indicated with (14), in the second-best case the CEO exerts the amount of effort that maximizes his certainty equivalent. Therefore, both firms are bound to this incentive compatibility constraint. As in the first-best case both firms have to offer an amount of certainty equivalent to the agent which is determined by the competition game between the firms. The effort level exerted by the manager conditional on working for firm i results from (14) and has the following value:

$$e_i^{sb} = (1-t_i)(1-\tau_i)\frac{b_i}{k_i} \tag{15}$$

Anticipating the agent's optimal effort level, firm i offers the following compensation contract:

$$b_i^{sb} = \frac{1}{(1-\tau_i)\left(1+k_i r\sigma^2\right)} \tag{16}$$

$$F_i^{sb} = \frac{u_i}{1-t_i} - \frac{(1-t_i)\left(1-k_i r\sigma^2\right)}{2k_i\left(1+k_i r\sigma^2\right)^2} \tag{17}$$

It can be observed immediately that the variable pay firm i offers the CEO is independent of u_i. Hence, the bonus payments made to the agent are not influenced by a competition between the two firms.[21] Further, the firm includes the corporate tax rate into the bonus parameter in order to compensate the CEO for the after-tax performance measure $(1-\tau_i)\widetilde{x}_i$. However, the individual income tax has no impact on the incentive parameter. As in the first-best case the amount of fixed salary F_i^{sb} is affected only by the individual income tax and is used in order to meet the amount of certainty equivalent u_i which is determined via the competition game between both firms. Applying the optimal contract parameters the expected after-tax profit of firm i conditional on hiring the CEO takes the following value:

$$E\left[\widetilde{\pi}_{i,t}^{sb}|S\right] = (1-\tau_i)\left(\frac{1-t_i}{2k_i(1+k_i r\sigma^2)} - \frac{u_i}{1-t_i}\right) \tag{18}$$

Again, in order to illustrate the impact of differential taxation on the competition between the firms, we first investigate as a benchmark a situation of uniform taxes with $t_1 = t_2 = t$ and $\tau_1 = \tau_2 = \tau$. Proposition 3 summarizes the equilibrium and outcome of the competition between the firms under a homogeneous tax system.

Proposition 3 (Equilibrium of the competition game in the second-best case with uniform taxation)**.**

1. *In a situation of uniform taxation, if the CEO is equally compatible with each firm ($k_1 = k_2 = k$), the equilibrium outcome of the competition game is $u_1^{sb,h} = u_2^{sb,h} = \frac{(1-t)^2}{2k}\left(\frac{1}{1+kr\sigma^2}\right)$ and the expected profits of both firms equal zero.*

[21] This result is exactly in line with Edmans / Gabaix / Landier (2009) who suggest that in a market for talented CEOs, determination of incentive pay can be separated from determination of total pay.

2. *Assume ε to be the smallest currency unit available with the property defined in Assumption 4 (see Appendix). If the CEO is more compatible with firm 1 ($k_2 > k_1$), the equilibrium outcome of the competition game is* $u_2^{sb,h} = \frac{(1-t)^2}{2k_2}\left(\frac{1}{1+k_2 r\sigma^2}\right)$ *and* $u_1^{sb,h} = \frac{(1-t)^2}{2k_2}\left(\frac{1}{1+k_2 r\sigma^2}\right) + \varepsilon$. *In this equilibrium the expected profits of the firms are* $E\left[\widetilde{\pi}_{2,t}^{sb,h}\right] = 0$ *and* $E\left[\widetilde{\pi}_{1,t}^{sb,h}\right] = \frac{1-\tau}{1-t}\left[\frac{(1-t)^2}{2}\left(\frac{1}{k_1+k_1^2 r\sigma^2} - \frac{1}{k_2+k_2^2 r\sigma^2}\right) - \varepsilon\right] > 0$.

As in the first-best case, under different compatibility ($k_2 > k_1$) the expected profit of firm 2 conditional on hiring the agent is driven to zero. Firm 1 succeeds in attracting the CEO by offering him a certainty equivalent which is slightly higher than $u_2^{sb,h}$ and uniform taxation has no impact on the constituting equilibria. Additionally, by an examination of $u_1^{sb,h}$ it can be concluded that the negative impact of the individual income tax for the CEO carries over to the second-best situation. The resulting fixed salaries which are offered by the firms are as follows:

$$F_1^{sb,h} = (1-t)\left[\frac{1}{2k_1\left(1+k_1 r\sigma^2\right)} + \frac{1}{2k_2\left(1+k_2 r\sigma^2\right)} - \frac{1}{k_1\left(1+k_1 r\sigma^2\right)^2}\right] + \frac{\varepsilon}{1-t} \tag{19}$$

$$F_2^{sb,h} = \frac{(1-t) r\sigma^2}{\left(1+k_2 r\sigma^2\right)^2} \tag{20}$$

It is easy to observe that Corollary 1 does also hold in a situation with non-observable effort. Therefore, the agent's private information about the amount of exerted effort does not have change the negative impact wage taxes have on offered fixed salaries.

In order to highlight the effect of differential taxation on the competition the second-best case, Proposition 4 summarizes the equilibria and outcome of the competition game for this case.

Proposition 4 (Equilibrium of the competition game in the second-best case with differential taxation)**.**

1. *Assume ε to be the smallest currency unit available with the property defined in Assumption 5 (see Appendix). In a situation of differential taxation, if the CEO is equally compatible with each firm ($k_1 = k_2 = k$), the equilibrium outcome of the competition game is dependent on the relation between the individual tax rates t_1 and t_2 only. More precisely, the following equilibria constitute:*

   (a) *If $t_1 > t_2$, in equilibrium* $u_1^{sb,d} = \frac{(1-t_1)^2}{2k(1+kr\sigma^2)}$ *and* $u_2^{sb,d} = \frac{(1-t_1)^2}{2k(1+kr\sigma^2)} + \varepsilon$. *The corresponding expected profits are* $E\left[\widetilde{\pi}_{1,t}^{sb,d}\right] = 0$ *and* $E\left[\widetilde{\pi}_{2,t}^{sb,d}\right] = \frac{1-\tau_2}{1-t_2}\left[\frac{(t_1-t_2)[(1-t_1)+(1-t_2)]}{2k(1+kr\sigma^2)} - \varepsilon\right] > 0$.

   (b) *If $t_1 < t_2$, in equilibrium* $u_1^{sb,d} = \frac{(1-t_2)^2}{2k(1+kr\sigma^2)} + \varepsilon$ *and* $u_2^{sb,d} = \frac{(1-t_2)^2}{2k(1+kr\sigma^2)}$. *The corresponding expected profits are* $E\left[\widetilde{\pi}_{1,t}^{sb,d}\right] = \frac{1-\tau_1}{1-t_1}\left[\frac{(t_2-t_1)[(1-t_1)+(1-t_2)]}{2k(1+kr\sigma^2)} - \varepsilon\right] > 0$ *and* $E\left[\widetilde{\pi}_{2,t}^{sb,d}\right] = 0$.

2. *Assume ε to be the smallest currency unit available with the property defined in Assumption 6 (see Appendix). If the CEO is more compatible with firm 1 ($k_2 > k_1$), the equilibrium outcome of the competition game is dependent on the relation between the compatibility parameters (k_1 and k_2), the individual income tax rates (t_1 and t_2) as well as the agent's risk attitude (r) and the firms' business risk (σ^2). More precisely, the following equilibria constitute:*

   (a) *If*

- $t_1 < t_2$ *or*
- $t_1 > t_2 \geq 1-(1-t_1)\sqrt{\frac{k_2}{k_1}}$ *or*
- $t_1 > t_2$ *and* $1-(1-t_1)\frac{k_2}{k_1} < t_2 < 1-(1-t_1)\sqrt{\frac{k_2}{k_1}}$ *and* $r\sigma^2 > \frac{(1-t_1)^2k_2-(1-t_2)^2k_1}{(1-t_2)^2k_1^2-(1-t_1)^2k_2^2}$*:*

In equilibrium, $u_2^{sb,d} = \frac{(1-t_2)^2}{2k_2(1+k_2r\sigma^2)}$ *and* $u_1^{sb,d} = \frac{(1-t_2)^2}{2k_2(1+k_2r\sigma^2)} + \varepsilon$*. The corresponding expected profits are* $E\left[\widetilde{\pi}_{1,t}^{sb,d}\right] = \frac{1-\tau_1}{1-t_1}\left[\frac{(1-t_1)^2}{2k_1(1+k_1r\sigma^2)} - \frac{(1-t_2)^2}{2k_2(1+k_2r\sigma^2)} - \varepsilon\right] > 0$ *and* $E\left[\widetilde{\pi}_{2,t}^{sb,d}\right] = 0$*.*

(b) If

- $t_1 > t_2$ *and* $1-(1-t_1)\frac{k_2}{k_1} < t_2 \leq 1-(1-t_1)\sqrt{\frac{k_2}{k_1}}$ *and* $r\sigma^2 < \frac{(1-t_1)^2k_2-(1-t_2)^2k_1}{(1-t_2)^2k_1^2-(1-t_1)^2k_2^2}$ *or*
- $t_1 > t_2$ *and* $1-(1-t_1)\frac{k_2}{k_1} \geq t_2$*:*

In equilibrium, $u_1^{sb,d} = \frac{(1-t_1)^2}{2k_1(1+k_1r\sigma^2)}$ *and* $u_2^{sb,d} = \frac{(1-t_1)^2}{2k_1(1+k_1r\sigma^2)} + \varepsilon$*. The corresponding expected profits are* $E\left[\widetilde{\pi}_{1,t}^{sb,d}\right] = 0$ *and* $E\left[\widetilde{\pi}_{2,t}^{sb,d}\right] = \frac{1-\tau_2}{1-t_2}\left[\frac{(1-t_2)^2}{2k_2(1+k_2r\sigma^2)} - \frac{(1-t_1)^2}{2k_1(1+k_1r\sigma^2)} - \varepsilon\right] > 0$*.*

A comparison between Proposition 2 and Proposition 4 reveals that individual income taxes affect the competition among firms for the CEO in the second-best case in a slightly different way. Firm 1 is successful in hiring the CEO in equilibrium 2.(a) of Proposition 4. As in the first-best case (see proposition 2) this equilibrium constitutes, if $t_2 > t_1$ or if t_2 is lower than t_1 but larger than the threshold value of $1-(1-t_1)\sqrt{\frac{k_2}{k_1}}$, because in these cases the tax effect either works in the same direction as the compatibility effect or does not exceed it. However, with non-observable effort and differential taxation competition between the two firms is subject to a third effect which can be labeled as 'risk effect'. Equation (3) indicates that individual income taxes reduce the CEO's compensation risk and therefore have a partially moderating effect on the firms' compensation costs. As a result, under differential taxation firm 2 may not only benefit from a lower individual tax rate but also suffer from the risk induced effect if risk is sufficiently important relatively to compatibility and taxes (r and/or σ^2 are sufficiently high). Therefore, whenever t_2 is between $1-(1-t_1)\sqrt{\frac{k_2}{k_1}}$ and $1-(1-t_1)\frac{k_2}{k_1}$ firm 1 is able to win the competition for the CEO if the risk effect dominates the trade-off between taxes and compatibility. On the other hand, if the risk effect is sufficiently small and hence lacks importance, firm 2 is able to hire the CEO whenever $t_2 \leq 1-(1-t_1)\sqrt{\frac{k_2}{k_1}}$ (equal to the first-best case). Finally, for those cases where $1-(1-t_1)\frac{k_2}{k_1} \geq t_2$ the tax benefit dominates any other effect and firm 2 always wins the competition for the CEO.

The resulting fixed salaries are dependent on the constituting equilibrium. If firm 1 is able to hire the agent, the following payments are offered:[22]

$$F_1^{sb,d} = (1-t_1)\left[\frac{1}{2k_1\left(1+k_1r\sigma^2\right)} + \frac{(1-t_2)^2}{2(1-t_1)^2k_2\left(1+k_2r\sigma^2\right)} - \frac{1}{k_1\left(1+k_1r\sigma^2\right)^2}\right] + \frac{\varepsilon}{1-t_1} \tag{21}$$

$$F_2^{sb,d} = \frac{(1-t_2)r\sigma^2}{\left(1+k_2r\sigma^2\right)^2} \tag{22}$$

[22] As in the first-best case, the payments are symmetrical for equilibrium 2.(b) of Proposition 4 and therefore not presented here.

6 Comparative Statics

This section aims to provide an intuition for the effects of marginal tax rate changes on the equilibrium parameters presented in Proposition 4. Due to the symmetry of equilibrium 2.(a) and 2.(b) with respect to the equilibrium parameters the comparative statics are derived in a generalized way with firm i representing the firm hiring the CEO and firm j representing the inferior competitor. First, it should be noted that even though the corporate income tax has no impact on the competition outcome it nevertheless determines the level of the offered bonus parameter (see (16)). As the after-tax bonus parameter of each firm explicitly corrects for the tax-induced reduction of the performance measure we would expect to observe higher performance sensitivity at firms which are located in countries with higher corporate income tax rates.

Next, we investigate the impact of individual income taxes on the fixed salary offered by the inferior competitor j and on the expected utility the CEO receives in equilibrium $u_i^{sb,d}$:

$$\frac{\partial F_j^{sb,d}}{\partial t_i} = 0 \qquad \frac{\partial F_j^{sb,d}}{\partial t_j} = -\frac{r\sigma^2}{(1+k_j r\sigma^2)^2} < 0 \tag{23}$$

$$\frac{\partial u_i^{sb,d}}{\partial t_i} = 0 \qquad \frac{\partial u_i^{sb,d}}{\partial t_j} = -\frac{1-t_j}{k_j(1+k_j r\sigma^2)} < 0 \tag{24}$$

As indicated in (23) and (24) the offered fixed salary of the inferior firm j and the expected utility received by the CEO are insensitive to marginal changes of the individual income tax rate applied at firm i and declining in the individual income tax rate applied at firm j. The intuition behind these observations can be explained by the same effects driving the result in Corollary 1. The individual income tax applied at firm j reduces the optimal amount of effort exerted by the CEO. As a result the CEO's potential economic rent declines which in turn reduces both his expected utility and the offered fixed salary of firm j. However, as in equilibrium the CEO is (nearly) held at his 'reservation utility' (the utility he would receive when working for firm j), marginal changes of t_i do not imply any effects on his expected utility or the salary offered by firm j. Further, the above described effects partially explain the effects of tax rate changes on the fixed salary offered by firm i:

$$\frac{\partial F_i^{sb,d}}{\partial t_i} = \frac{(1-t_j)^2}{2(1-t_i)^2 k_j(1+k_j r\sigma^2)} + \frac{1}{k_i(1+k_i r\sigma^2)^2} - \frac{1}{2k_i(1+k_i r\sigma^2)} + \frac{\varepsilon}{(1-t_i)^2} \left\{ \begin{matrix} > \\ = \\ < \end{matrix} \right\} 0 \tag{25}$$

$$\frac{\partial F_i^{sb,d}}{\partial t_j} = -\frac{1-t_j}{(1-t_i)k_j(1+k_j r\sigma^2)} < 0 \tag{26}$$

An increase of t_j leads to a decline of the fixed salary offered by the successful firm i. This indirect effect occurs, because a higher t_j reduces the expected utility received by the CEO in equilibrium (see 24) and enables firm i to lower the offered fixed salary without 'loosing' the CEO. However, the tax rate applied at the successful competitor i has an ambiguous effect on the fixed salary he offers to the CEO. [23] Due

[23] With observable effort, the fixed salary offered by firm i is strictly decreasing in the individual income tax rate t_i because $\frac{\partial F_i^{fb,d}}{\partial t_i} = \frac{(1-t_j)^2 k_i - (1-t_i)^2 k_j}{2(1-t_i)^2 k_i k_j} + \frac{\varepsilon}{(1-t_i)^2} < 0$. Therefore we can conclude that private information and the implied

to the complex structure of (25), deriving necessary conditions with respect to the sign of the partial derivative does not yield very meaningful expressions. Nevertheless, it it is possible to observe that the wage tax rate t_i has a positive effect on the offered fixed salary $F_i^{sb,d}$ whenever the first two addends exceed the third one (assuming $\varepsilon \approx 0$) providing us with the following conclusions:

Corollary 2. *The fixed salary offered by the competition winning firm i is more likely to increase in the wage tax rate t_i if*

1. *the agent is more compatible with firm j (lower k_j),*
2. *the wage tax rate at firm j is low,*
3. *the wage tax rate at firm i is high.*

Intuitively, if the competition among the two firms is very severe (e.g. neither effect dominates the others by very much), an increase of the wage tax provides the successful firm with a considerable additional burden and the attraction of the agent can only be maintained by increasing the offered fixed salary.

Finally, the effects of marginal tax rate changes on the expected profit of the successful competitor i are presented below:

$$\frac{\partial E\left[\widetilde{\pi}_{i,t}^{sb,d}\right]}{\partial t_i} = -(1-\tau_i)\left[\frac{1}{2k_i(1+k_i r\sigma^2)} + \frac{(1-t_j)^2}{2(1-t_i)^2 k_j(1+k_j r\sigma^2)} + \frac{\varepsilon}{(1-t_i)^2}\right] < 0 \tag{27}$$

$$\frac{\partial E\left[\widetilde{\pi}_{i,t}^{sb,d}\right]}{\partial t_j} = \frac{(1-\tau_i)(1-t_j)}{(1-t_i)k_j(1+k_j r\sigma^2)} > 0 \tag{28}$$

Despite the ambiguous effect of t_i on the fixed salary offered by the successful firm i, an increase of t_i has always a negative impact on the expected profit. This effect can be explained by a joint examination of (18) with (24). On the one hand, t_i does not change firm i's optimal strategy u_i in the competition game. On the other hand, t_i reduces the expected profit due to a lower optimal amount of effort and the additional wage costs incurred by the difference between gross and net wages. However, an increase of the tax rate the CEO would face when working for the inferior firm j has an unambiguous positive effect on the successful firm's expected profit, because it helps to lower the needed compensation offer $u_i^{sb,d}$ which still ensures attraction of the agent.

7 Conclusion

This paper analyses the effects of taxation on a competition between two firms for a unique and highly qualified CEO. By using a partial equilibrium model of moral hazard it illustrates the possible impact of uniform and differential taxation on the outcome of such a competition as well as the optimal contracts offered by both firms. I showed that the constituting competition equilibria are crucially dependent on

risk effect does not only alter the constituting competition equilibria but also has an impact on marginal effects of the individual income tax rate.

the CEO's compatibility with both firms. Further, they are insensitive to uniform taxation of corporate and individual income. However, it was possible to derive the novel result that offered gross fixed salaries decline with uniform individual taxes in this setting of competition. The main explanation for this observation can be found in the CEO's ability to extract a considerable amount of economic rents from both firms due to his uniqueness. As an individual income tax decreases these rents it implies also a softening effect on the competition among the firms which in turn translates into reduced gross fixed salaries.

A key finding of this paper is that different individual income tax rates have a substantial impact on the outcome of the competition between two firms. Sufficiently large tax rate differentials can offset the effect of different compatibility and hence lead to situations where the less compatible firm is able to hire the CEO. However, this tax effect is moderated in a situation of unverifiable effort with sufficiently risky cash flows or a sufficiently risk averse CEO. Further, I showed that different corporate income taxes have no impact on the competition outcome. Nevertheless, they translate into different (gross) incentive parameters offered by the firms because of the tax-reduced performance measure. Additionally, the paper provides some intuitions on the effects of marginal changes of all individual income tax rates. An increase of the tax rate applied at the successful firm has a negative effect on this firm's expected profit but does not change the expected utility received by the CEO. On the other hand, an increase of the tax rate where the inferior firm is located reduces the expected utility received by the CEO and increases the expected profit of the successful firm due to lowered compensation costs.

The results of this paper try provide a first intuition on the question how taxes take influence on a market for very specific jobs like CEOs. However, the analysis is subject to several limitations which should be discussed very briefly within this section. First, it should be noted that the partial equilibrium model applied in this paper might be silent about effects that can only be observed in a general equilibrium. Even though the model seems to be quite robust to an increasing number of competing firms a transfer of the attained results to a labor market with an excess supply of talented CEOs would need further justifications. Second, in the presented model private information of the CEO is limited to the effort he exerts for the hiring firm. However, we would expect that the agent's compatibility with either firm can be an additional source of information asymmetry between the CEO and both firms in practice.[24] As this problem would not only affect the firms' optimal contracting solution but also the outcome of competition between the firms an analysis of this situation could enrich our understanding of this special kind of labor market and should therefore be considered for future research. Third, our investigation illustrated that the firms' business risk and the CEO's risk attitude can play a major role for the competition among firms in the case of non-observable effort with different tax rates. For this reason it would be interesting to see whether a departure of the simplifying assumption of equal business risks could cause further frictions with respect to the pre- and after-tax outcome of the competition. We can expect that a more generalized setting with different business risks could make the CEO facing a trade-off between risk and return even in a situation without taxes.

[24] Bénabou / Tirole (2015) investigate such a scenario without considering any issues of international taxation.

Finally, it should also be possible to draw some important conclusions for the tax regulator and empirical tax research from this investigation. Even though in the public discussion about excessive compensation of top level managers a regulation through taxation is demanded very frequently I showed that raising individual income tax rates unilaterally might imply a substantial competitive disadvantage for attracting highly-skilled human resources on an international labor market. Additionally, the paper provides the result that a unilateral increase of the individual income tax rate has an ambiguous effect on the observed gross wage levels.[25] However, for a local job market or a market consisting of tax jurisdictions with very homogeneous individual income tax rates the model predicts that observed gross wages should decrease with a higher tax rate. At last, it should be noticed that the presented findings might not be limited to a market for superstar CEOs only but also apply for other scarce human resources, like football players or top researchers as well.

Appendix

Assumptions

Assumption 1. *ε has the following property:* $\frac{(1-t)^2}{2}\left(\frac{1}{2k_1}-\frac{1}{2k_2}\right)>\varepsilon>0$

Assumption 2. *ε has the following property:* $\frac{(t_i-t_j)[(1-t_i)+(1-t_j)]}{4k}>\varepsilon>0$
with $i,j\in\{1,2\}$, $i\neq j$ and $t_i>t_j$.

Assumption 3. *ε has the following property:* $\frac{k_i(1-t_j)^2-k_j(1-t_i)^2}{4k_ik_j}>\varepsilon>0$
with $i,j\in\{1,2\}$ and $i\neq j$.

Assumption 4. *ε has the following property:* $\frac{(1-t)^2}{4}\left(\frac{1}{k_1+k_1^2r\sigma^2}-\frac{1}{k_2+k_2^2r\sigma^2}\right)>\varepsilon>0$

Assumption 5. *ε has the following property:* $\frac{(t_i-t_j)[(1-t_i)+(1-t_j)]}{4k(1+kr\sigma^2)}>\varepsilon>0$
with $i,j\in\{1,2\}$, $i\neq j$ and $t_i>t_j$.

Assumption 6. *ε has the following property:* $\frac{(1-t_i)^2}{2k_i(1+k_ir\sigma^2)}-\frac{(1-t_j)^2}{4k_j(1+k_jr\sigma^2)}>\varepsilon>0$
with $i,j\in\{1,2\}$ and $i\neq j$.

Proofs

Proof of Proposition 1. Part 1: In equilibrium, the expected profit of each firm is at least as high as the expected profit from hiring an 'ordinary' CEO ($E[\widetilde{\pi}_{i,t}|O]=0$). Therefore, $u_i^{fb,h}\leq\frac{(1-t)^2}{2k_i}$ with $i\in\{1,2\}$.

In order to prove that in equilibrium both firms offer the same certainty equivalent suppose first that $u_1^{fb,h}<u_2^{fb,h}<\frac{(1-t)^2}{2k}$. In this case the CEO would be hired by firm 2 and the expected profit of firm 1 equals zero. However, firm 1 could increase its expected profit by raising the offered certainty equivalent to $u_2^{fb,h}<\widehat{u}_1<\frac{(1-t)^2}{2k}$ and thereby attracting the CEO which contradicts $u_1^{fb}<u_2^{fb,h}<\frac{(1-t)^2}{2k}$ being an

[25] This result could also serve as an explanation for the empirical observation of Frydman / Molloy (2011) who are not able to find any short-term effects of tax rate changes on CEO compensation.

equilibrium. Second, suppose that $u_1^{fb,h} < u_2^{fb,h} = \frac{(1-t)^2}{2k}$. This configuration cannot be an equilibrium as well since firm 2 has the opportunity to strictly increase its profit by decreasing the offered certainty equivalent by a small amount. Therefore, in equilibrium $u_1^{fb,h} = u_2^{fb,h}$.

Assume now that $u_1^{fb,h} = u_2^{fb,h} < \frac{(1-t)^2}{2k}$. In this situation both firms have an incentive to deviate by offering a certainty equivalent which is slightly higher (some small amount $\varepsilon > 0$) in order to increase their expected profit. Hence, the equilibrium constituted by $u_1^{fb,h} = u_2^{fb,h} = \frac{(1-t)^2}{2k}$ is the only Nash equilibrium for $k_1 = k_2 = k$.

Part 2: When the CEO's compatibility is different ($k_2 > k_1$) by the same arguments as for part 1 there cannot exist an equilibrium with $u_i^{fb,h} < u_j^{fb,h} < \frac{(1-t)^2}{2k_2}$. Further, in equilibrium firm 2 sets $u_2^{fb,h} = \frac{(1-t)^2}{2k_2}$ and has no incentive to deviate unilaterally because it cannot increase its expected profit. However, firm 1 is able to earn some positive expected profit by setting $u_1^{fb,h} \geq \frac{(1-t)^2}{2k_2}$. If $u_1^{fb,h} = u_2^{fb,h} = \frac{(1-t)^2}{2k_2}$ the CEO randomizes between both firms and the expected profit of firm 1 equals $E\left[\widetilde{\pi}_{1,t}^{fb,h}\right] = \frac{1}{2}(1-\tau)\left(\frac{1-t}{2k_1} - \frac{1-t}{2k_2}\right)$. By increasing the offered certainty equivalent for the smallest currency unit ε firm 1 could earn an expected profit equal to

$$E\left[\widetilde{\pi}_{1,t}^{fb,h}\right] = (1-\tau)\left(\frac{1-t}{2k_1} - \frac{1-t}{2k_2} - \varepsilon\right) \tag{29}$$

Hence, if ε fulfills the property defined in Assumption 1, in equilibrium firm 1 offers $u_1^{fb,h} = \frac{(1-t)^2}{2k_2} + \varepsilon$.

□

References

Bebchuk, Lucian A./ Fried, Jesse M. (2004): Pay without performance: The unfulfilled promise of executive compensation, Harvard University Press, Cambridge and Mass.

Bénabou, Roland/ Tirole, Jean (2015): Bonus Culture: Competitive Pay, Screening, and Multitasking, Journal of Political Economy, forthcoming.

Conyon, Martin J. (2006): Executive Compensation and Incentives, Academy of Management Perspectives, 20, 1, p. 25–44.

Cremers, K. J. M./ Grinstein, Y. (2014): Does the Market for CEO Talent Explain Controversial CEO Pay Practices?, Review of Finance, 18, 3, p. 921–960.

Edmans, Alex/ Gabaix, Xavier (2009): Is CEO Pay Really Inefficient? A Survey of New Optimal Contracting Theories, European Financial Management, 15, 3, p. 486–496.

Edmans, Alex/ Gabaix, Xavier/ Landier, Augustin (2009): A Multiplicative Model of Optimal CEO Incentives in Market Equilibrium, The Review of Financial Studies, 22, 12, p. 4881–4917.

Ewert, Ralf/ Niemann, Rainer (2012): Steuern in Agency-Modellen: Mehrperioden- und Multi-Task-Strukturen, volume Nr. 135 of arqus Working Paper, Arbeitskreis Quantitative Steuerlehre c/o Universität Paderborn, Lehrstuhl für BWL, Paderborn.

Frydman, Carola/ Molloy, Raven S. (2011): Does tax policy affect executive compensation? Evidence from postwar tax reforms, Journal of Public Economics, 95, 11/12, p. 1425–1437.

Frydman, Carola/ Saks, Raven E. (2010): Executive compensation: A new view from a long-term perspective, 1936-2005, Review of Financial Studies, 23, 5, p. 2099–2138.

Gabaix, Xavier/ Landier, Augustin (2008): Why has CEO pay increased so much?, The Quarterly Journal of Economics, p. 49–100.

Göx, Robert F. (2008): Tax incentives for inefficient executive pay and reward for luck, Review of Accounting Studies, 13, 4, p. 452–478.

Halperin, Robert M./ Kwon, Young K./ Rhoades-Catanach, Shelley C. (2001): The Impact of Deductability Limits on Compensation Contracts: A Theoretical Examination, Journal of the American Taxation Association, 23, p. 52–65.

Holmstrom, Bengst/ Milgrom, Paul (1987): Aggregation and Linearity in the Provision of Intertemporal Incentives, Econometrica, 55, 2, p. 303–328.

Holmström, Bengt (1979): Moral hazard and observability, The Bell Journal of Economics, 10, p. 74–91.

Katuscak, P. (2009): Taxes and Executive Compensation: Evidence from the 1990s, CESifo Economic Studies, 55, 3-4, p. 542–568.

Katuscak, Peter (2005): Impact of Personal Income Taxation on Executive Compensation, Proceedings of the Annual Conference on Taxation, p. 183–189.

Martini, Jan Thomas/ Niemann, Rainer (2014): The impact of taxation on international assignment decisions: a principal–agent approach, Review of Managerial Science, p. 1–27.

Mishel, Lawrence/ Davis, Alyssa (2014): CEO Pay Continues to Rise as Typical Workers Are Paid Less, Economic Policy Institute Issue Brief, 380.

Murphy, Kevin J./ Zabojnik, Jan (2004): CEO Pay and Appointments A Market-Based Explanation for Recent Trends, American Economic Review, 94, 2, p. 192–196.

Murphy, Kevin J./ Zabojnik, Jan (2007): Managerial Capital and the Market for CEOs, Working Paper (available at SSRN).

Niemann, Rainer (2008): The Effects of Differential Taxation on Managerial Effort and Risk Taking, FinanzArchiv, 64, 3, p. 273–310.

Rosen, Sherwin (1981): The Economics of Superstars, The American Economic Review, 71, 5, p. 845–858.

Schellekens, Marnix (2013): European tax handbook 2013, Global Tax Series, IBFD Publications, Amsterdam.

Shy, Oz (1995): Industrial organization: Theory and applications, MIT Press, Cambridge, Mass.

Spremann, Klaus (1987): Agent and Principal, Günter Bamberg/ Klaus Spremann (editors), Agency Theory, Information, and Incentives, Springer Berlin Heidelberg, p. 3–37.

Terviö, Marko (2008): The Difference That CEOs Make An Assignment Model Approach, American Economic Review, 98, 3, p. 642–668.

Tirole, Jean (1989): The theory of industrial organization, MIT Press, Cambridge, Mass.

Wolfstetter, Elmar (1999): Topics in microeconomics: Industrial organization, auctions, and incentives, Cambridge University Press, Cambridge, UK and New York.

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