The Efficiency Costs of Dividend Taxation with Managerial Firms*

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Abstract

The paper provides a positive and efficiency analysis of dividend taxation in a corporate agency model with costly managerial effort. Unlike existing (agency) models, this model is consistent with empirical work in corporate finance and able to predict empirically-observed investment responses to dividend taxation. In addition, we show that investment changes are not sufficient to infer, first, the efficiency cost of dividend taxation and, second, the financing regime underlying firms' investments. We provide a testable implication that allows to empirically uncover the source of investment finance by comparing investment responses to dividend taxes and managerial incentive pay.

JEL-Classification: H21, D21, H24

Keywords: dividend taxation, quiet-life model, corporate governance, tax on incentive pay, managerial firms

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1 Introduction

The way in which dividend taxes influence resource allocation is a long-standing discussion in economic policy. Taxing dividends is perceived as desirable for redistributive reasons because dividend income accrues disproportionately to wealthy individuals. Whether this comes at efficiency costs is, however, controversially debated. The discussion ranges from the view that dividend taxes are efficiency neutral to the assessment that they generate large efficiency costs by distorting firms' investment and financing behaviour and thereby impede economic growth. Given the diverging views, it is not surprising that dividend tax policies across countries have followed different patterns. Some countries lowered their dividend tax rate, while others increased it. In some cases, countries even adopted both types of reforms consecutively (Becker et al., 2013).[1]

In explaining the efficiency cost of dividend taxation, the existing literature primarily builds on the neoclassical model in which managers act in the interest of shareholders.[2] Only recently, the literature adopted an empire-building model, in which managers have private benefits of investing capital and, thereby, tend to overinvest from the perspective of shareholders (Kanniainen, 1999; Chetty and Saez, 2010).[3] This model is helpful in explaining the frequent empirical finding that firms immediately initiate dividend distributions after a dividend tax cut; a response that cannot be explained by the neoclassical model, which predicts a zero effect.[4] While having the virtue of reconciling empirical work with theory, the empire-building model is hardly supported by the growing body of empirical work in corporate finance. Instead, the data support the so-called quiet-life model, in which managerial effort matters and managers are reluctant to exert costly effort in managing the firm. This type of agency model characterizes observed man-

[1] Becker at al. (2013) analyse a data set of 25 countries over the period from 1990 to 2008 and report 15 substantial tax reforms and 67 discrete changes in payout taxes, including 15 major (by at least 3 percentage points) reductions and 14 major increases in payout taxes.

[2] See Sinn (1987) and Auerbach (2002) for a review of the neoclassical model of dividend taxation.

[3] There is a growing, albeit small body of literature in public economics analyzing agency conflicts, however, with a focus on corporate taxes. See, for instance, Kanniainen and Södersten (1994), Crocker and Slemrod (2005), Desai and Dharmapala (2006), Desai et al. (2007), Chetty and Saez (2010), or Koethenbuerger and Stimmelmayr (2014).

[4] An immediate spike in dividend payouts after a cut in dividend taxes has been found in Chetty and Saez (2005), Brown et al. (2007), Nam et al. (2010), Blouin et al. (2011), and Yagan (2015) for the US, in Smart (2018) for Canada, and in Alstadsæter et al. (2017) and Jacob and Michaely (2017) for Sweden. Similarly, following a rise in dividend taxes, Berzins et al. (2019) document a decrease in dividend payments for Norway. The generally-observed pattern that the dividend response is heterogeneous across firms, as measured by the ownership share of executives, highlights the relevance of agency conflicts in explaining this finding. Note, the neoclassical model can explain an immediate increase in dividends only if firms expect the dividend tax cut to be non-permanent, but it cannot explain the heterogeneous response pattern.

agerial behaviour better than the empire-building model (Bertrand and Mullainathan, 2003). Also, the quiet-life type of agency conflict rather than a managerial preference to build corporate empires accounts for the observed lower firm performance in non-competitive industries (Giroud and Mueller, 2010). Similarly, the way in which managerial incentives influence investments and firm performance is consistent with managers having private costs of investment instead of private benefits of investment (Aggarwal and Samwick, 2006). In detail: 'While there is surely anecdotal evidence of over-investment problems at individual firms, our results suggest that they are not, on average, significant problems in the determination of capital expenditures at a broad cross-section of U.S. corporations.' (Aggarwal and Samwick, 2006, p. 513).[5]

In this paper, we propose a quiet-life model that is able to accommodate a wide range of empirically-observed corporate responses to dividend taxation. The quiet-life model builds on the insight that both managerial effort and quality are important determinants of firm performance and essential in explaining productivity differences across firms and countries (see Bertrand and Schoar, 2003; Aggarwal and Samwick, 2006; Bartelsman and Doms, 2010; Guner et al., 2018; and Bennedsen et al., 2020, for instance).[6] In this model, managerial quality and effort determine the way in which inputs are combined in production and thereby the effectiveness of additional factors such as physical investment (Lucas, 1978; Rosen, 1982; and Tirole, 2006). Managers prefer a 'quiet life' since exerting effort incurs a private cost, which gives rise to an agency conflict between the manager and shareholders and requires the use of an incentive contract to align interests.

Our analysis provides three important findings. First, we find that the prediction of the quiet-life model –similar to the prediction of the empire-building model– is consistent with the empirical finding that lower dividend taxes increase dividend payouts (Chetty and Saez, 2005, for instance) and reduce investments of cash-rich firms (Becker et al., 2013).[7] In addition, the quiet-life model also accommodates the empirical finding that cash-rich firms increase investments in response to lower dividend taxes. This result is in line with the empirical analyses in Campbell et al. (2013), Smart (2018), and Egger et al. (2020), but it cannot be explained by the empire-

[5]Further evidence in favour of quiet-life models includes Gromley and Matsa (2016) and Guo et al. (2018), among others.

[6]See Bloom and Van Reenen (2010) for an overview of the literature on the relationship between management practices and firm performance and Kaplan and Rauh (2013), who reconcile the recent changes in top incomes with the productivity effects of managerial input.

[7]Chetty and Saez (2005) do not explicitly distinguish between cash-rich and cash-constrained firms, but the observed immediate payout response suggests that firms tend to be cash rich and, thereby, use retained earnings (and not new share issues) to finance investments.

building model.[8] Intuitively, in the quiet-life model, a decrease in the dividend tax increases the manager's net-of-tax compensation, resulting in higher managerial effort and higher investment, provided the two inputs are complements in production. Conversely, the empire-building model predicts a negative investment response to lower dividend taxes because, for cash-rich firms, a decrease in the dividend tax makes dividend distributions more attractive relative to the untaxed private benefits from empire-building investments (Chetty and Saez, 2010).[9] A table summarizing the key predictions of the different models is provided in Section 6.

Second, the implications of the quite-life model differ from the conventional insight that investment responses to dividend taxes and corporate financing behaviour are uniquely linked. Based on the neoclassical model, an empirically-observed negative investment response to a higher dividend tax indicates the use of new share issue to finance investments, while a zero investment response indicates that firms are cash rich and use retained earnings to finance investments.[10] In the quiet-life model, the link is ambiguous. A negative investment response to a higher dividend tax can occur when firms use new share issue or retained earnings. This paper proposes a novel way to infer a firm's financing behaviour from investment responses in the quiet-life model. It builds on the model's prediction that, for cash-rich firms, dividend taxes and the sharing parameter in the equity-based incentive contract influence a firm's investment behaviour in the same way. Differently, for cash-constrained firms, dividend taxes affect investment incentives more strongly than the sensitivity of managerial pay to performance.[11] This differential prediction is testable and requires data that entail variation in the exposure to dividend taxes (due to tax reforms, for instance) and variation in the pay-performance sensitivity

[8] Campbell et al. (2013) analyse firms' investment response in the aftermath of the 2003 U.S. dividend tax cut and find a substantial increase of capital expenditures for the majority of firms in their sample. Yagan (2015), who analyses the same reform, does not find investment responses. However, in Yagan, the sample selection tends to exclude larger firms for whom agency problems might be most important. See Section **??** for a more thorough discussion of Yagan (2015). Smart (2018, Table 5) reports a positive investment effect in response to the 2006 Canadian dividend tax reform, which introduced substantial dividend tax credits for domestic shareholders. Analysing firms' investment response to dividend taxation across countries, Egger et al. (2020) document an increase in investments in response to lower dividend taxes for cash-rich firms with positive investment levels.

[9] As explained in more detail in Section **??**, a negative investment response is also consistent with a neoclassical model where firms are cash-constrained and use equity injections at the margin. However, given the limited use of new share issues (as compared to retained earnings) in financing investments, it is less likely that the neoclassical model can explain economy-wide, negative investment responses.

[10] For cash-rich firms, the retention of profits to finance investments implies only a re-timing of dividend taxes, which renders the dividend tax neutral for investment behaviour (King 1974; Auerbach 1979; Bradford 1981). For cash-constrained firms, the cost of equity finance is not tax deductible, while the investment return will be taxed. This asymmetric tax treatment affects firm investments negatively (Harberger 1962; Feldstein 1970; Poterba and Summers 1985).

[11] This prediction is robust to a wide range of agency models, including quiet-life models (used in this paper) and models of empire building.

of managerial compensation.

Third, the quiet-life model yields different efficiency implications of dividend taxation. In the empire-building model and the neoclassical model, only investment responses matter for the efficiency costs of dividend taxes. With quiet-life managers, the efficiency costs generally depend on the response of managerial effort and investment to dividend taxes. We identify situations in which the change in investment is neutral for efficiency and, thus, the efficiency implications originate solely from the manager's effort response. Moreover, we show that dividend taxes can still incur efficiency costs even when investment increases, which, in isolation, enhances efficiency in our setting. As such, investment responses are insufficient to infer the magnitude as well as the sign of the efficiency costs of dividend taxes in the quiet-life model. Explaining corporate firm behaviour without considering managerial effort choices implies an underestimation of the efficiency costs of dividend taxation. This finding is key in the optimal tax design, where capital income taxes would be a desirable policy instrument to address income inequalities (Piketty, 2014).

Different implications for future empirical research follow from our analysis. First, the prediction of the differential investment response to dividend taxes and the performance sensitivity of the incentive contract is useful to infer the firms' financing mode in environments where this piece of financial information is difficult to retrieve from the data. There is a continuously growing body of literature that analyses the influence of dividend taxes and incentive provision on firms' investment behaviour, albeit it does not rely on the differentiating test proposed in this paper (see, for instance, Yagan 2015; or Aggarwal and Samwick 2006). A second empirical implication relates to the heterogeneous responses to dividend taxes. As explained below, firms' investment and payout responses to dividend taxes depend on how managerial effort and investment interact in production. The ambiguity of the interaction between the two input factors allows for different signs of these responses. In empirical analyses, aggregate responses might masquerade a heterogeneity in firm-level responses, resulting in a possibly non-significant aggregate response.

The paper's insights are informative for different fields in economics including public economics, financial economics, and macroeconomics. First, it bridges financial and public economics by using insights from financial economics to select a principal-agent relationship that is able to consistently explain the effects of dividend taxation and unveil the associated efficiency costs – issues which are at the core of public economics. Second, the paper is informative for

research in financial economics, which, based on differential predictions of the quiet-life model and empire-building model, analyses the empirical relevance of the two types of agency conflicts. This paper presents a broad set of differential predictions, including tax reform effects, to distinguish between different types of agency models. For instance, a positive investment response to lower dividend taxes, as reported in empirical analyses, is inconsistent with the empire-building model. Instead, it is in line with the quiet-life model, thereby broadening the empirical foundation of the quiet-life model in corporate finance and macro-related studies. Third, as explained above, this analysis offers a new set of predictions that help to uncover the source of investment finance in empirical work. In addition to public economics, these testable predictions are relevant in corporate finance to infer whether firms are cash constrained and to assess the associated implications for macroeconomic outcomes, including economic growth (see Fazzari et al., 1988; Kaplan and Zingales 1997; Rajan and Zingales, 1998; Beck et al. 2005).

Lastly, this paper shows that dividend taxes have wider efficiency implications than documented in the existing literature. This relates to the question whether a differentiated dividend tax system, which controls for the different behavioural margins of managers and shareholders, is an optimal tax policy. In some countries, equity-based incentive pay receives a differential tax treatment compared to general income (Hall and Liebman, 2000), and the issue of using such a tax scheme has regained momentum in recent tax policy discussions. A differential tax treatment may correct a tendency to under- or over-incentivize managers (Benabou and Tirole, 2016; Besley and Ghatak, 2013) and may limit socially wasteful bargaining effort by managers (Piketty et al., 2014). We show that imposing a separate dividend tax on managers or a dividend tax on all shareholders yields equivalent effects on firm behaviour and efficiency. This result is surprising given that the two taxes are imposed on different sets of individuals and, thus, the individuals' decision should be impacted differently. The reason for the equivalence is that shareholders, who set the managerial wage, become residual claimants.[12] Shareholders perceive the two instruments as perfect substitutes and the incentive contract offered to managers changes with both instruments in an identical way. As a consequence, the contract-induced managerial effort and investment choices also coincide with the two tax instruments. Compared to a special tax on manager equity-based income, a general dividend tax has the potential to achieve identical efficiency effects.

[12]Later, we will show that the equivalence result extends to other forms of wage determination in which shareholders do not have all the bargaining power.

The paper proceeds as follows. In Section 2 we set up a quiet-life agency model with endogenous incentive pay. In Section 3 we characterize the shareholders' choice of incentive pay, managerial effort choices, investment behaviour and the welfare implications of dividend taxation. In Section 4, we introduce new share issues as a financial policy. In Section 5, we turn to various extensions of the basic model and, in Section 6, we relate the findings of the previous sections to empirical analyses of the effects of dividend taxation. Finally, we provide a summary of the results and offer some concluding remarks in Section 7.

2 Model

We consider a managerial firm that exists for two periods. In period 1, the firm has initial cash holdings X and might issue new shares at an amount V_1^N. Cash holdings and new share issues are used to finance investments I and are residually distributed to shareholders as dividends, $D_1 = X - I + V_1^N \geq 0$. In period 2, the firm produces output. The production function is stochastic $F(I, e) = f(I, e) + \varepsilon$ with $\varepsilon \sim \mathcal{N}(0, \sigma^2)$.[13] Production depends on investment I and on managerial effort choices e, and satisfies $f_I, f_e > 0$, $f_{II}, f_{ee} < 0$ and $f_{Ie} \gtreqless 0$.[14]

The cross derivative captures different ways in which managerial effort interacts with physical investments (Stein, 2003; Tirole, 2006). The two input factors might be complements or substitutes. It might be straightforward to assume that managerial effort enhances not only the productivity of physical investment but also of all other production factors. This 'neutral' view of managerial effort is captured by a span of control technology (Rosen, 1982). It describes a situation in which the implementation of organizational changes or new management practices requires managerial effort and directly allows the whole span of resources under the control of the manager to be more productive (see, Bloom and Van Reenen, 2010, for instance). Examples for the latter include genuine managerial innovations such as quality control systems and lean manufacturing systems (Bloom and Van Reenen, 2007). In this case, managerial effort and physical investments are complements, i.e. $f_{Ie} > 0$.

However, in several situations managerial effort and physical investments might be substitutes, i.e. $f_{Ie} < 0$. This occurs, for instance, in industries where local information and expertise

[13] To save on notation, we implicitly assume that the distribution of ε is such that realized profits are non-negative.

[14] Throughout the paper, subscripts denote partial derivatives where the order in which derivatives are taken is indicated by the sequence of subscripted variables.

are indispensable in selecting investment projects.[15] A higher central supervision (higher e) might discourage local managers to exert effort either because verification problems make it more costly for local managers to justify their investment decisions (Mookherjee, 2006) or because it increases local managers' fear of dismissal, thereby restraining local managers from investing in firm-specific human capital (Shleifer and Summers, 1988). A negative cross derivative f_{Ie} may also characterize non-competitive, possibly declining industries where managers exert less effort in negotiations for production inputs (Giroud and Mueller, 2010) or where managers are reluctant in exerting effort to shut down old plants or badly performing projects (Stein, 2003).[16] In Appendix A.1, we provide a formal discussion of production functions that exhibit a positive or negative sign of f_{Ie}.

Profits are taxed at the rate $\tau > 0$. Investments depreciate at rate $\delta > 0$, where economic depreciation δI and the fixed wage of the manager a are deductible from the corporate tax base. At the end of period 2, the firm is liquidated and net-of-tax profits as well as the liquidation proceeds $(1-\delta)I$ are distributed to shareholders.[17] Thus, second-period dividends are given by

$$D_2 = (1-\tau)(f(I,e) + \varepsilon - a) + \tau\delta I + (1-\delta)I. \tag{1}$$

Dividend distributions are taxed at rate τ^D at the shareholder level. Arbitrage behaviour implies that the firm value equals the stream of discounted net-of-tax dividend income corrected for new share issues. Hence,

$$V = (1-\tau^D)\left(D_1 + \frac{D_2}{1+r}\right) - V_1^N. \tag{2}$$

Shareholders offer the manager a share α of the firm and a fixed wage a. The manager is risk-averse and derives utility from income

$$w = \alpha V + \frac{a}{1+r} \tag{3}$$

net of the private costs of effort provision $\phi(e)$. Expected utility is $E(U) = E\left(u\left(w\right)\right) - \frac{\phi(e)}{1+r}$ with $u' > 0 > u''$ and $\phi', \phi'' > 0$.

Private costs of effort introduce a conflict of interest between managers and shareholders about the preferred level of managerial effort (Tirole, 2006). The assumed relation between effort

[15] The reliance on local expertise becomes important in industries with new technologies in which firms opt for a decentralized decision structure to exploit local information (Acemoglu et al., 2007).

[16] Bertrand and Mullainathan (2003) find that the destruction of old plants as well as the creation of new plants falls when managers are insulated from hostile takeovers, which undermines incentives to exert effort (enjoying a quiet life).

[17] For simplicity, the corporate tax base does not include liquidation proceeds $(1-\delta)I$. The findings are unaffected by this modelling choice.

and investment can be understood as a structural modelling of a reduced-form representation that is frequently taken as a first-order conflict in the investment level in quiet-life agency models. For instance, in Aggarwal and Samwick (2006) the production function is $f(I)$ and the cost of effort is BI, $B > 0$. This is compatible with an effort cost Be and a production function $F(I, e) = f(\min\{I, e\}) + \varepsilon$ which implies $I = e$ and thus $F(I, I) = f(\min\{I, I\}) + \varepsilon = f(I) + \varepsilon$. In reduced form, the conflict is over investment policy, but the underlying conflict is related to managerial effort.

In the model, we could additionally introduce a 'first-order' conflict in the investment level.[18] We adopt the more parsimonious modelling strategy since the former type of conflict is sufficient to derive our most important findings.

Assuming utility over income to be exponential, and thus to exhibit constant absolute risk aversion (CARA), we can rewrite expected utility of the manager as $E(U) = u\left(E(w) - \rho Var(w)\right) - \frac{\phi(e)}{1+r}$, where $\rho > 0$ is a constant that represents the degree of risk aversion. Using (**??**) to (**??**), the mean and the variance of wage income are

$$E(w) = \alpha E(V) + \frac{a}{1+r} \quad \text{and} \quad Var(w) = \left(\alpha \frac{(1-\tau^D)(1-\tau)}{1+r}\right)^2 \sigma^2. \tag{4}$$

Therefore, manager utility is given by

$$E(U) = u\left(\alpha E(V) + \frac{a}{1+r} - \rho\left(\alpha \frac{(1-\tau^D)(1-\tau)}{1+r}\right)^2 \sigma^2\right) - \frac{\phi(e)}{1+r}. \tag{5}$$

Shareholders must obey the manager's participation constraint $E(U) \geq 0$, where the manager's reservation utility is normalized at zero. As manager remuneration is costly to shareholders, they will choose a wage schedule such that the participation constraint holds as an equality. Inserting $E(U) = 0$ into shareholder wealth $(1-\alpha)E(V)$, while noting (**??**), yields[19]

$$(1-\alpha)E(V) = E\left(V\right) + \frac{a}{1+r} - \rho\left(\alpha \frac{(1-\tau^D)(1-\tau)}{1+r}\right)^2 \sigma^2 - u^{-1}\left(\frac{\phi(e)}{1+r}\right). \tag{6}$$

Eq (**??**) shows that, due to the participation constraint $E(U) = 0$, shareholders become residual claimants, which induces them to account for manager utility.

Expected fiscal resources of the public sector, $E(T)$, comprise dividend and corporate tax revenues

$$E(T) = \tau^D\left(D_1 + \frac{E(D_2)}{1+r}\right) + \tau \frac{f(I,e) - a - \delta I}{1+r}. \tag{7}$$

[18] We could assume that higher investments directly generate higher private costs $\psi(I)$, $\psi' > 0$. A formal analysis of this extension is available upon request. The basic findings are unaffected.

[19] With CARA utility, $u(\cdot)$ is invertible; a property that we use in deriving (**??**).

In the model, shareholders and the manager move sequentially. At the beginning of period 1, shareholders decide on the incentive contract (α, a) and choose the level of equity injections V_1^N, anticipating the manager's choice of effort e and investment I at the end of period 1. In period 2, production takes place, taxes are paid and the firm is liquidated. We solve the game by backward induction.

3 Retained earnings as the marginal source of funds

We start out by assuming that firms are cash rich and use retained earnings to finance investments. In practice, retained earnings are the dominant source of investment finance and particularly so for mature firms (Auerbach and Hasset, 2003). In this setting, shareholders optimally set the level of new share issues to zero, $V_1^N = 0$ (Sinn, 1987). The amount of retained earnings X is used to finance investments I and first-period dividend payments are determined as the residual after the firm finances all profitable projects with internal cash:

$$D_1 = X - I > 0. \tag{8}$$

3.1 Firm behaviour

Solving backwards, the manager decides on investments and effort for given values of α and a. Inserting (**??**) into (**??**), while noting (**??**) and (**??**), the manager's choice of investments satisfies the following

$$I: \quad \alpha(1-\tau^D)\left(-1+\frac{(1-\tau)f_I+\tau\delta+1-\delta}{1+r}\right)=0. \tag{9}$$

The increase in second period dividend distributions due to higher investments equals the costs of reduced distributions in the first period. The manager symmetrically participates in the benefits and costs of investments. The incentive contract hence aligns the interests of the manager and of shareholders with respect to investment levels. The manager's effort choice follows from

$$e: \quad u'\left(\alpha(1-\tau^D)\frac{(1-\tau)f_e}{1+r}\right)-\frac{\phi'(e)}{1+r}=0. \tag{10}$$

The marginal increase in net-of-tax profits assigned to the manager through the incentive contract is equated to the marginal costs of effort. As the manager privately bears the effort costs, but receives only a fraction of the total return on effort, the effort level is below the level

shareholders prefer.[20]

From (**??**) and (**??**), we obtain

$$\frac{de}{d\alpha} = -\frac{1}{|\Delta|}\frac{\alpha((1-\tau^D)(1-\tau))^2}{1+r} f_e f_{II} > 0 \qquad \text{and} \qquad \frac{dI}{d\alpha} = \frac{1}{|\Delta|}\frac{\alpha((1-\tau^D)(1-\tau))^2}{(1+r)^2} f_e f_{Ie}, \tag{11}$$

where $|\Delta| > 0$ is the determinant of the Hessian matrix of the manager's decision problem. From (**??**), a higher sharing parameter, α, strengthens managerial incentives to exert effort. More effort provision changes the marginal productivity of investment, as captured by $f_{Ie} \gtreqless 0$, and the interaction between effort and investment determines the sign of the investment response, i.e. sign$\{dI/d\alpha\}$=sign$\{f_{Ie}\}$. For instance, if effort and investments are complements in production, $f_{Ie} > 0$, higher effort provision strengthens incentives to invest.

At stage 1, shareholders choose the incentive contract so as to maximize shareholder wealth (**??**), noting (**??**), (**??**), and (**??**). Applying the envelope theorem, the first-order condition is

$$(1-\alpha)\frac{(1-\tau^D)(1-\tau)f_e}{1+r}\frac{de}{d\alpha} = 2\alpha\rho\left(\frac{(1-\tau^D)(1-\tau)}{1+r}\right)^2\sigma^2. \tag{12}$$

The choice of α follows from an incentive-insurance trade-off (Holmstrom, 1979). As captured by the left-hand side of (**??**), a higher sharing parameter induces more effort provision which increases shareholder wealth. At the same time, a higher sharing parameter exposes the risk-averse manager to more risk, which shareholders need to compensate through a higher flat wage payment, a, to satisfy the manager's participation constraint $E(U) = 0$. The associated marginal costs are captured by the right-hand side of (**??**).

The first-order condition (**??**) implicitly defines α as a function of τ^D. Differentiating investment and effort with respect to τ^D yields

$$\frac{de}{d\tau^D} = \frac{\partial e}{\partial \tau^D} + \frac{\partial e}{\partial \alpha}\frac{d\alpha}{d\tau^D} \qquad \text{and} \qquad \frac{dI}{d\tau^D} = \frac{\partial I}{\partial \tau^D} + \frac{\partial I}{\partial \alpha}\frac{d\alpha}{d\tau^D}. \tag{13}$$

The first term in the two expressions captures the direct effect of the dividend tax on managerial choices, while the second term summarizes the indirect effect due to changes in the sharing parameter. The direct and indirect effect might be opposite in sign. We can straightforwardly sign the overall responses by resorting to an equivalent representation of the managerial incentive contract and the behavioural responses that are induced by it. Rewriting the incentive contract

[20] Shareholders prefer a level of effort that satisfies (**??**) with $\alpha = 1$. The intuition is that shareholders are residual claimants, which entails that they are interested in aligning the total marginal increase in net-of-tax profit to the marginal costs of effort.

by replacing α with $\tilde{\alpha}(1-\tau^D)^{-1}$ makes managerial pay independent of the dividend tax and mechanically shifts the tax burden onto shareholders. The incidence and efficiency effects of corporate behaviour are unaffected by the reformulation as shareholders are able to shift the tax burden back onto the manager by adjusting the sharing rate $\tilde{\alpha}$.[21] As shown in Appendix A.2, using the re-formulated sharing rate $\tilde{\alpha} = \alpha(1-\tau^D)$, and re-iterating all steps to derive the optimal managerial choices and the sharing rate $\tilde{\alpha}$ yields $de/d\tau^D < 0$ and $\text{sign}\{dI/d\tau^D\}=-\text{sign}\{f_{Ie}\}$. A higher dividend tax discourages effort provision and thereby influences investment levels depending on how the marginal productivity of investment varies with effort. To summarize,

Proposition 1. *Assume retained earnings are the marginal source of investment finance. Accounting for the adjustment in incentive contracting, a higher level of τ^D reduces managerial effort and changes investment depending on the way effort and investment interact in production, i.e. $sign\{dI/d\tau^D\}=-sign\{f_{Ie}\}$. Following a dividend tax increase, instantaneous dividend payments D_1 change according to $dD_1/d\tau^D = -dI/d\tau^D$.*

The above finding is different to the neoclassical notion of how dividend taxes affect firm behaviour when firms are cash rich and, thereby, use retained earnings as the marginal source of investment funds (King, 1974; Auerbach, 1979; Bradford, 1981). The present setting replicates the neoclassical model when $e \equiv 0$. In this case, investment, I, and instantaneous as well as future dividend distributions, D_1 and D_2, are unaffected by the dividend tax, and the tax burden only capitalizes in firm value, c.f. (**??**) and (**??**).[22] In the quiet-life model, the dividend tax influences managerial effort choices, the investment behaviour and payout behaviour of firms. A higher dividend tax raises investments and lowers instantaneous distributions when effort and investments are substitutes in production, $f_{Ie} < 0$. The opposite holds when effort and investments are complements, $f_{Ie} > 0$. As discussed above, both type of responses are consistent with recent empirical findings on the effect of dividend taxes on dividend payments and investments. We relegate a more detailed discussion of the empirical literature vis-à-vis the predictions of the quiet-life model to Section 6.

[21] Intuitively, the equivalence result is related to the equivalence of levying taxes on the demand side or supply side of a market. The dividend tax, which relates to the dividend income of the manager, can be levied on the manager or on shareholders. Adjustments in the sharing rate will neutralize the way in which the manager's dividend tax is levied, but will not affect 'quantities', i.e., investment and effort choices.

[22] More precisely, when $de \equiv 0$, (**??**) implies $\partial I/\partial\alpha = 0$ and $\partial I/\partial\tau^D = 0$. From (**??**), it then follows that $dI/d\tau^D = 0$.

3.2 Welfare

The welfare measure includes shareholder wealth (**??**), which accounts for manager utility through the participation constraint of the manager, and expected tax revenues

$$W = E(V) + \frac{a}{1+r} - \rho\left(\alpha\frac{(1-\tau^D)(1-\tau)}{1+r}\right)^2\sigma^2 - u^{-1}\left(\frac{\phi(e)}{1+r}\right) + E(T). \tag{14}$$

Tax revenues comprise dividend and corporate tax revenues, as given by (**??**). Differentiating welfare (**??**) with respect to τ^D, while invoking the envelope theorem, yields

$$(1+r)\frac{dW}{d\tau^D} = \tau^D(1-\tau)f_e\frac{de}{d\tau^D} + \tau\left(f_e\frac{de}{d\tau^D} + (f_I-\delta)\frac{dI}{d\tau^D}\right). \tag{15}$$

To disentangle the welfare effects of dividend taxation, it is instructive first to assume that effort is exogenous. As explained above, in the absence of effort changes, investment levels are unaffected by dividend taxation. This implies that dividend taxes are neutral for welfare, $dW/d\tau^D = 0$. The result mirrors the neoclassical view when firms are cash rich and, thereby, use retained earnings to finance new investments (as assumed here).

In the presence of non-verifiable effort choices, the dividend tax influences managerial effort provision and thereby investment levels. The associated change in shareholder wealth does not constitute an efficiency cost, which follows from the application of the envelope theorem. The incentive contract aligns incentives between shareholders and the manager such that investment levels are set so as to maximize shareholder wealth, c.f. (**??**). Hence, any tax-induced change in investments does not generate a first-order welfare loss. Possibly surprisingly, although the manager's objective $E\left(u(\alpha V + \frac{a}{1+r})\right) - \frac{\phi(e)}{1+r}$ and the shareholders' objective $(1-\alpha)E(V)$ differ, the managerial effort choices equally do not have a first-order effect on shareholder wealth. Shareholders choose the sharing parameter α and thereby the exposure of the manager to dividend taxes $\alpha(1-\tau^D)$ optimally. As all effects of dividend taxes on effort work through the term $\alpha(1-\tau^D)$, shareholder wealth does not vary with effort (Chetty and Saez, 2010).[23] Hence, shareholder wealth is insulated from behavioural responses that follow from dividend taxation, although the tax aggravates the pre-existing investment and effort distortion.

[23] Differentiating (**??**) with respect to τ^D, while accounting for (**??**) and (**??**), and noting $\frac{de}{d\alpha} = (1-\tau^D)\frac{de}{d\alpha(1-\tau^D)}$, the change in shareholder wealth (net of the mechanical tax effect which is neutral for efficiency) is given by

$$\frac{1}{1-\tau^D}\left((1-\alpha)\frac{(1-\tau^D)(1-\tau)f_e}{1+r}\frac{de}{d\alpha} - 2\alpha\rho\left(\frac{(1-\tau^D)(1-\tau)}{1+r}\right)^2\sigma^2\right)\frac{d\alpha(1-\tau^D)}{d\tau^D}.$$

Given the first-order condition for the choice of α in (**??**), the partial effect of dividend taxation vanishes.

Still, managerial effort changes introduce two sources of welfare variation. Effort drops in response to a higher dividend tax rate and lowers dividend tax revenues (c.f. the first term in (**??**)). The dividend tax revenue term captures a negative fiscal externality that shareholders and the manager exert on the public budget through the choice of the incentive contract and the managerial choice of effort and investment. This effect in isolation indicates that dividend taxation incurs an efficiency cost when retained earnings are the marginal source of funds. It is important to note, if the investment policy maximizes firm value, the effect on dividend tax revenues, resulting from a change in investment, vanishes due to an application of the envelope theorem.

The dividend tax change 'spills over' to corporate tax revenues. Less effort lowers taxable corporate profits, as depicted by the first term in brackets in (**??**). Furthermore, depending on sign$\{f_{Ie}\}$, effort adjustments change investment incentives, which affects corporate tax revenues, as summarized by the second term in brackets in (**??**). For instance, when investments and effort are complements in production, $f_{Ie} > 0$, a higher dividend tax reduces investments, which adds to the efficiency costs of dividend taxation through its negative effect on corporate tax revenues. A reversed type of reasoning applies when $f_{Ie} < 0$. In this case, higher dividend taxes spur investments generating a positive effect on corporate tax revenues. The investment response follows from effort changes and, thereby, is of second order compared to the effort response. Consequently, the positive investment-related fiscal externality will most likely not compensate for the negative fiscal externality on corporate tax revenues following from managerial effort provision. Thus,

Proposition 2. *Assume retained earnings are the marginal source of investment finance. An increase in the dividend tax reduces welfare due to lower managerial effort, e. The induced response in the corporate investment level, I, further aggravates welfare when $f_{Ie} > 0$ and partially counteracts the negative welfare effect of effort adjustments when $f_{Ie} < 0$.*

The welfare term (**??**) can be related to the discussion of income-shifting incentives and the associated welfare implications (Slemrod, 1995; Gordon and Slemrod, 2000).[24] Changes in the dividend tax affect incentives to remunerate the manager either through dividend payments or a wage payment a, and thereby to save on taxes levied on each of the two forms of remuneration.[25]

[24] See Saez et al. (2012) for a survey of the literature.

[25] We may extend the analysis to include a wage tax τ^W on the fixed salary payment a to formally introduce different tax bases related to managerial pay.

Thus, income shifting might come at an efficiency cost. Precisely, the residually determined adjustment in a (so as to satisfy the manager's participation constraint) is neutral for efficiency as it carries no behavioural responses. However, as captured by (**??**), the change in α induces efficiency effects which follow from changes in effort as well as investment. The observation is different from the standard notion of how income shifting affects welfare. The latter is related to the mechanical shifting of income between different tax bases, most notably the dividend tax base and the wage tax base.[26]

3.3 Adding empire-building preferences

In this section, we introduce a second source of agency conflict by allowing the manager to have empire-building preferences (Jensen 1986). The manager is motivated to grow firms beyond the optimal size in order to have more resources under control. With retained earnings as the marginal source of funds, the manager can use the disposable cash flow to finance investments or dividend distributions. The manager and shareholders differ in their preferences on how to use these funds. The manager prefers the funds to stay within the firm to build a corporate empire, rather than distributing the funds, as preferred by shareholders. We model empire-building preferences by introducing unproductive investments P (perks), which give the manager private benefits of $\psi(P)$, with $\psi' > 0 > \psi''$. Since unproductive investments expand capital outlays, dividend distributions in the first and second period are[27]

$$D_1 = X - I - P > 0 \quad \text{and} \quad D_2 = (1-\tau)(F(I,e) - a) + \tau\delta(I+P) + (1-\delta)(I+P). \quad (16)$$

In the extended model, expected utility of the manager is

$$E(U) = u\left(\alpha E(V) + \frac{a}{1+r} - \rho\left(\alpha\frac{(1-\tau^D)(1-\tau)}{1+r}\right)^2\sigma^2\right) - \frac{\phi(e)}{1+r} + \frac{\psi(P)}{1+r}. \quad (17)$$

Inserting (**??**) into (**??**), while noting (**??**), the level of unproductive investments follows from

$$P: \quad u'\left(\alpha(1-\tau^D)\left(-1 + \frac{\tau\delta + 1 - \delta}{1+r}\right)\right) + \frac{\psi'(P)}{1+r} = 0. \quad (18)$$

[26] We are able to replicate the standard mechanical income-shifting effect and its relevance for welfare by assuming that tax revenues are not rebated in a lump-sum fashion, but through distortionary taxes. This implies multiplying tax revenues T in (**??**) by $\lambda > 1$, where λ captures the marginal cost of public funds with distortionary taxes.

[27] Without loss of generality, we condition depreciation on total capital outlays and not on its components.

The manager's choice of unproductive investments equates the marginal cost due to a reduced net-of-tax first-period dividend distribution to the marginal benefit of empire-building.[28] The first-order conditions for I and e continue to be given by (**??**) and (**??**).

To compare the predictions of the quiet-life model with those of the empire-building model, it is instructive to assume $e \equiv 0$. In this case, the model reduces to a pure empire-building model. Using (**??**), (**??**) and (**??**), the change in investments and first-period distributions are[29]

$$dI/d\tau^D = 0, \quad dP/d\tau^D > 0 \quad \text{and, thereby,} \quad dD_1/d\tau^D < 0. \tag{19}$$

Due to the incentive contract, the manager proportionally participates in the benefit and cost of investing productively. The dividend tax scales the extent to which the manager participates in the benefit and cost, but it does not change the level of productive investments. Differently, the dividend tax subsidizes perks. The dividend tax increases the cost of first-period dividend distributions, which reduces the manager's opportunity cost of investing unproductively. In response, the manager invests more funds unproductively, which lowers first-period dividend distributions, D_1 (Chetty and Saez, 2010). The findings of the model with empire-building preferences are congruent with the analysis of the quiet-life model when effort and productive investments are substitutes ($f_{eI} < 0$).

It is informative to assess the welfare costs of dividend taxation in the empire-building model and to infer whether they are sensitive to the underlying type of agency conflict. Differentiating welfare (**??**) with respect to τ^D, while assuming $e \equiv 0$ and invoking the envelope theorem, yields[30]

$$(1+r)\frac{dW}{d\tau^D} = \tau^D(1-\tau)(-(1+r)+\tau\delta+(1-\delta))\frac{dP}{d\tau^D} + \tau\left(-\delta\frac{dP}{d\tau^D}\right). \tag{21}$$

In the empire-building model, the change in investment outlays, $d(I+P)/d\tau^D = dP/d\tau^D$, is a sufficient statistic for computing the welfare effects. Differently, in the quiet-life model, investment changes are not a sufficient statistic, c.f. (**??**). Managerial effort is central to this type of agency model, and ignoring the tax-induced changes in effort leads to an underestimation

[28] Given the first-order condition for productive investment (**??**), the reduced first-period dividend distribution corrected for the tax implications of higher investment outlays, as captured by the first term in (**??**), is negative.

[29] As before, the contract choice adjustment quantitatively influences the responses, but does not overturn the sign of the direct, tax-induced responses that follow from (**??**) and (**??**).

[30] With $e \equiv 0$, tax revenues are

$$T = \tau^D\left(D_1 + \frac{D_2}{1+r}\right) + \tau\frac{f(I,e)-a-\delta(I+P)}{1+r}. \tag{20}$$

of the welfare loss of dividend taxation.

4 New share issues

Especially young and immature firms, which still grow, might be cash constrained. They might not have sufficient internal funds to finance investments and have to resort to new share issues. To analyze the effect of dividend taxes when firms issue shares we return to the 'pure' quiet-life model of Section 3.1.

With new share issues in the first period, we have $V_1^N > 0$ and first-period dividend distributions are zero, i.e. $D_1 = X - I + V_1^N = 0$. Thus, the manager's choice of investment satisfies

$$I: \quad \alpha\left(-1 + \frac{(1-\tau^D)((1-\tau)f_I + \tau\delta + 1 - \delta)}{1+r}\right) = 0. \tag{22}$$

The first-order condition (**??**) differs from (**??**). Intuitively, the government participates in the return to investment, but provides no subsidy to the costs of equity investments. Thereby, the dividend tax undermines investment incentives, conditional on effort. The first-order condition for managerial effort choices continues to be given by (**??**).

Three implications are noteworthy at this point. First, the present setting replicates the neoclassical view when $e \equiv 0$. In this case, investments reduce in response to dividend taxation because of the asymmetric tax treatment of the return of investment and the costs of new share issues, as captured by (**??**) (Harberger, 1962; Feldstein, 1970; Poterba and Summers, 1985). Second, in the quiet-life model, dividend taxes influence investment behaviour not only directly through the asymmetric tax treatment, but also indirectly through effort changes. As such, even when investments and effort are substitutes in production ($f_{Ie} < 0$), in which case the effort response to dividend taxes increases investments, the overall investment response to dividend taxation might be negative in sign. Third, cash-constrained and cash-rich firms might have the same investment response to dividend taxes despite the difference in the financing regime (new share issues vs. retained earnings). This finding argues against the ability to infer the firm's financing regime from observed investment behaviour, as it is feasible in the neoclassical model. Therein, a decline in investments in response to higher dividend taxes is consistent with the use of new share issues as the marginal source of funds, whereas investments do not vary with dividend taxes when retained earnings finance investments at the margin.

However, the quiet-life model offers some guidance on the ability to infer the mode of fi-

nancing based on the firm's investment response. Key to the identification is the finding that equity-based incentive pay α and the dividend tax factor $1-\tau^D$ exert the same effect on investments that are financed out of retained earnings, while α and $1-\tau^D$ affect investments financed through new share issues differently.[31] In (**??**) and (**??**) the term $\alpha(1-\tau^D)$ summarizes the effect of the sharing parameter and the dividend tax on investment and effort choices when retained earnings are sufficient to finance investment outlays. Intuitively, the incentive contract and the dividend tax base depend on the same set of variables, which includes the equity costs of investment and the profit net of corporation tax. With new share issues, the equity costs of investment are excluded from the dividend tax base, but the incentive contract still depends on these costs (c.f. (**??**) and (**??**)). It follows that investments respond more strongly to tax changes than to changes in the sharing parameter. Hence, using superscripts re and nsi for retained earnings and new share issues as the marginal source of finance, we find

$$\frac{\partial I^{re}}{\partial \alpha} = \frac{\partial I^{re}}{\partial (1-\tau^D)} \quad \text{and} \quad \frac{\partial I^{nsi}}{\partial \alpha} > \frac{\partial I^{nsi}}{\partial (1-\tau^D)}. \tag{23}$$

Taking the differential predictions to data requires to address the fact that α is endogenous and depends on τ^D. For instance, following a dividend tax reform, some exogenous variation in α is thus needed. This serves to exclude the possibility that the empirical relation between I and α is not causal and driven by adjustments in I and α that are induced by the dividend tax change.

Inferring the marginal source of funds from (**??**) is informative in corporate agency models (as in the neoclassical model). With new share issues rather than retained earnings, the investment level is not only more downward pressured (c.f. (**??**) and (**??**)), but also the marginal welfare change qualitatively differs. Differentiating welfare (**??**) with respect to τ^D, while invoking the envelope theorem, yields

$$\begin{aligned}(1+r)\frac{dW}{d\tau^D} &= (1-\alpha)(1-\tau^D)(1-\tau) f_e \left(\frac{\partial e}{\partial \tau^D} + \frac{\alpha}{1-\tau^D} \frac{\partial e}{\partial \alpha} \right) \\ &+ \tau^D (1-\tau) f_e \frac{de}{d\tau^D} + \tau \left(f_e \frac{de}{d\tau^D} + (f_I - \delta) \frac{dI}{d\tau^D} \right), \end{aligned} \tag{24}$$

where the first-order condition (**??**) has been used to rearrange terms.[32] The welfare effect (**??**) differs from (**??**) by the first line that captures the effect of a higher τ^D on shareholder wealth. It follows from the different influence of the sharing rate and the dividend tax rate on managerial

[31] The empirical relevance of the two determinants, τ^d and α, for investment behaviour is frequently analysed, albeit separately. See Yagan (2015) and Aggarwal and Samwick (2006) as well as the literature cited therein.

[32] With both modes of financing marginal investments, the first-order condition for α is (**??**).

effort under the two modes of finance. With retained earnings as the marginal source of funds, managerial investment and effort depend on $\alpha(1-\tau^D)$. As shown above, when α is optimized, the two counteracting effects offset each other and changes in τ^D have no effect on shareholder wealth, despite of the pre-existing distortion in managerial behaviour.[33] Intuitively, shareholders neutralize the effect of the dividend tax on managerial effort by adjusting the sharing rate α, as they effectively choose $\alpha(1-\tau^D)$. Differently, with new share issues, managerial behaviour does not depend on $\alpha(1-\tau^D)$, but distinctly on its subcomponents α and τ^D. In this situation, shareholders can no longer neutralize the effect of the dividend tax on shareholder wealth, and a higher dividend tax aggravates the pre-existing distortion in managerial behaviour, as reflected by the first line in (**??**). Thus,

Proposition 3. *When firm uses new share issues to finance investments,*

(i) changes in the sharing rate α and the dividend tax τ^D have different effects on investment levels, i.e. $\partial I^{nsi}/\partial\tau^D < \partial I^{nsi}/\partial\alpha$, which provides a testable implication to infer the mode of investment finance, and

(ii) dividend taxation induces a first-order welfare loss through its negative effect on shareholder wealth. Thus, dividend taxes are more distortionary as compared to the situation in which retained earnings are the marginal source of funds, where only the fiscal externalities matter for welfare.

The suggested identification in (**??**) relies on general features of the incentive contract and the definition of the dividend tax base. Thus, it does not only apply to quiet-life models, but also to empire-building models and models of managerial overconfidence (Malmendier and Tate, 2005).[34] In these models, the sharing parameter applies to all corporate distributions. The dividend tax base includes all distributions when retained earnings are used at the margin, but excludes the costs of investment when new share issues are the marginal source of funds.

The negative effect of dividend taxes on shareholder wealth in (**??**) only nullifies when shareholders directly determine the level of investment and thereby the amount of new share issues.[35] In this situation, shareholders choose V_1^N along with α so as to maximize their wealth,

[33] In this case, $\partial e/\partial\tau^D = -\alpha/(1-\tau^D)\partial e/\partial\alpha$ and, as a consequence, the bracketed term in the first line of (**??**) vanishes.

[34] In models of managerial overconfidence, the non-congruence of interests between shareholders and managers is related to the too optimistic beliefs managers have with respect to the desirability of investment projects.

[35] In Chetty and Saez (2010), external investors are only willing to participate in the increase of capital if monitoring of the manager eliminates perk investment. Thus, when injecting capital, shareholders directly choose the level of productive investment.

while the manager only selects the effort level which depends on $\alpha(1-\tau^D)$, c.f. (**??**). Since shareholders can neutralize the effect of changes in τ^D on $\alpha(1-\tau^D)$ (and thereby on e) by adjusting α, shareholder wealth is insulated from dividend tax changes.

5 Further analyses

5.1 Taxation of equity-based incentive wages

Recent tax policy discussions centre on whether equity-based managerial wages should be taxed differently to general wage income. Equity-based wages might well influence managerial behaviour in socially undesirable ways and a tax on managerial wages might at least partially correct for this (see, for instance, Benabou and Tirole, 2016; Murphy, 1999, and Piketty et al., 2014).

In what follows, we assume that the equity-based incentive income of the manager is taxed at the personal income tax rate τ^E. The net-of-tax income of the manager is $w = (1-\tau^E)\alpha V + \frac{a}{1+r}$ and the expected utility of the manager states

$$E(U) = u\left((1-\tau^E)\alpha E(V) + \frac{a}{1+r} - \rho\left(\alpha\frac{(1-\tau^E)(1-\tau^D)(1-\tau)}{1+r}\right)^2\sigma^2\right) - \frac{\phi(e)}{1+r}. \quad (25)$$

From (**??**), we can conclude that conditional on α, the two taxes τ^E and τ^D are equivalent in terms of their impact on the manager's choice of investment and effort. At the beginning of the first period, shareholders choose the incentive contract, and the manager accepts the incentive contract and works for the firm provided the participation constraint $E(U) = 0$ holds. Inserting $E(U) = 0$ into external shareholder wealth $(1-\alpha)E(V)$, while noting (**??**), yields

$$(1-\alpha)E(V) = E(V) + \frac{1}{1-\tau^E}\left(\frac{a}{1+r} - \rho\left(\alpha\frac{(1-\tau^E)(1-\tau^D)(1-\tau)}{1+r}\right)^2\sigma^2 - u^{-1}\left(\frac{\phi(e)}{1+r}\right)\right). \quad (26)$$

Maximizing (**??**) with respect to the sharing parameter α, while applying the envelope theorem, the first-order condition is

$$(1-\alpha)\frac{(1-\tilde{\tau})f_e}{1+r}\frac{de}{d\alpha} = 2\alpha\rho\left(\frac{1-\tilde{\tau}}{1+r}\right)^2\sigma^2, \quad (27)$$

where $1-\tilde{\tau} = (1-\tau^D)(1-\tau^E)(1-\tau)$. It becomes evident from the optimality condition that shareholders perceive the dividend tax τ^D and personal income tax τ^E as equivalent tax instruments. This might be surprising as the personal income tax only applies to the manager.

However, shareholders become residual claimants and get all utility gains above the reservation utility. Effectively, the personal income tax becomes a tax on shareholder wealth and is equivalent to the dividend tax τ^D in affecting the sharing parameter in the incentive contract. Combining this insight with the previous conditional equivalence results, which relate to the tax effect on investments and effort for a given value of α, the two tax instruments become equivalent in their implications for manager and shareholder behaviour and, thus, welfare.[36] As a consequence, the model predicts that a special tax on the equity-based wage of the manager is redundant and the same efficiency effects can be achieved through the general dividend tax τ^D. Thus,

Proposition 4. *Assume equity-based incentive income of the manager is taxed at the personal income tax rate τ^E, while dividend income of external shareholders is taxed at the rate of tax τ^D. The two tax instruments τ^D and τ^E have identical effects on incentive contracting, managerial effort choices and investment levels. Thereby, τ^D and τ^E are equivalent in their effects on welfare.*

A natural question is the extent to which the equivalence result carries over to other forms of managerial wage determination, such as Nash bargaining.[37] To analyse the issue, we use the set up adopted above and modify the way the sharing rate α is chosen. With Nash bargaining, the sharing rate is determined by maximizing the product of the manager utility and shareholder utility (net of the value of the respective outside option). From (**??**), shareholder utility $(1-\alpha)E(V)$ is a fraction $(1-\tau^D)$ of the received stream of dividend payments when the firm uses retained earnings as the marginal source of funds. The term $(1-\tau^D)$ scales the product of the two utilities, but will not change the bargaining outcome. In contrast, the dividend tax and personal income tax influence manager utility through the tax term $(1-\tau^D)(1-\tau^E)$.[38] Given the additive structure of manager utility $E(U^M) = E\left(u(w)\right) - \frac{\phi(e)}{1+r}$, the tax term will not factor out of manager utility and will thereby influence the bargaining solution. The two tax instruments τ^D and τ^E are thus equivalent in determining the Nash bargaining outcome, and

[36] Note the relevant welfare measure now comprises private welfare (**??**) plus tax revenues (**??**), which needs to be augmented by the tax payment $\tau^E \alpha V$.

[37] See Kleven et al. (2014) for a recent application of the widely used approach in the context of top-income earners.

[38] This insight holds for different specifications of the outside option of shareholders, including the scenario that the manager is indispensable to the firm ($\overline{U}^S = 0$) and that shareholders will have to find a replacement for the manager when negotiations break down, who then runs the firm, possibly at a reduced firm value.

also in their direct effects on investment and effort (c.f. (**??**)). See Appendix A.3 for a more formal analysis of this issue.

5.2 Investment responses and welfare changes

A common prediction of existing analyses of dividend taxes is that the level and structure of investment responses are a sufficient statistic for the welfare effects of dividend taxation (Auerbach, 2002; Chetty and Saez, 2010). In this section we revisit the finding. As shown above, the efficiency effects of dividend taxes are also related to the fiscal effects of investment responses and this effect emerges when dividend taxes and corporate taxes are levied simultaneously, as typically observed in practice. Corporate taxation generally discourages investments unless the cost of investment is fully tax deductible, as offered by e.g. an R-based cash flow tax and an allowance for corporate equity (ACE) system - two frequently discussed and probed variants of a tax system that entail a full deduction of investment costs.[39] The importance of the tax treatment of the cost of investment for economic efficiency is not restricted to corporate taxation, but also carries over to dividend taxation. To show this, we consider an R-based cash flow tax in the model.[40] The tax system alters total tax revenues to

$$T = \tau^D \left(D_1 + \frac{D_2}{1+r} \right) + \tau \left(-I + \frac{f(I,e) - a}{1+r} + \frac{(1-\delta)I}{1+r} \right). \tag{28}$$

The first and third term in the second brackets are new, as compared to tax revenues in (**??**). They represent the costs of investment and the proceeds of liquidation. The inclusion of the two terms reflects the aim of the R-based cash flow tax to tax all inflowing cash and to subsidize all out-flowing cash.

We start out with the assumption that retained earnings are sufficiently available to finance investments. Noting that first-period dividends become $D_1 = X - (1-\tau)I \geq 0$, the manager's choice of investment satisfies

$$I: \quad \alpha(1-\tau^D)(1-\tau)\left(-1 + \frac{f_I + 1 - \delta}{1+r} \right) = 0 \quad \Leftrightarrow \quad f_I = r + \delta, \tag{29}$$

[39] The issue of whether this cost should be fully tax deductible is central to tax reform discussions in many countries (for instance, see Auerbach et al., 2010).

[40] The two corporate tax systems are equivalent in the current setting. They only differ with respect to the timing of the reimbursement of the full cost of investment. The R-based cash flow tax offers an immediate write-off of the investment, coupled with the taxation of liquidation proceeds. The ACE system offers a tax deductibility of the cost of investment finance, combined with a yearly depreciation allowance (Boadway and Bruce, 1984; Devereux and Freeman, 1991).

while managerial effort choices still follow from (**??**). The tax system treats the investment cost and benefits symmetrically, leaving the investment choice undistorted. Conditional on effort choices, investment levels are insulated from corporate taxation as well as dividend taxation. However, from (**??**) and (**??**), dividend taxation undermines managerial effort provision, and depending on sign$\{f_{Ie}\}$, this 'spills over' to the investment choice, as before. As such, effort levels are negatively related to dividend taxes and the associated tax-induced investment response depends on sign$\{f_{Ie}\}$.

Using (**??**) and (**??**) and applying the envelope theorem, we find

$$(1+r)\frac{dW}{d\tau^D} = \tau^D(1-\tau)f_e\frac{de}{d\tau^D} + \tau\left((\overbrace{f_I - r - \delta}^{=0})\frac{dI}{d\tau^D} + f_e\frac{de}{d\tau^D}\right).$$

From (**??**) we obtain $f_I = r + \delta$, which implies that the effect of investments on corporate tax revenues vanishes. This finding might be surprising, given that investments change with dividend taxation. However, the manager symmetrically participates in all benefits and costs of investments through the incentive contract, which, at the margin, insulates tax revenues and thereby welfare from investment changes.[41] The dividend tax influences effort and this behavioural response is sufficient to calculate the efficiency costs of dividend taxation. The welfare neutrality of investment responses is different from the neoclassical model of dividend taxation where the retention of profits implies a re-timing of dividend taxation and, thus, the dividend tax does not influence investment levels.[42]

When investments are financed by new share issues, the marginal welfare measure above needs to be augmented by the shareholder wealth effect of dividend taxation, which is captured by the first line in (**??**). The effect depends on effort changes, but not on investment responses. Hence, the welfare neutrality of investment responses continues to hold. Intuitively, the neutrality finding relies on the symmetric way the corporate tax system treats the investment cost and the return to investment and this applies independently of the source of investment finance. In sum,

Proposition 5. *Assume the tax system provides a symmetric treatment of the proceeds of investment and the cost of investment. Although the investment level changes with dividend taxes,*

[41] As before, private welfare is insulated from tax-induced investment changes, which is an implication of the envelope theorem.

[42] Precisely, absent agency conflicts, (**??**) implies $dI/d\tau^D = 0$. Using (**??**), the welfare change is $dW/d\tau^D = 0$.

the sign of the investment response has no implications for welfare. The welfare costs of dividend taxation are only related to the distortion in managerial effort provision.

6 Discussion

In this section, we provide a summary of our findings and relate them to the corresponding results of the neoclassical model and the empire-building agency model. Table 1 and 2 summarize the key predictions of the different models following an increase in the dividend tax rate, assuming retained earnings (Table 1) and new share issues (Table 2) as the marginal source of funds. The two tables show the responses in investments I, immediate dividend payments D_1 and new share issues V_1^N to dividend taxes as well as the sign of the efficiency costs of dividend taxation. In the two tables and in the subsequent discussion, we adopt the frequently-used terminology 'new view' and 'old view' to refer to the neoclassical approach when firms use retained earnings and new share issues at the margin.

Table 1: Key predictions of neoclassical vs. agency models (retained earnings)

	Neoclassical Model	Agency Models		
	New View	Empire Building	Quiet Life	
Conflict of interest	none	unproductive investment	costly effort, e $f_{Ie} > 0$	costly effort, e $f_{Ie} < 0$
Initial cash, X	high	high$^{(*)}$	high	high
Dividends, D_1	$D_1 > 0$	$D_1 > 0$	$D_1 > 0$	$D_1 > 0$
Equity issues, V_1^N	$V_1^N = 0$	$V_1^N = 0$	$V_1^N = 0$	$V_1^N = 0$
Investment				
Productive, I	$I > 0$	$I > 0$	$I > 0$	$I > 0$
Unproductive, J	none	$J > 0$	none	none
Increase in dividend tax, τ^D	no effect on I no effect on D_1 no effect on V_1^N	no effect on I increase in J decrease in D_1 no effect on V_1^N	decrease in e drop in I (via e) increase in D_1 no effect on V_1^N	decrease in e rise in I (via e) decrease in D_1 no effect on V_1^N
Efficiency cost of τ^D	no	yes	yes	yes

Notes: The table summarizes the effects of an increase in the dividend tax on firm choices and the related efficiency cost. It is assumed that firms have sufficiently high initial cash implying that firms pay dividends and retained earnings are the marginal source of investment funds. The predictions of the quiet-life agency model differ depending on whether physical investment I and managerial effort e are complements ($f_{Ie} > 0$) or substitutes ($f_{Ie} < 0$) in production. $^{(*)}$ In Table 1 of Chetty and Saez (2010), the scenario is referred to as "very high" initial cash. Their "high"-scenario refers to the knife-edge case where initial cash is just sufficient to finance the optimal level of investment. For simplicity, in the table (and in our model) we have suppressed this case.

A considerable body of literature has evaluated the validity of the old view and new view of dividend taxation. Depending on data availability and the methods applied, some analyses

identify the marginal source of investment finance to infer the efficiency effects of dividend taxation based on the diverging predictions of the old and the new view. Other studies have tested the implications of dividend taxes for corporate payout and investment behaviour and infer the marginal source of funds from these responses (see Auerbach, 2002, for an overview of the literature).[43] The two methods are less informative for the efficiency effects of dividend taxes in a corporate agency model. Knowing the marginal source of funds is informative in itself, but it is not sufficient to draw conclusions concerning the efficiency costs of dividend taxation. When investments are financed by retained earnings, dividend taxes might still impact investment incentives in agency models, yielding positive or negative investment responses to taxes that are different to the prediction of the new view (c.f. Table 1). Interestingly, while the two types of agency models are able to explain a positive investment response to higher dividend taxes, it is only the quiet-life model that can also accommodate empirically-observed negative investment responses. The differential prediction complements other differential predictions that are used in the corporate finance literature to analyse the empirical relevance of the empire-building and the quiet-life model (Aggarwal and Samwick, 2006; Giroud and Mueller, 2010).

Conversely, empirical estimates on the effects of dividend taxation on investments cannot be connected to a financing regime in a straightforward manner. Dividend taxes might well distort investment levels downward under either source of finance. However, as implied by Proposition 3, the quiet-life model provides auxiliary predictions, which allows the inference of the financing regime based on the empirically-observed investment behaviour.

The two types of agency models and the neoclassical model generate identical qualitative predictions for the response of investments in a retained-earnings (re) vs. new-share-issues (nsi) regime. In the models, the difference $I^{re} - I^{nsi}$ is increasing in the dividend tax.[44] Some empirical analyses use such relative responses as the outcome variable. For instance, Becker et al. (2013)

[43] To infer the source of investment funds, Auerbach and Hasset (2003) look at the sensitivity of dividend payments to investments. They make use of the testable prediction that under the new view, dividends are residually determined and decline as investment spending increases, whereas investments have no immediate impact on distributions under the old view. Poterba and Summers (1985) estimate investment equations based on Tobin's q-theory of investment, which includes the new and old views as special cases. Poterba (2004) analyses corporate payout policies to disentangle the empirical relevance of the two views and Chetty and Saez (2005) investigate how dividend payments change with dividend taxes.

[44] Intuitively, in the neoclassical model, changes in the investment difference $I^{re} - I^{nsi}$ are exclusively related to changes in I^{nsi} (c.f. Table 1 and 2). This follows from the dividend tax neutrality under the new view of dividend taxation. Differently, dividend taxes discourage investments under the old view because of the asymmetric tax treatment of the return an the cost of investment. The negative effect of the dividend tax on investments I^{nsi} carries over to agency models and implies that the difference $I^{re} - I^{nsi}$ continues to be increasing in the dividend tax.

Table 2: Key predictions of neoclassical vs. agency models (new share issues)

	Neoclassical Model	Agency Models		
	Old View	Empire Building	Quiet Life	
Conflict of interest	none	unproductive investment	costly effort, e $f_{Ie} > 0$	costly effort, e $f_{Ie} < 0$
Initial cash, X	low	low	low	low
Dividends, D_1	$D_1 = 0$	$D_1 = 0$	$D_1 = 0$	$D_1 = 0$
Equity issues, V_1^N	$V_1^N > 0$	$V_1^N > 0$	$V_1^N > 0$	$V_1^N > 0$
Investment				
Productive, I	$I > 0$	$I > 0$	$I > 0$	$I > 0$
Unproductive, J	none	$J = 0$	none	none
Increase in dividend tax, τ^D	decrease in I decrease in V_1^N no effect on D_1	decrease in I no effect on $J^{(*)}$ decrease in V_1^N no effect on D_1	drop in I (direct) decrease in e drop in I (via e) decrease in V_1^N no effect on D_1	drop in I (direct) decrease in e rise in I (via e) decrease in V_1^N no effect on D_1
Efficiency cost of τ^D	yes	yes	yes	yes

Notes: The table summarizes the effects of an increase in the dividend tax on firm choices and the related efficiency cost. It is assumed that firms have insufficient initial cash implying that firms pay no dividends and new share issues are the marginal source of investment funds. The predictions of the quiet-life agency model differ depending on whether physical investment I and managerial effort e are complements ($f_{Ie} > 0$) or substitutes ($f_{Ie} < 0$) in production. $^{(*)}$ In the empire-building agency model, external investors are only willing to participate in the increase of capital if sufficiently high monitoring of the manager eliminates unproductive perk investment J.

and Alstadsæter et al. (2017) divide the firm sample into firms that are likely to use retained earnings or new share issues to finance new investments (proxied by the access to equity markets or by cash holdings) and relate the tax-induced investment response of the two groups of firms to each other. They find that the empirically-observed change in relative investment $I^{re} - I^{nsi}$ to a dividend tax increase is generally positive in sign, and thus consistent with the old and new view.[45] Against the background of this paper, their findings can be interpreted more broadly as there is also a carry over to the empire-building model and the quiet-life agency model of firm behaviour (c.f. Table 1 and 2). Unfortunately, the differential response is not sufficient to calculate the efficiency cost of dividend taxation in the agency model. It generally requires knowledge of investment responses under each of the two financing regimes. The information can be inferred from the relative investment response in the neoclassical model, but less so in agency models, given that investments are affected by the dividend tax under both modes of finance. Interestingly, in an environment where firms are pre-clustered in groups according to their presumed marginal source of funds (as in Becker et al., 2013, for instance), the auxiliary

[45] Alstadsæter et al. (2017) exploit a dividend tax cut in Sweden and report the result for the investment difference $I^{nsi} - I^{re}$, which increases following the tax reform (Alstadsæter et al., 2017, Table 3).

prediction (**??**) suggested in this paper is useful to verify the consistency of the pre-assignment of firms with the essence of a large class of corporate agency models.

Alstadsæter et al. (2017) find that relative dividend payouts $D^{re} - D^{nsi}$ increased after a reduction of the dividend tax in Sweden. This response is consistent with predictions of a model with unproductive investment (as in Chetty and Saez, 2010) and the quiet-life model with productive investments, provided $f_{Ie} < 0$ (see Table 1 and 2). Key to the explanatory power of the two models is the prediction that a decrease in dividend taxes reduces investment outlays and, thereby, increase instantaneous dividend payouts D^{re} of firms with a sufficient amount of retained earnings, while leaving instantaneous payouts D^{nsi} at a zero level. The efficiency implications of the investment responses following an increase in dividend payouts differ however in the quiet-life and empire-building model. More unproductive investments lower efficiency in the empire-building model, while more productive investments enhance the efficiency of resource allocation in the quiet-life model. This differential prediction renders the welfare interpretation of the empirical findings in Alstadsæter et al. (2017) ambiguous.

Using the 2003 U.S. dividend tax cut as a policy experiment, Yagan (2015) finds no significant investment response of private U.S. C-corporations (treatment group) vis-à-vis U.S. S-corporations, which are not subject to dividend taxes (control group). The finding might not be interpreted as evidence against the relevance of agency models. By nature, S-corporations are on average "smaller" companies which limits the spectrum of C-corporations that can be included in the treatment group. This implies that all publicly traded C-corporations need to be excluded from the sample in his core analysis. Agency conflicts might be less prevalent for private C-corporations as compared to publicly traded C-corporations.[46] The results in Yagan remain unchanged when including the 76 percent of publicly traded corporations that fall in the paper's company size range, but become negative when including all publicly traded corporations (Yagan, 2015, p. 3552). Thus, agency problems are likely a much bigger problem in public firms, which are not a part of his core analysis.

Finally, using publicly-traded and private corporations, Desai and Goolsbee (2004) find that the U.S. dividend tax reduction enacted in 2003 had little effect on investment. The finding might be the result of the short one year post-reform time period considered, which allows for only very immediate investment responses to be measured. Those might however be only small

[46] Yagan notes that "public corporations have much more dispersed ownership and thus may be more prone to agency problems than this paper's private corporations." (Yagan, 2015, footnote 34)

in scale due to adjustment costs, for instance. Alternatively, the nearly-zero response might masquerade a heterogeneity in investment responses across firms, which differ in the sign of f_{Ie}. This observation might also apply to the empirical results in Egger et al. (2020, Table 5 and 6). In their cross-country analysis, investments react positively to lower dividend taxes when the sample only includes cash-rich firms with positive investment levels.[47] When including cash-rich firms that disinvest, the response vanishes. As explained in Section 2, managerial firms that disinvest might well be subject to a negative sign of f_{Ie}. To the extent that investing firms exhibit a complementarity between managerial effort and investment ($f_{Ie} > 0$), the overall zero investment response hides heterogeneous firm-level responses, as implied by Proposition 1.

7 Summary and concluding remarks

The neoclassical model of dividend taxation has limited capacity to explain recent empirical findings concerning the effects of dividend tax reforms. The empire-building model can explain some of these findings, but the underlying agency conflict does not square well with empirical evidence in corporate finance. This paper analyses the efficiency costs of dividend taxation in a quiet-life model. The virtue of the model is that it provides predictions consistent with empirical results in public economics and corporate finance. It also accommodates empirical findings on firm behaviour that are inconsistent with the empire-building model. Thereby, the quiet-life model is able to systematically explain observations that are prominent in different strands of literature.

Different results emerge from the analysis. First, the paper offers a nuanced view of the efficiency effects of dividend tax reforms. The overall behavioural response to dividend taxes lowers welfare and this result holds independently of the financing regime of the firm. Second, we provide a testable implication to infer the source of investment finance from the investment sensitivity to dividend taxes and managerial incentive provision. The test builds on the model's prediction that, for cash-rich firms, dividend taxes and the sharing parameter in the equity-based incentive contract influence firms' investment behaviour in the same way. Differently, for cash-constrained firms, dividend taxes affect investments more strongly than the sensitivity of managerial pay to performance. This insight is valuable in corporate finance and macroeconomics to identify firms' internal cash constraints and the resulting macroeconomic implications.

[47] More precisely, in this regression Egger et al. (2020) code negative investment values as zero investment values.

Finally, imposing an income tax on managerial equity pay is equivalent to a general dividend tax. From this perspective, the paper suggests a cautious efficiency-based demand for such a type of managerial tax.

Different extensions to the analysis are conceivable. For instance, ownership of firms might be dispersed, which imply that not all, but only a subset of shareholders (e.g., majority shareholders) decide on the incentive contract. In such an environment, dividend taxes will exert additional efficiency costs as the coordination problem between shareholders leads to an externality that majority shareholders impose on minority shareholders (see Jacob and Michaely, 2017). Despite being interesting, we leave a formal treatment of this and other possible extensions to future research.

Appendix

A Cross derivative f_{Ie}

As discussed in Section, 2, the cross derivative $f_{Ie} \gtreqless 0$ might capture different ways in which managerial effort interacts with physical investments.

A.1 Cross derivative $f_{Ie} < 0$

The two input factors might be substitutes, reflecting a situation in which managerial effort augments capital, thereby increasing the quality of the investment input, but not of other production factors.[48] Such a situation might be captured by the production function $f(I,e) = \tilde{f}(h(I,e))$ with $\tilde{f}' > 0 > \tilde{f}''$ and $h_i > 0 > h_{ii}$, $i = e, I$. The function $h(I,e)$ measures the quality of the capital input, which is enhanced by managerial effort provision and physical investment. Provided h_{Ie} is not too positive, the two inputs are substitutes, i.e., $f_{Ie} < 0$.[49] For instance, when $h(e,I)$ is additive, the production function is $f(I+e)$, which implies $f_{Ie} < 0$. The capital-augmenting view of managerial effort might apply when stricter managerial supervision (and thus higher effort) of the selection and implementation of investment projects increases the quality of the firm's investment choices.

[48] Other inputs might include fixed factors which, for simplicity, are omitted from the notation.

[49] More precisely, the cross derivative is $f_{Ie} = \tilde{f}'' h_e h_I + \tilde{f}' h_{Ie}$. Given the assumptions stated above, the sign of f_{Ie} is negative when h_{Ie} is not too positive. Effort and investments might thus be complements in forming the quality of the capital input $h(I,e)$ and substitutes in overall production.

A micro foundation for $h(I,e)$ might be as follows. Assume a manager has a portfolio of projects under his/her control and influences the success of each project through his/her effort. There are two quality levels $I^h > I^l > 0$. The two quality levels are increasing in physical investments I, i.e. $I^i_I > 0$, $i = h,l$. By exerting effort, the manager makes some of the projects more successful, as measured by the differential $I^h - I^l$. The manager thereby decides on the relative importance of the two quality levels in the total capital stock where the aggregate quality level is $h(I,e) = eI^H + (1-e)I^l$. The specification is consistent with the idea that more managerial effort stimulates high-quality investment projects and curtails badly performing projects (Stein, 2003). The ways in which effort and investments interact in production follow from $f_{Ie} = \tilde{f}''(I^h - I^l)(eI^h_I + (1-e)I^l_I) + \tilde{f}'(I^h_I - I^l_I)$. For instance, when physical investments symmetrically change the two quality levels, $I^h_I = I^l_I$, effort and investments turn out to be substitutes in production, $f_{Ie} < 0$.

A.2 Cross derivative $f_{Ie} > 0$

Alternatively, the productivity-enhancing effect of effort might not only be directed toward investments but might apply to all production factors, as described by the production function $f(I,e) = A(e)g(I)$, with $g' > 0 > g''$ and $A' > 0$.[50] Managers influence firm productivity through the efficiency parameter $A(e)$ of the production function and thereby operate a span of control technology, as in Rosen (1982). The 'neutral' view of managerial effort implies $f_{Ie} > 0$.

B Gross definition of the incentive contract

Assume that the managerial incentive contract is a tuple $(\tilde{\alpha}, a)$ where $\tilde{\alpha}$ is the fraction of before-tax dividend payments that accrue to the manager and a is a fixed wage payment, i.e.

$$w = \tilde{\alpha}\left(D_1 + \frac{D_2}{1+r}\right) + \frac{a}{1+r}. \tag{30}$$

With the gross definition of the incentive contract, manager utility is given by

$$E(U) = u\left(\tilde{\alpha}\left(D_1 + \frac{E(D_2)}{1+r}\right) + \frac{a}{1+r} - \rho\left(\tilde{\alpha}\frac{(1-\tau)}{1+r}\right)^2\sigma^2\right) - \frac{\phi(e)}{1+r}. \tag{31}$$

[50] It should be noted that the production function $g(I)$ also captures the use of a fixed factor, which gives rise to diminishing returns, $g'' < 0$.

Solving backwards, at stage 2 the manager chooses the level of investment and effort. Using (**??**), (**??**), and (**??**), the manager's choice of investment and effort follow from

$$I: \quad \tilde{\alpha}\left(-1+\frac{(1-\tau)f_I+\tau\delta+1-\delta}{1+r}\right)=0 \tag{32}$$

and

$$e: \quad u'\left(\tilde{\alpha}\frac{(1-\tau)f_e}{1+r}\right)-\frac{\phi'(e)}{1+r}=0. \tag{33}$$

The first-order conditions implicitly define investment and effort as a function of $\tilde{\alpha}$, i.e. $I(\tilde{\alpha})$ and $e(\tilde{\alpha})$, where

$$\frac{de}{d\tilde{\alpha}}>0 \qquad \text{and} \qquad \frac{dI}{d\tilde{\alpha}}\gtreqless 0 \quad \Leftrightarrow \quad f_{Ie}\gtreqless 0. \tag{34}$$

Shareholder wealth is given by

$$(1-\tau^D)(1-\tilde{\alpha})\left(D_1+\frac{E(D_2)}{1+r}\right)-\tau^D\tilde{\alpha}\left(D_1+\frac{E(D_2)}{1+r}\right)=(1-\tilde{\alpha}-\tau^D)\left(D_1+\frac{E(D_2)}{1+r}\right)$$

Using the manager's participation constraint $E(U)=0$ and (**??**), shareholder wealth becomes

$$(1-\tau^D)\left(D_1+\frac{E(D_2)}{1+r}\right)+\frac{a}{1+r}-\rho\left(\tilde{\alpha}\frac{(1-\tau)}{1+r}\right)^2\sigma^2-u^{-1}\left(\frac{\phi(e)}{1+r}\right). \tag{35}$$

At stage 1, shareholders choose the incentive contract so as to maximize shareholder wealth (**??**), noting (**??**) and (**??**). Applying the envelope theorem, the associated first-order condition is as follows

$$(1-\tau^D)(1-\tilde{\alpha})\frac{(1-\tau)f_e}{1+r}\frac{de}{d\tilde{\alpha}}=2\tilde{\alpha}\rho\left(\frac{1-\tau}{1+r}\right)^2\sigma^2. \tag{36}$$

Noting that investment and effort do not depend on τ^D (c.f. (**??**) and (**??**)), differentiation of (**??**) with respect to $\tilde{\alpha}$ and τ^D yields

$$\frac{d\tilde{\alpha}}{d\tau^D}=\left(\frac{-(1-\tilde{\alpha})(1-\tau)}{1+r}f_e\frac{de}{d\tilde{\alpha}}\right)\Psi^{-1}<0, \tag{37}$$

where, due to the second-order condition for the choice of $\tilde{\alpha}$, we have $\Psi>0$.

The equivalence between the net definition of the incentive contract, as used in the paper, and the gross definition follows from the possibility to transform the first-order conditions for investment, effort, and the sharing parameter ((**??**), (**??**), and (**??**)) into the respective first-order condition under the net definition of the incentive contract ((**??**), (**??**), and (**??**)). These can be transformed using the relation $\tilde{\alpha}=(1-\tau^D)\alpha$, and based on this, $d\iota/d\alpha=(1-\tau^D)d\iota/d\tilde{\alpha}$, $\iota=I,e$.

Hence, the responses of the behavioural margins to changes in the dividend tax must be the same under the two definitions. Differentiating investment and effort with respect to τ^D yields

$$\frac{de}{d\tau^D} = \frac{de}{d\tilde{\alpha}}\frac{d\tilde{\alpha}}{d\tau^D} < 0 \qquad \text{and} \qquad \frac{dI}{d\tau^D} = \frac{dI}{d\tilde{\alpha}}\frac{d\tilde{\alpha}}{d\tau^D} \lessgtr 0 \quad \Leftrightarrow \quad f_{Ie} \gtrless 0. \tag{38}$$

The sign of the responses in (**??**), and thereby the sign of the responses in (**??**), follows from (**??**) and (**??**).

C Nash bargaining

We slightly modify the notation by denoting $\overline{U}^M$ and $\overline{U}^S$ as the outside option of the manager and shareholders, respectively. With Nash bargaining, the maximand of the bargaining problem is given by

$$(E(U^M) - \overline{U}^M)^\beta (E(U^S) - \overline{U}^S)^{1-\beta}, \tag{39}$$

where $E(U^M)$ and $E(U^S)$ is the expected utility of the manager and of shareholders respectively. The exponent $\beta \in [0,1]$ represents the bargaining power of the manager (and $1-\beta$ is the bargaining power of shareholders). Note, for $\beta = 0$ the specification reduces to the model analysed in the main part of the paper. With retained earnings as the marginal source of funds, shareholder utility $E(U^S) = (1-\alpha)E(V)$ is proportional to the 'before-dividend-tax' shareholder utility, where the proportionality factor is $1-\tau^D$ (c.f. (**??**)). Provided the shareholders' outside option entails a continuation of the firm and of the liability to dividend taxation,[51] the tax factor $1-\tau^D$ scales the difference $E(U^S) - \overline{U}^S$ and thereby the maximand of the Nash bargaining problem (**??**). It will thereby not influence the choice of the incentive contract. Technically, the Nash bargaining solution is immune to the scaling of shareholder utility net of the outside option due to its axiomatic construction which involves invariance to equivalent utility representations (see Osborne and Rubinstein, 1990).

In contrast, manager utility depends on the tax factor $(1-\tau^D)(1-\tau^E)$ and is additive in structure, $E(U^M) = E\left(u(w)\right) - \frac{\phi(e)}{1+r}$, where the last term is not mechanically related to $(1-\tau^D)(1-\tau^E)$. This implies that the tax term $(1-\tau^D)(1-\tau^E)$ does not factor out of $E(U^M)$. Finally, we conjecture that the two taxes τ^D and τ^E influence the manager's outside option

[51] This captures the scenario that shareholders will find a replacement for the manager when negotiations break down. The replacement runs the firm possibly at a reduced firm value due to the specificity of the manager's human capital. Alternatively, we may also assume that the manager is indispensable to the firm, i.e., $\overline{U}^S = 0$. In either case, the tax term $1-\tau^D$ factors out the difference $E(U^S) - \overline{U}^S$.

through the tax factor $(1-\tau^D)(1-\tau^E)$, if at all. For instance, this naturally happens when the outside option also entails a managerial job with equity-based remuneration or a job for which the remuneration is not subject to the two taxes (only a fixed-wage payment, for instance). In this case, the effect of the two taxes on the bargaining outcome goes through the tax term $(1-\tau^D)(1-\tau^E)$. Hence, the tax on managerial incentive pay τ^E is equivalent to a general dividend tax τ^D, both in terms of induced firm responses and efficiency.

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