The Efficiency Costs of Dividend Taxation with Managerial Firms*

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Abstract

The paper analyzes the efficiency costs of dividend taxation in a quiet-life corporate agency model. Unlike existing models, the quiet-life model is able to predict negative corporate investment responses for mature firms that are consistent with empirical analyses. We further show that investment changes following a rise in dividend taxes might not be sufficient to infer, first, the efficiency cost of dividend taxation and, second, the financing regime of the firm that underlies the investment response, in contrast to insights from previous literature. We provide a testable implication to infer the mode of investment finance from investment responses. Finally, we relate the results to recent empirical findings in the literature on dividend taxation.

JEL-Classification: H21, D21, H24

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1 Introduction

The issue of how dividend taxes affect firm behavior is of widespread interest in the academic profession and among policy makers alike. Recent empirical evidence on the effects of dividend tax reforms points to the role of corporate agency conflicts in the way in which dividend taxes influence firm behavior. For instance, firms with more powerful principals, as indicated by the extent of taxable institutional ownership or the representation of independent shareholders on the board of directors, increased dividend payments more strongly after the 2003 US dividend tax cut (Chetty and Saez, 2005).[1] Furthermore, executives with larger managerial stock ownership have been found to be more likely to increase dividend distributions, consistent with managers acting in their own interests (Brown et al., 2007; Blouin et al., 2011). Dividend distributions influence investment behavior through their impact on corporate cash flow, thereby inducing investment changes in response to dividend taxes that are unique to agency models (Becker et al., 2013; Chetty and Saez, 2010).

Despite the relevance of agency models for explaining corporate behavior, existing agency models are limited in their capacity in explaining empirical evidence on corporate investment responses to dividend taxes. A major source of investment finance are retained earnings for which corporate agency models predict a positive investment response to dividend taxes (Chetty and Saez, 2010). In this paper, we propose a quiet-life corporate agency model that predicts empirically-observed negative investment responses when firms use retained earnings to finance investments, as documented in e.g. Campbell et al. (2013) and Egger et al. (2014). With this model, we also have a fresh look at two main findings established in previous work: the use of investment responses as a sufficient statistic for the welfare effects of dividend taxes and the unique link between investment responses and the financing behavior of firms. In contrast to previous work (Auerbach, 2002; Chetty and Saez, 2010), we show that investment changes following a rise in dividend taxes might not be sufficient, first, to infer the efficiency cost of dividend taxation and, second, to uniquely link the investment responses to the financing regime of the firm. The insights change the welfare interpretation of empirical work on dividend taxation and the policy implications that follow from it.

[1] In a related manner, Jacob et al. (2015) show that the sensitivity of dividend policy to owners' tax preferences phases out as the number of owners increases, suggesting that managers pursue private agendas different to satisfying shareholder interests as ownership becomes more dispersed. Exploiting the 2006 rise in dividend taxes in Norway, Berzins et al. (2014) find a strong negative effect of dividend taxes on pay-outs, and that a pre-existing agency conflict between shareholders and the management moderates the tax effect.

The quiet-life model we use in the paper builds on the insight that managerial effort and quality is an important empirical determinant of firm performance and essential in explaining productivity differences across firms and countries (see Bertrand and Schoar, 2003; Bartelsman and Doms, 2010; Bennedsen et al., 2010; and Guner et al., 2015, for instance).[2] In particular, managerial quality and effort determine the way in which inputs are combined in production and thereby the effectiveness of other inputs such as physical investment (Lucas, 1978; Rosen, 1982; and Tirole, 2006).[3] Effort and investment might be complements or substitutes. For instance, more managerial effort might reduce or increase investment depending on whether the decision at hand involves to shut down badly performing projects or to select new promising projects (Stein, 2003). In either case, managers prefer a 'quiet life' since exerting effort incurs a private cost which gives rise to an agency conflict between shareholders and the manager and the use of incentive contracts to align interests.

In this setting, we show that dividend taxes influence investment behavior depending on how effort interacts with investments in production. For instance, the complementarity of the two inputs implies a negative investment response to dividend taxes. The finding holds independently of whether marginal investments are financed by retained earnings or external equity. This contrasts with the prediction of existing corporate agency models (Chetty and Saez, 2010) as well as with the traditional tax efficiency analysis, which builds on the new view and old view of dividend taxation. The different views predict that dividend taxes are neutral for the investment behavior of firms that use retained earnings as the marginal source of funds (new view), but they downwardly distort investments of those firms that use equity injections at the margin (old view). Our findings have implications for linking investment responses to economic efficiency. The investment response in the quiet-life corporate agency model might be observationally equivalent to the investment response under the old view, although retained earnings ultimately finance investments at the margin. The result suggests that some of the negative investment responses to dividend taxes, which are documented in empirical work and have been previously attributed to new share issues, may be equally well explained by the quiet-life corporate agency model, given the prevalent use of retained earnings to finance investments. Thus, firms that rely

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

[3]In the model we use a reduced-form representation of the relation between output and effort, thereby capturing various structural models of output-enhancing managerial effort choices.

on retained earnings for investment finance may amplify the welfare costs of dividend taxation rather than being 'innocent bystanders', as predicted by the new view of dividend taxation.

The model's implications can be put in relation to two established insights. First, in existing analyses of dividend taxation, investment responses and corporate financing behavior are uniquely linked. The insight has been commonly used in empirical work to uncover the efficiency cost of dividend taxes, but it loses validity in corporate agency models. The paper proposes an alternative way to infer the firms' financing behavior from investment responses in corporate agency models.[4] It builds on the testable implication that dividend taxes and the sharing parameter in the equity-based incentive contract influence a firm's investment behavior in the same way when retained earnings are the marginal source of funds. Differently, dividend taxes affect investment incentives more strongly than the sensitivity of managerial pay to performance when the firm uses equity injections at the margin.[5] There is a continuously growing body of literature looking at the two determinants of investment behavior, albeit not on the basis of the differentiating test proposed here.[6]

Second, investment responses are a sufficient statistic for the efficiency costs of dividend taxes in traditional tax efficiency analysis. In the quiet-life agency model, dividend taxation incurs efficiency costs and these costs generally depend on the responses of effort and investment to dividend taxes. We identify situations in which the investment changes are neutral for efficiency and the efficiency effects solely follow from effort responses. Furthermore, dividend taxes might still incur an efficiency cost even when they increase investment, which in isolation enhances efficiency in our setting. As such, it turns out that investment responses might be insufficient to infer the magnitude as well as the sign of the efficiency implications of dividend taxes once frictions within the firm are accounted for.

The agency model allows us to address the frequently voiced issue of levying a separate tax on equity-based incentive pay. Equity-based incentive pay receives differential tax treatment compared to general income in some countries (Hall and Liebman, 2000) and the issue of using such a tax scheme has regained momentum in recent tax policy discussions. Theoretically, a differential tax treatment might correct a tendency to under- or over-incentivize managers

[4] As shown in the paper, distinguishing between the two modes of finance is crucial for assessing the severeness of the investment distortion as well as for the measurement of the excess burden of dividend taxation.

[5] Interestingly, this testable hypothesis is robust to a wide range of corporate agency models, including quiet-life agency models (used in this paper) and models of free cash flow (Jensen, 1986).

[6] For instance, see Yagan (2015) and Aggarwal and Samwick (2006) as well as the literature cited therein.

(Benabou and Tirole, 2016; Besley and Ghatak, 2013), or might limit socially wasteful bargaining effort by managers (Piketty et al., 2014). It transpires that imposing a separate income tax and a dividend tax on all shareholders is equivalent in terms of their effects on firm behavior and efficiency. This result might be surprising given that the two taxes are imposed on different sets of individuals and thus might be expected to have a different impact on their decisions. The reason for the equivalence in this result is that shareholders, who set the managerial wage, become residual claimants and perceive the two instruments as perfect substitutes.[7] Most notably, the incentive contract they offer to managers changes with each of the two instruments in an identical way. As a consequence, the contract-induced managerial effort and investment choice 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.

Some of the findings have broader relevance than suggested by the agency model used in the paper. The findings might equally apply to settings where the manager and the owner are one and the same person and the managing owner has private costs of effort that are not tax deductible. We present the analysis in an agency model since this setting might well be more empirically relevant to explain corporate behavior. This requires to explicitly model the underlying relation between dividend taxes and the agency conflict to coherently analyze the effects of dividend taxes.[8] Importantly, a variety of the findings in the paper turn out to be unique to the existence of an agency conflict.

1.1 Literature Review

The literature on the effects of dividend taxation largely centers on the old view and new view of dividend taxation (Sinn, 1987; Auerbach, 2002). The two alternative views draw on different assumptions about the source of investment funds. Under the old view, analyzed in Harberger (1962), Feldstein (1970), and Poterba and Summers (1985), the source of funds is the issue of new equity. Dividend distributions are taxed while capital injections do not receive a subsidy.[9] The asymmetric tax treatment introduces tax distortions and reduces firm investments. Under

[7] As shown later on, the equivalence results extends to other forms of wage determination in which shareholders do not have all the bargaining power.

[8] Once departing from the managing-owner perspective, endogenous incentive contracting is crucial. An agency model with exogenous ownership shares would yield erroneous welfare implications of dividend taxation, as described below.

[9] See Lindhe and Södersten (2014) for a refined treatment of the imperfect tax deductibility of the costs of investment finance that underlies the old view of dividend taxation.

the new view, developed in King (1974), Auerbach (1979), and Bradford (1981), the source of investment funds is retained earnings. Retaining profits to finance investments implies only a re-timing of dividend taxes, which renders dividend taxes neutral for investment behavior.[10,11] The literature derives two competing views from a theoretical framework in which corporate agency issues are not considered.

Kanniainen (1999) sets up a free cash flow model of firm behavior in which managers try to build an empire and invest resources differently to shareholder preferences, analyzing the role of dividend taxes for investments therein. More recently, Chetty and Saez (2010) resort to a free-cash flow model to explain firm responses after the 2003 U.S. dividend tax cut relating them to efficiency effects.[12] In this setting, dividend taxes do not change incentives to invest productively provided retained earnings finance marginal investments. This is consistent with the new view of dividend taxation. Nevertheless, total investment outlays increase after a tax hike because dividend taxes incentivize managers to expand the empire and invest resources unproductively rather than making distributions to shareholders.[13] In the agency model analyzed in this paper, all investments are productive and managers are not empire builders. Yet, the model likewise predicts a positive investment response to higher dividend taxes, provided effort and investment are substitutes in production. This corroborates the finding that positive investment responses to dividend taxes are consistent with optimal corporate behavior once frictions within the firm are accounted for.

Unlike the free cash flow model, the investment response of firms that use retained earnings at the margin is not limited in sign to explain anomalies (based on traditional analysis) in investment responses to dividend taxation. The model might also predict negative investment responses, which are frequently documented in empirical analyses, both when retained earnings and new share issues are used as the marginal source of funds.[14] A negative investment response

[10]More precisely, tax neutrality under the new view applies even more broadly provided the source of funds and use of funds are the same. Thereby, the tax treatment is also the same and neutral for investment decisions.

[11]Empirical analyses of the relevance of the two views include Poterba and Summers (1985), Poterba (2004), and Auerbach and Hasset (2002).

[12]There is an evolving, albeit small, body of literature on the role of corporate taxes in agency models. For instance, see Kanniainen and Södersten (1994), Crocker and Slemrod (2005), Desai and Dharmapala (2006), Desai et al. (2007), Chetty and Saez (2010), and Koethenbuerger and Stimmelmayr (2014).

[13]Related contributions on dividend taxation include Gordon and Dietz (2009) and Korinek and Stiglitz (2009). In particular, Gordon and Dietz (2009) review the role of dividend taxes in classical, signaling, and agency models of firm behavior. Compared to other approaches, they find that agency models provide a sound explanation of empirical findings.

[14]See Auerbach and Hasset (2002) for indirect evidence, and Campbell et al. (2013), Egger et al. (2014), and Alstadsæter et al. (2017), for more direct evidence on negative investment effects of dividend taxes. A positive

is consistent with the conventional views of dividend taxation and a model of free cash flow only when the firm uses new share issues to finance marginal investments (Harberger, 1962; Chetty and Saez, 2010). This suggests that the informational value of observing a negative investment response is more limited than the two conventional views of dividend taxation, as well as a model of free cash flow, imply. As explained above, the paper provides a testable hypothesis to infer the financing regime underlying a negative (as well as a positive) investment response, and this test draws on the comparison of the effects of incentive pay and dividend taxes on investments. Inferring the mode of finance is crucial in the agency model as the efficiency cost measure qualitatively changes with the mode of finance.

Finally, corporate agency models can be distinguished by the manager's preference for investment. Compared to shareholders, managers prefer higher investments in empire-building models such as free cash flow models (Jensen, 1986). In contrast, in most work on quiet-life agency models, managers prefer lower investment levels as handling investments requires effort, which is costly to managers (Aggarwal and Samwick, 1999; Bertrand and Mullainathan, 2003). The model of this paper falls into the second category of corporate agency models, but offers a more nuanced perspective on the link between effort and investment. Quiet-life agency models generally resort to a reduced form representation of the positive relation between effort and investment. In our model, effort is costly to managers, but might decrease or increase with investment depending on how the two inputs interact in production. This ambiguity has implications for the efficiency effects of dividend taxation. Higher investments do not necessarily coincide with more managerial effort provision, thus potentially indicating efficiency losses.

The paper proceeds as follows. In Section 2 we set up a corporate agency model with endogenous incentive pay. In Section 3 we characterize the shareholders' choice of incentive pay, the managerial effort, and investment behavior and the welfare implications of dividend taxation. In Section 4 we turn to various extensions of the basic model and in Section 5 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 6.

investment response is consistent with findings in Becker et al. (2013).

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 $\varepsilon \sim \mathcal{N}(0, \sigma^2)$.[15] Production depends on investment I and on managerial effort choices e, and satisfies $f_I, f_e > 0$, $f_{II}, f_{ee} < 0$ and $f_{Ie} \gtreqless 0$.[16]

The cross derivative might capture different ways in which managerial effort interacts with physical investments (Stein, 2003; Tirole, 2006). For instance, 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.[17] 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., $f_{Ie} < 0$.[18] 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.[19] 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

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

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

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

[18] 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.

[19] A microfoundation 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 $f_{Ie} = \tilde{f}''(I^h - I^l)(eI_I^h + (1 - e)I_I^l) + \tilde{f}'(I_I^h - I_I^l)$. For instance, when physical investments symmetrically change the two quality levels, $I_I^h = I_I^l$, effort and investments turn out to be substitutes in production, $f_{Ie} < 0$.

$f(I,e) = A(e)g(I)$, with $g' > 0 > g''$ and $A' > 0$.[20] 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). This implies $f_{Ie} > 0$. The 'neutral' view of managerial effort might describe a situation in which the implementation of organizational changes or new management practices requires managerial effort and directly allows the whole span of resources, which are under the control of the manager, to be more productive.

Investments depreciate at a rate $\delta > 0$. Profits are taxed at the rate $\tau > 0$, 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, and the liquidation proceeds $(1-\delta)I$ are distributed to shareholders.[21] Thus, the flow of second-period dividends is given by:

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

Dividend distributions are taxed at rate τ^D at the shareholder level. Arbitrage behavior implies that 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.[22] The manager is risk-averse and derives utility from income $w = \alpha V + \frac{a}{1+r}$ net of the private costs of effort provision $\phi(e)$, i.e. $E(U) = E\left(u(w)\right) - \frac{\phi(e)}{1+r}$ 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 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

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

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

[22] Alternatively, shareholders might condition the equity compensation on before-tax dividend payments, assuming that, by construction, shareholders reimburse the dividend tax payments to managers. This is equivalent to making the firm liable for the dividend taxes that are due to the dividend payment the manager receives. The incidence and behavioral responses under the two means of levying the dividend tax are the same. In what follows, we assume that the incentive contract does not mechanically insulate managers from dividend taxes. The modelling choice might be congruent with the practice of incentive contracts, where managers pay dividend taxes and shareholders possibly adjust the after-tax sharing rate α to compensate managers for the dividend tax burden.

cost of effort is BI, $B > 0$. This is compatible with an effort cost Be and a production function $F(\min\{I, e\})$ which implies $I = e$ and thus $F(\min\{I, I\}) = f(I)$. 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.[23] 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 CARA, we can simplify manager utility as $E(U) = u\left(E(w) - \rho Var(w)\right), \quad \rho > 0$. Using (1), (2) and $w = \alpha V + \frac{a}{1+r}$, the mean and the variance of wage income are thus:

$$E(w) = \alpha E(V) + \frac{a}{1+r} \quad \text{and} \quad Var(w) = \rho \left(\alpha \frac{(1-\tau^D)(1-\tau)}{1+r}\right)^2 \sigma^2. \tag{3}$$

Therefore, manager utility is given by:

$$E(U) = u\left(\alpha E(V) + \frac{a}{1+r} - \rho \left(\alpha \frac{(1-\tau^D)(1-\tau)}{1+r}\right)^2 \sigma^2\right) - \frac{\phi(e)}{1+r}. \tag{4}$$

Shareholders must obey the participation constraint of the manager $E(U) \geq 0$ 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 external shareholder wealth $(1-\alpha)E(V)$, while noting (4) and $w = \alpha V + \frac{a}{1+r}$, yields the following:[24]

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

Eq (5) shows that, due to the participation constraint $E(U) = 0$, shareholders become residual claimants, which induces them to account for manager utility.

The fiscal resources of the public sector, T, comprise dividend and corporate tax revenues:

$$T = \tau^D \left(D_1 + \frac{D_2}{1+r}\right) + \tau \frac{f(I,e) - a - \delta I}{1+r}. \tag{6}$$

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.

[23] 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.

[24] With CARA utility, $u(\cdot)$ is invertible; a property that we use in deriving (5).

3 Retained Earnings as the Marginal Source of Funds

We start out by assuming that investments are financed by retained earnings. In practice, retained earnings are the dominant source of investment finance and particularly so for mature firms (Auerbach and Hasset, 2002). 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 from internal cash flow, $D_1 = X - I \geq 0$.

3.1 Firm Behavior

Solving backwards, the manager decides on investments and effort for given values of α and a. Inserting (2) into (4) while noting (1), $w = \alpha V + \frac{a}{1+r}$ and $D_1 = X - I \geq 0$, the manager's choice of investment satisfies the following:

$$I: \quad \alpha(1-\tau^D)\left(-1 + \frac{(1-\tau)f_I + \tau\delta + 1 - \delta}{1+r}\right) = 0. \tag{7}$$

The increase in second period dividend distributions due to higher investment 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 managerial effort choice follows from:

$$e: \quad u'\left(\alpha(1-\tau^D)\frac{(1-\tau)f_e}{1+r}\right) - \frac{\phi'(e)}{1+r} = 0. \tag{8}$$

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 cost, but receives only a fraction of the total return on effort, the effort level is below the level shareholders prefer.[25]

From (7) and (8), we obtain:

$$\frac{de}{d\alpha} = -\frac{1}{|\Delta|}\frac{\alpha((1-\tau^D)(1-\tau))^2}{1+r} f_e f_{II} > 0 \qquad \text{and} \qquad \frac{dI}{d\alpha} = \frac{1}{|\Delta|}\frac{\alpha((1-\tau^D)(1-\tau))^2}{(1+r)^2} f_e f_{Ie}, \tag{9}$$

where $|\Delta| > 0$ is the determinant of the Hessian matrix of the manager's decision problem. From (9), a higher sharing parameter, α, strengthens managerial incentives to exert effort.

[25] Shareholders prefer a level of effort that satisfies (8) 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 cost of effort.

More effort provision changes the marginal productivity of investment, as captured by $f_{Ie} \gtreqless 0$, and the interaction induced 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.

In stage 1, shareholders choose the incentive contract so as to maximize shareholder wealth (5), noting (1), (2), $w = \alpha V + \frac{a}{1+r}$ and $D_1 = X - I$. Applying the envelope theorem, the associated first-order condition is:

$$(1-\alpha)\frac{(1-\tau^D)(1-\tau)f_e}{1+r}\frac{de}{d\alpha} = 2\alpha\rho\left(\frac{(1-\tau^D)(1-\tau)}{1+r}\right)^2\sigma^2. \tag{10}$$

The choice of α follows from an incentive-insurance trade-off (Holmstrom, 1979). As captured by the left-hand side of (10), 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, so as to satisfy the manager's participation constraint $E(U) = 0$. The associated marginal costs are captured on the right-hand side of (10).

The first-order condition (10) implicitly defines α as a function of τ^D. Differentiating investment and effort with respect to τ^D yields:

$$\frac{de}{d\tau^D} = \frac{\partial e}{\partial \tau^D} + \frac{\partial e}{\partial \alpha}\frac{d\alpha}{d\tau^D} \qquad \text{and} \qquad \frac{dI}{d\tau^D} = \frac{\partial I}{\partial \tau^D} + \frac{\partial I}{\partial \alpha}\frac{d\alpha}{d\tau^D}. \tag{11}$$

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 behavioral responses that are induced by it. Rewriting the incentive contract 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 behavior are unaffected by the reformulation as shareholders are able to shift the tax burden back onto the manager by adjusting the sharing rate $\tilde{\alpha}$.[26] As shown in Appendix A.1, using the re-formulated sharing rate $\tilde{\alpha} = \alpha(1-\tau^D)$, and re-iterating all steps to derive the optimal

[26]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.

managerial choices and the sharing rate $\tilde{\alpha}$ yields $de/d\tau^D < 0$ and sign$\{dI/d\tau^D\}$=$-$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 tax hike, instantaneous dividend payments D_1 change according to $dD_1/d\tau^D = -dI/d\tau^D$.*

Multiple implications of the analysis are worth discussing at this point. The above finding is different to the standard notion of how dividend taxes affect investments when retained earnings are the marginal source of investment funds. As predicted by the new view of dividend taxation, a higher dividend tax leaves investments and thereby distributions to shareholders unchanged (c.f. Auerbach and Hasset, 2002). In the present setting, a higher dividend tax influences managerial effort choices and the investment behavior of firms. It raises investments and lowers distributions when effort and investments are substitutes in production, $f_{Ie} < 0$. The response is consistent with recent empirical findings. Becker et al. (2013) find a positive investment response to higher dividend taxes. Chetty and Saez (2005) show that corporate distributions increased in response to the U.S. dividend tax cut in 2003. This finding has been observed for mature firms in which retained earnings are frequently argued to be a major source of investment finance.[27]

Furthermore, the predictions of the model are observationally equivalent to the old view of dividend taxation when effort and investments are complements in production, $f_{Ie} > 0$. In this case, a higher dividend tax lowers investments. This observation is consistent with the managerial model presented here, in which retained earnings are the marginal source of funds, and with a neoclassical model of firm behavior in which new share issues are used to finance investments at the margin. While empirical papers often resort to dividend tax-induced

[27]Corporate agency models of free cash flow equally predict that investment rises with dividend taxes when retained earnings are the marginal source of investment funds. See Kanniainen (1999) and Chetty and Saez (2010). Thereby, this paper corroborates the finding that positive investment responses to dividend taxes are consistent with optimal corporate behavior, once frictions within the firm are accounted for.

investment changes to infer the marginal financing regime of a firm, the managerial model in this case suggests that there is no clear relation between negative investment responses to dividend taxation and the underlying financing regime. In Section 4 we derive a testable hypothesis to distinguish between the two modes of finance in agency models based on observed investment changes.

A straightforward question is whether it is possible to narrow down sign$\{f_{Ie}\}$. Invoking production theory, the two cases $f_{Ie} \gtrless 0$ may equally arise, as shown in Section 2. Also, comparing the differential predictions of the model with empirical evidence does not unequivocally restrict sign$\{f_{Ie}\}$. Precisely, from (9), the model predicts sign$\{dI/d\alpha\}$=sign$\{f_{Ie}\}$ and, following (11), it implies sign$\{dI/d\tau^D\}$=-sign$\{f_{Ie}\}$. For instance, Aggarwal and Samwick (2006) find $dI/d\alpha > 0$ and the findings in Becker et al. (2013) include the response $dI/d\tau^D > 0$, leading to dividend responses to taxes that are consistent with the results in Chetty and Saez (2005).

3.2 Welfare

The welfare measure includes shareholder wealth (5), which accounts for manager utility through the participation constraint of the manager, and expected tax revenues:

$$W = E(V) + \frac{a}{1+r} - \rho\left(\alpha\frac{(1-\tau^D)(1-\tau)}{1+r}\right)^2\sigma^2 - u^{-1}\left(\frac{\phi(e)}{1+r}\right) + E(T). \tag{12}$$

Tax revenues comprise dividend and corporate tax revenues, as given by (6). Differentiating welfare (12) with respect to τ^D, while invoking the envelope theorem, yields:

$$(1+r)\frac{dW}{d\tau^D} = \tau^D(1-\tau)f_e\frac{de}{d\tau^D} + \tau\left(f_e\frac{de}{d\tau^D} + (f_I-\delta)\frac{dI}{d\tau^D}\right). \tag{13}$$

To disentangle the welfare effects of dividend taxation, it is instructive first to assume that effort is exogenous. In the absence of effort changes, investment levels are unaffected by dividend taxation, c.f. (7), (9), and (11).[28] This result is consistent with the new view of dividend taxation, implying that dividend taxation exerts no efficiency effects. Dividend taxes fully capitalize in firm value and are neutral for welfare, $dW/d\tau^D = 0$.

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

[28] More precisely, when $de \equiv 0$, (7) implies $\partial I/\partial\alpha = 0$ and $\partial I/\partial\tau^D = 0$. From (11), it then follows that $dI/d\tau^D = 0$.

incentive contract aligns incentives between shareholders and the manager such that investment levels are set so as to maximize shareholder wealth, c.f. (7). Hence, any tax-induced change in investments does not generate a first-order welfare loss. Possibly surprisingly, although effort choices do not maximize shareholder wealth (c.f. (8)), their first-order effect on shareholder wealth equally nullifies. 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).[29] Hence, shareholder wealth is insulated from behavioral responses that follow from dividend taxation, although the tax aggravates the pre-existing investment and effort distortion.

Still, managerial effort changes introduce two sources of welfare variation. Effort drops in response to a higher tax rate and lowers dividend tax revenues (c.f. the first term in (13)). 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 should be noted that as the investment policy maximizes firm value, the effect of investment changes on dividend tax revenues 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 (13). Furthermore, depending on sign$\{f_{Ie}\}$, effort adjustments change investment incentives, which affects corporate tax revenue, as summarized by the second term in brackets in (13). 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. As the investment response follows from effort changes and thereby is of second order compared to the effort response, the positive investment-related fiscal externality will most likely not compensate for the negative

[29] Differentiating (5) with respect to τ^D, while accounting for (7) and (8), 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 (10), the partial effect of dividend taxation vanishes.

fiscal externality on corporate tax revenues following from managerial effort provision.

Thus,

Proposition 2: *Assume retained earnings are the marginal source of investment finance. Dividend taxation is not welfare neutral. It generates fiscal externalities through adjustments in managerial effort behavior, e, and the corporate investment level, I.*

The welfare term (13) can be related to the discussion of income-shifting incentives and the associated welfare implications (Slemrod, 1995; Gordon and Slemrod, 2000).[30] 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.[31] 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 behavioral responses. However, as captured by (13), the change in α induces efficiency effects and the efficiency effects follow from effort as well as investment changes. 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.[32]

4 Extensions

4.1 Taxation of Equity-Based Incentive Wages

Recent tax policy discussions center on the issue of whether equity-based managerial wages should be taxed differently to general wage income. The proposed rationale is that equity-based wages might well influence managerial behavior 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).[33]

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

[31] 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.

[32] 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 (12) by $\lambda > 1$, where λ captures the marginal cost of public funds with distortionary taxes.

[33] For instance, the agency model abstracts from the effort that the manager might exert to improve his or her bargaining power in the wage negotiation process, as in Piketty et al. (2014). To capture this, we could introduce

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 $w = (1-\tau^E)\alpha V + \frac{a}{1+r}$. The expected utility of the manager is given by:

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

From (14), 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 (14), yields:

$$(1-\alpha)E(V) = E(V) + \frac{1}{1-\tau^E}\left(\frac{a}{1+r} - \rho\left(\alpha\frac{(1-\tau^E)(1-\tau^D)(1-\tau)}{1+r}\right)^2\sigma^2 - u^{-1}\left(\frac{\phi(e)}{1+r}\right)\right). \quad (15)$$

Maximizing (15) with respect to the sharing parameter α, while applying the envelope theorem, the first-order condition is as follows:

$$(1-\alpha)\frac{(1-\tilde{\tau})f_e}{1+r}\frac{de}{d\alpha} = 2\alpha\rho\left(\frac{1-\tilde{\tau}}{1+r}\right)^2\sigma^2, \quad (16)$$

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 residually receive 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 its effect on 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 terms of their implications for manager and shareholder behavior, and thus also in terms of their effects on welfare.[34] As a consequence, the model predicts that a special tax

a decision stage prior to the choice of the incentive contract, at which point the manager might take actions to improve the outside option $\overline{U}$ (normalized at zero in the model). As such, total wage income increases. The effort related to this activity is socially wasteful as it only influences the distribution of payoffs between the manager and shareholders. The extension will not change the basic finding of this section. A formal analysis is available upon request.

[34]Note the relevant welfare measure now comprises private welfare (15) plus tax revenues (6), which needs to be augmented by the tax payment $\tau^E\alpha V$.

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 3: *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.[35] To analyze 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 (2), 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 $(1-\tau^D)(1-\tau^E)$.[36] 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 also in their direct effects on investment and effort (c.f. (14)). See Appendix A.2 for a more formal analysis of this issue.

4.2 New Share Issues

Firms might not have sufficient internal funds to finance investments, and therefore might resort to new share issues as the marginal source of funds. This might particularly apply to newly created, immature firms that are still in the growth phase. Such firms have not accumulated

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

[36] 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.

a sufficient amount of retained earnings to finance investments and thus rely predominantly on external equity finance. This mode of financing marginal investments underlies the old view of dividend taxation (Harberger, 1962; Poterba and Summers, 1985).

With new share issues in the first period, we have $V_1^N > 0$ and $D_1 = 0$. Noting that the first-period resource constraint becomes $D_1 = X - I + V_1^N = 0$, the manager's choice of investment satisfies the following:

$$I: \quad \alpha \left(-1 + \frac{(1-\tau^D)((1-\tau)f_I + \tau\delta + 1 - \delta)}{1+r} \right) = 0. \tag{17}$$

The first-order condition (17) differs from (7). Intuitively, the government shares 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 distortion arising from the asymmetric tax treatment mirrors the old view of dividend taxation. Different to investment choices, the first-order condition for managerial effort choices continues to be given by (8).

Two implications are noteworthy at this point. First, in the case of external equity finance, dividend taxes influence investment behavior not only indirectly through effort changes, but also directly. Compared to the situation with retained earnings as the marginal source of funds, the direct effect downwardly influences the investment response $dI/d\tau^D$. As such, even when investments and effort are substitutes in production ($f_{Ie} < 0$), the investment response to dividend taxation might be negative in sign. Second, and related to the previous observation, the tax-induced investment response can take any sign. This finding argues against the ability to infer the firm's financing regime from observed investment behavior as is feasible in the case of the neoclassical model of firm behavior. Recall, in the latter model, a negative investment change in response to dividend taxation is consistent with the use of new share issues as the marginal source of funds. In contrast, investments do not vary with dividend taxes when retained earnings finance investments at the margin. The agency model nevertheless offers some guidance on the ability to infer the mode of financing 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 impact on investments that are financed out of retained earnings, while α and $1-\tau^D$ differentially affect investments financed through new share issues.[37] More precisely, from (7) and (8), the term $\alpha(1-\tau^D)$ summarizes the effect of the sharing parameter and the

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

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. (7) and (17)). 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:

$$\frac{\partial I^{re}}{\partial \alpha} = \frac{\partial I^{re}}{\partial (1-\tau^D)} \quad \text{and} \quad \frac{\partial I^{nsi}}{\partial \alpha} > \frac{\partial I^{nsi}}{\partial (1-\tau^D)}. \tag{18}$$

Inferring the marginal source of funds from (18) is informative in corporate agency models (as in neoclassical models of firm behavior). With new share issues rather than retained earnings, the investment level is not only more downward pressured (c.f. (7) and (17)), but also the excess burden measure qualitatively differs. Differentiating welfare (12) with respect to τ^D, while invoking the envelope theorem, yields:

$$\begin{aligned} (1+r)\frac{dW}{d\tau^D} &= (1-\alpha)(1-\tau^D)(1-\tau) f_e \left(\frac{\partial e}{\partial \tau^D} + \frac{\alpha}{1-\tau^D} \frac{\partial e}{\partial \alpha} \right) \\ &+ \tau^D (1-\tau) f_e \frac{de}{d\tau^D} + \tau \left(f_e \frac{de}{d\tau^D} + (f_I - \delta) \frac{dI}{d\tau^D} \right), \end{aligned} \tag{19}$$

where the first-order condition (10) has been used to rearrange terms.[38] The welfare effect (19) differs from (13) by the first line that captures the effect of a higher τ^D on shareholder wealth. It follows from the counteracting influence of the sharing rate and the dividend tax rate on managerial effort. 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 behavior.[39] Differently, with new share issues managerial behavior does not depend on $\alpha(1-\tau^D)$, but distinctly on its subcomponents α and τ^D. Since dividend taxation becomes more distortionary for managerial behavior as compared to a reduction in the sharing rate α, it is the negative tax effect on effort that dominates in the overall impact of dividend taxation on shareholder wealth.

[38] With both modes of financing marginal investments, the first-order condition for α is (10).

[39] 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 (19) vanishes.

Thus,

Proposition 4: *Consider the firm uses new share issues to finance investments. Different to the situation with retained earnings as the marginal source of finance,*

(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.

The suggested identification in (18) 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 agency models, but also to free cash flow models (Jensen, 1986)[40] and models of managerial overconfidence (Malmendier and Tate, 2005)[41], two further prominent types of corporate agency models. 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 (19) only nullifies when shareholders directly determine the level of investment and thereby the amount of new share issues, as in Chetty and Saez (2010). In this situation, shareholders choose V_1^N along with α, while the manager only selects the effort level that then depends on $\alpha(1-\tau^D)$, c.f. (8). Since the optimal level of V_1^N and α maximize shareholder wealth and shareholders can neutralize the effect of changes in τ^D on $\alpha(1-\tau^D)$ (and thereby on e) by adjustments in α, shareholder wealth is insulated from dividend tax changes.[42]

[40] In these models, shareholders and managers disagree on the amount of cash flow that is distributed to shareholders. Empire-building managers have a preference for keeping cash in the firm, which allows them to finance projects earning low returns which otherwise would not be funded by shareholders or equity markets. For instance, see Kanniainen (1999), Chetty and Saez (2010) and Koethenbuerger and Stimmelmayr (2014) for an analysis of tax policy in this type of corporate agency model.

[41] 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.

[42] A formal treatment of this extension is available upon request.

4.3 Efficiency Neutral Investment Responses

A common prediction of existing analyses of dividend taxes is that 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 cost.[43] 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.[44] The tax system alters total tax revenues to

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

The first and third terms in the second brackets are new. They represent the tax deductibility of the costs of investment and the inclusion of the proceeds of liquidation in the corporate tax base. 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 the following:

$$I: \quad \alpha(1-\tau^D)(1-\tau)\left(-1 + \frac{f_I + 1 - \delta}{1+r} \right) = 0 \quad \Leftrightarrow \quad f_I = r + \delta, \tag{21}$$

while managerial effort choices still follow from (8). 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 (8) and (21), 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

[43] 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).

[44] 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 depreciation allowance, after the investment has been made (Boadway and Bruce, 1984; Devereux and Freeman, 1991).

are negatively related to dividend taxes and the associated tax-induced investment response depends on sign$\{f_{Ie}\}$.

Using (12) and (20) 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 (21) 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.[45] The dividend tax influences effort and this behavioral response is sufficient to calculate the efficiency costs of dividend taxation. The welfare neutrality of investment responses is different from the new view 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.[46]

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 (19). 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, 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.*

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

[46] Precisely, absent agency conflicts, (21) implies $dI/d\tau^D = 0$. Using (22), the welfare change is $dW/d\tau^D = 0$.

5 Discussion

A considerable body of literature has evaluated the validity of the old view and new view of dividend taxation, using a variety of methods to determine the impact of dividend taxation on corporate investment and distributions. Depending on data availability and the methods applied, some analyses determine the marginal source of finance, and based on the diverging predictions of the two views, infer the efficiency effects of dividend taxation. Alternatively, studies have tested the implications of either dividend taxes for corporate payout and investment behavior, or of investment changes for distributions, and infer the marginal source of funds from these responses (see Auerbach, 2002, for an overview of the literature).[47] The two methods are informative in different ways in terms of the efficiency effects of dividend taxation in the corporate agency model. Knowing the marginal source of funds is informative in itself, but it is not sufficient to draw conclusions concerning dividend tax neutrality. When investments are financed out of retained earnings, dividend taxation might also change investment incentives, yielding observable investment responses to taxes that are opposite to the predictions of the two views. For instance, investments might be unresponsive to dividend taxation with new share issues at the margin (provided $f_{Ie} < 0$)[48], while they affect new investments that are financed by retained earnings. Conversely, empirical estimates of dividend tax effects on investments cannot be connected in a straightforward manner to a financing regime. Dividend taxes might well distort investment levels downward under either source of finance. However, the agency model provides auxiliary predictions which make it possible to infer the financing regime based on empirically observed investment behavior. With retained earnings as the marginal source of funds, investment responses to dividend taxes and to the performance-related sensitivity of managerial wages (α in our model) are identical, while the two responses differ with new share issues as the marginal source of funds (c.f. (18)).

The agency model and the neoclassical model of firm behavior generate identical qualitative implications for the differential response of investments in a retained earnings (re) vs. new share

[47] For instance, to infer the source of funds for investments, Auerbach and Hasset (2002) 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) analyzes 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.

[48] In this case, the investment response is ambiguous in sign and a zero investment response might be observed in aggregate.

issues (nsi) regime. In both models, the difference $I^{re} - I^{nsi}$ is increasing in the dividend tax.[49] Some empirical analyses use such relative responses as the outcome variable. For instance, Becker et al. (2013) and Alstadsæter et al. (2017) divide the firm sample into firms that are likely to use new share issues or retained earnings 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 firm groups to each other. They find that the empirically observed relative investment changes are generally negative in sign, and thus consistent with the old and new views of dividend taxation. Against the background of this paper, their findings can be interpreted more broadly as there is also a carry over to the agency model of firm behavior. Unfortunately, the differential response tends not to be sufficient to calculate the efficiency costs 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 of firm behavior, but less so in agency models as investments change under both modes of finance.[50] Interestingly, in an environment in which firms are pre-clustered in groups according to their presumed marginal source of funds (as in Becker et al., 2013, for instance), the auxiliary prediction (18) suggested in this paper might be 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) found relative dividend payouts $D^{re} - D^{nsi}$ increased after a dividend tax reduction in Sweden. This response is consistent with predictions of the model with perk investments in Chetty and Saez (2010) and of the current model with productive investments, provided $f_{Ie} < 0$. Key to the explanatory power of the two models is the prediction that dividend taxes increase investment outlays and thereby decrease instantaneous dividend payouts D^{re} of firms with a sufficient amount of retained earnings, while naturally leaving instantaneous payouts D^{nsi} at a zero level. The efficiency implications of investment responses underlying a rise in dividend payouts in the two models differ however. More perks lower efficiency, while more productive investment enhances the efficiency of resource allocation, a differential prediction which renders the welfare interpretation of the empirical findings in Alstadsæter et al.

[49] In the neoclassical model the differential investment response follows from the dividend tax neutrality under the new view of dividend taxation, that is, changes in the investment difference $I^{re} - I^{nsi}$ are exclusively related to changes in I^{nsi}. In the agency model in this case, the difference in responses qualitatively follows from the direct negative effect the dividend tax has on investments when new share issues are used at the margin (c.f. (7) and (17)).

[50] In the neoclassical model, $I^{re} - I^{nsi}$ only changes because of the response in I^{nsi}, i.e., $dI^{nsi}/d\tau^D < 0$.

(2017) ambiguous.[51]

Using the 2003 U.S. dividend tax cut as a policy experiment, Yagan (2015) finds no significant tax effect on investment of firms that are subject to dividend taxation. As discussed in Yagan, such a finding might be related to firm-specific responses to the dividend tax cut, as analyzed in Chetty and Saez (2010). The diverging responses reflect inefficiencies due to corporate agency problems, which might offset each other in aggregate. In particular, firms might use different sources of finance, giving rise to counteracting investment responses to dividend taxes.[52] This model provides a different mechanism that is consistent with the empirical finding. The heterogeneity of firm responses due to heterogeneity in the sign and the magnitude of f_{Ie} might generate investment responses that might well neutralize in aggregate. Intuitively, in quiet-life models more managerial effort might reduce or increase investment depending on whether the decision at hand involves to shut down badly performing projects or to select new promising projects, for instance (Stein, 2003). This introduces a tendency towards zero investment responses to dividend taxes. Thereby, the heterogeneity in investment responses might be related not only to firms that resort to different sources of finance at the margin but also to firms that use the same source of investment finance, as in the model employed here. Interestingly, against the background of this model, dividend taxes incur efficiency costs due to adjustments in managerial effort levels even when investments do not vary with the dividend tax (due to firm-level heterogeneity in f_{Ie}, for instance). This allows for the interpretation that the US dividend tax cut might have increased efficiency although aggregate corporate investment has not changed.[53] Such heterogeneity in responses might also explain why e.g. Desai and Goolsbee (2004) find that the U.S. dividend tax reductions enacted in 2003 had little or no effect on investment.

6 Summary and Concluding Remarks

Efficiency analysis of dividend taxes in public finance is not firmly connected to corporate agency theory. This paper analyzes the efficiency costs of dividend taxation in a quiet-life corporate agency model in which non-verifiable managerial effort enhances taxable profits. The model is able to produce rapid negative investment responses to dividend taxes in an environment in

[51] Alstadsæter et al. (2017) refer to the model in Chetty and Saez (2010) to interpret the results.

[52] In the free cash flow model used in Chetty and Saez (2010) investment outlays rise with dividend taxation when retained earnings are sufficient to finance investments, but might drop with new share issues.

[53] Note, the response $de/d\tau^D$ is independent of sign$\{f_{Ie}\}$. It influences the welfare cost of dividend taxation (13) also when firm-level heterogeneity in sign$\{f_{Ie}\}$ nullifies the aggregate investment response.

which firms use retained earnings at the margin. Thereby, different to existing agency models that predict positive investment responses, the model is not limited in its capacity in accommodating empirical evidence on corporate investment responses to dividend taxes. We further show that, in contrast to traditional efficiency analysis, the source of investment finance and the sensitivity of investment to dividend taxes are not uniquely linked. Investment might be distorted downward when retained earnings or new equity issue finance investments at the margin. We provide a testable implication to infer the mode of investment finance from the investment sensitivity to dividend taxes and incentive provision. The theory-guided empirical strategy might be particularly helpful in environments in which this piece of financial information is otherwise difficult to retrieve from the data. In addition, we demonstrate that efficiency effects generally depend on tax-induced investment and effort responses. However, in the case of a tax system that offers a full deductibility of investment costs, dividend taxes do not impair efficiency due to investment changes, rendering observable investment responses uninformative for efficiency analysis. Finally, we show that imposing an income tax on managerial equity pay is equivalent to a general dividend tax. From this perspective, our paper suggests a cautious efficiency-based demand for such a type of managerial tax.

Different extensions to the analysis are conceivable. For instance, firms might be finance constrained, as frequently documented. With finance constraints, corporate investments fall short of the level that maximizes firm profits. An immediate implication is that investments are invariant to dividend taxes.[54] However, this does not imply that dividend taxes are welfare neutral, as in the neoclassical model of firm behavior. They continue to lower managerial effort provision and incur efficiency costs.[55] A further extension might address coordination problems between shareholders, 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. Despite

[54] With finance constraints ($D_1 = X - I = 0$), the first-order condition (7) is replaced by $(1-\tau)f_I + \tau\delta + 1 - \delta > 1 + r$. Managerial effort choices are qualitatively unaffected by the existence of finance constraints and continue to follow from (8). Consequently, the fiscal externality of investments on the public budget becomes zero and all efficiency effects of dividend taxation are related to the negative managerial effort response $de/d\tau^D$ (c.f. (13)).

[55] Firms might also be heterogeneous in their exposure to finance constraints and the exposure is endogenous to the managerial effort choice (through its effect on f_I). Firm heterogeneity might be related to different managerial costs of effort provision $\phi(e) = \omega\tilde{\phi}(e)$, where ω differs across firms. In such a world, the investment response in the fiscal externality term (13) needs to be weighted by the mass of firms that are not finance constrained, thereby leaving the results qualitatively intact. A formal treatment of this extension is available upon request.

being interesting, we leave a formal treatment of this and other possible extensions to future research.

A Appendix

A.1 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.:

$$w = \tilde{\alpha}\left(D_1 + \frac{D_2}{1+r}\right) + \frac{a}{1+r}. \tag{22}$$

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

$$E(U) = u\left(\tilde{\alpha}\left(D_1 + \frac{E(D_2)}{1+r}\right) + \frac{a}{1+r} - \rho\left(\tilde{\alpha}\frac{(1-\tau)}{1+r}\right)^2\sigma^2\right) - \frac{\phi(e)}{1+r}. \tag{23}$$

Solving backwards, at stage 2 the manager chooses the level of investment and effort. Using (1), $D_1 = X - I \geq 0$, and (23), the manager's choice of investment and effort follow from:

$$I: \quad \tilde{\alpha}\left(-1 + \frac{(1-\tau)f_I + \tau\delta + 1 - \delta}{1+r}\right) = 0 \tag{24}$$

and

$$e: \quad u'\left(\tilde{\alpha}\frac{(1-\tau)f_e}{1+r}\right) - \frac{\phi'(e)}{1+r} = 0. \tag{25}$$

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:

$$\frac{de}{d\tilde{\alpha}} > 0 \qquad \text{and} \qquad \frac{dI}{d\tilde{\alpha}} \gtreqless 0 \quad \Leftrightarrow \quad f_{Ie} \gtreqless 0. \tag{26}$$

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 (23), shareholder wealth becomes:

$$(1-\tau^D)\left(D_1 + \frac{E(D_2)}{1+r}\right) + \frac{a}{1+r} - \rho\left(\tilde{\alpha}\frac{(1-\tau)}{1+r}\right)^2\sigma^2 - u^{-1}\left(\frac{\phi(e)}{1+r}\right). \tag{27}$$

At stage 1, shareholders choose the incentive contract so as to maximize shareholder wealth (27), noting (1) and $D_1 = X - I$. Applying the envelope theorem, the associated first-order condition is as follows:

$$(1-\tau^D)(1-\tilde{\alpha})\frac{(1-\tau)f_e}{1+r}\frac{de}{d\tilde{\alpha}} = 2\tilde{\alpha}\rho\left(\frac{1-\tau}{1+r}\right)^2\sigma^2. \tag{28}$$

Noting that investment and effort do not depend on τ^D (c.f. (24) and (25)), differentiation of (28) with respect to $\tilde{\alpha}$ and τ^D yields:

$$\frac{d\tilde{\alpha}}{d\tau^D} = \left(\frac{-(1-\tilde{\alpha})(1-\tau)}{1+r} f_e \frac{de}{d\tilde{\alpha}} \right) \Psi^{-1} < 0, \tag{29}$$

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 ((24), (25), and (28)) into the respective first-order condition under the net definition of the incentive contract ((7), (8), and (10)). 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 behavioral 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:

$$\frac{de}{d\tau^D} = \frac{de}{d\tilde{\alpha}} \frac{d\tilde{\alpha}}{d\tau^D} < 0 \qquad \text{and} \qquad \frac{dI}{d\tau^D} = \frac{dI}{d\tilde{\alpha}} \frac{d\tilde{\alpha}}{d\tau^D} \lessgtr 0 \quad \Leftrightarrow \quad f_{Ie} \lessgtr 0. \tag{30}$$

The sign of the responses in (30), and thereby the sign of the responses in (11), follows from (26) and (29).

A.2 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:

$$(E(U^M) - \overline{U}^M)^\beta (E(U^S) - \overline{U}^S)^{1-\beta}, \tag{31}$$

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 analyzed 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. (2)). Provided the shareholders' outside option entails a continuation of the firm and of the liability to dividend taxation,[56] the tax factor

[56] 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 $E(U^S) - \overline{U}^S$.

$1-\tau^D$ scales the difference $E(U^S)-\overline{U}^S$ and thereby the maximand of the Nash bargaining problem (31). 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 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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