

National Centre of Competence in Research
Financial Valuation and Risk Management

Working Paper No. 404

A Principal-Agent View on Dividend Taxation and Investment Efficiency

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First version: September 2006
Current version: May 2007

This research has been carried out within the NCCR FINRISK project on
“New Methods in Theoretical and Empirical Asset Pricing”

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Abstract

We propose an equity finance model with agency problems and investigate the relationship between dividend taxation and inefficient investments. Contrary to both the “old” and the “new” view of dividend taxation, a fall in the dividend tax rate is found to improve corporate governance by increasing dividends and limiting inefficient overinvestments. These results are derived both in a two-period framework and in more general cases with multiple periods with perfectly informed and uninformed, but learning investors. The predictions of our model are confirmed empirically in a cross-sectional panel analysis of 4,272 firms between 1980 and 2005. The data also supports the prediction that uncertainty about the firm’s expected rate of return further lowers inefficient overinvestments.

JEL Classification Codes: D83, G33, H21.

Keywords: Agency Problems, Dividend Taxation, Investment, Learning, Outside Equity.

First Version: September 2006

This Version: May 20, 2007

*All authors are at the University of St. Gallen. The usual disclaimer applies. Comments from Anne Anderson, Kai-Joseph Fleischhauer, Christian Keuschnigg, Claudio Loderer, Jens Jackwerth, Nielsen Kasper Meisner, Blaise Melly, Evelyn Ribi, Felix Schwarze, Carlo Sgarra, Fabio Trojani, and seminar participants at the University of St. Gallen, the Politecnico di Milano, the 2007 Campus for Finance Research Conference, Vallendar, the 2007 Annual Meeting of the Swiss Society for Financial Market Research, Zürich, the 2007 Eastern Finance Conference, New Orleans, and the 2007 European Financial Management Symposium on Corporate Governance and Shareholder Activism, Milan, are gratefully acknowledged.

I. Introduction

FOLLOWING MONTHS OF DEBATE AND POLITICAL WRANGLING, the U.S. congress passed the “Jobs and Growth Tax Relief Reconciliation Act” (JGTRRA) in May 2003, which among other provisions reduces the maximum tax rate on dividends from 38% to 15%, thus eliminating the tax wedge between income from capital gains and dividends. This legislation has been hailed by the administration as a much needed jump-start to the struggling economy and is set to expire in 2008. However, the debate on the effects of the JGTRRA is still very controversial. For instance, according to Auerbach and Hassett (2005), one of the objectives of the act, namely to promote investments and thus increase economic growth, seems to have been missed. Further, opinion polls in the Wall Street Journal, document that six out of ten surveyed claim that the act will solely increase the financial deficit and benefit only the wealthiest.² The JGTRRA is hence defied by many and its perpetuation in 2008 is questionable.

While a vast literature has studied the effect of the 2003 dividend tax cut on financial markets,³ to our best knowledge, so far, no paper has formally studied the impact of a dividend tax cut on investment behavior in a corporate governance setting. This approach, however, adds a crucial dimension to the analysis of tax cuts in general and the JGTRRA in particular. By allowing managers to act in a self-interested way and by focusing on the relationship between shareholders and managers as principles and agents, a dividend tax cut may indirectly influence investment behavior by acting on this principle-agent relationship. This setup may thus provide arguments in favor of the JGTRRA by focussing not so much on the total amount invested, but rather on investment efficiency as the outcome of the principle-agent interaction.

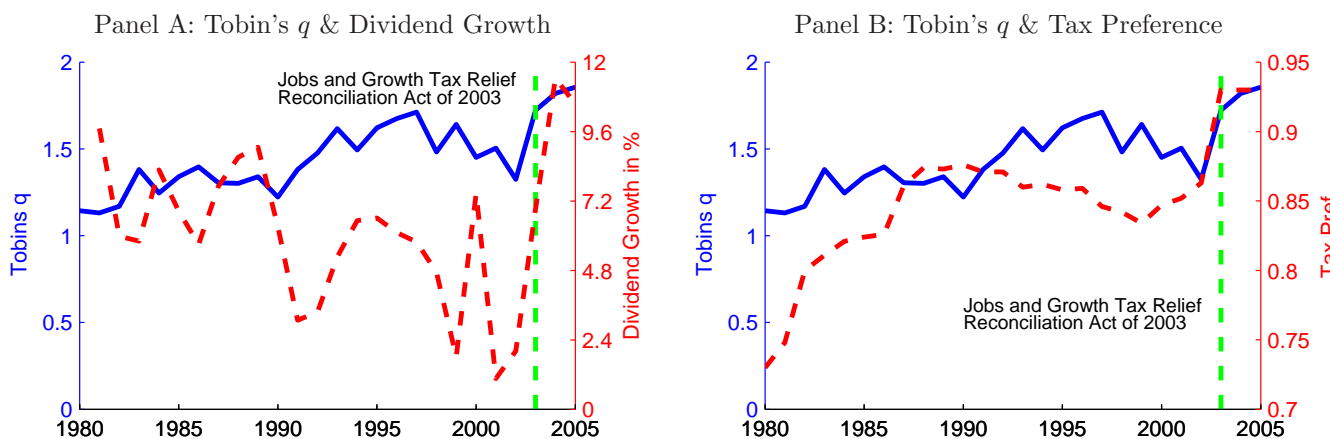


Figure 1. Tobin's q , Dividend Growth, and Tax Preference

This Figure displays the cross-sectional median of dividend growth, tax preference according to Poterba (2004), and Tobin's q over the period 1980 to 2005. The average correlation from Engle's (2002) DCC model is 0.46 for all three variables.

²The Wall Street Journal, *Americans Fear New Tax Cuts Will Unfairly Benefit the Rich*, June 20, 2003.

³Chetty and Saez (2005) document a substantial boost to dividends from the tax cut. Brown, Liang, and Weisbenner (2004) find that the tax cut had a more muted effect on total payouts because of share repurchases. Poterba (2004) estimated that the tax cut could have boosted the value of U.S. equities by approximately 6%.

In Figure 1 we plot the cross-sectional average of Tobin’s q as a proxy for investment efficiency, dividend growth, and tax preference as defined by Poterba (2004) – measuring the extent to which dividends are discriminated against when compared to capital gains – for the firms studied in the empirical analysis. Even at an aggregate level, we note a positive dependency between the three time-series, motivating further investigation of the interplay of these variables in a corporate finance setting with outside equity and agency problems, much in the spirit of Myers (2000) and Tirole (2001).

The effect of dividend taxation on corporate investment is an issue of ongoing debate. In trying to determine whether changes in dividend taxation influence investment decisions, two main views have evolved, namely the “old” and the “new” view of dividend taxation. While the former predicts that the overall investment of a firm falls if the dividend tax rate increases, the latter claims that investment decisions are unaffected by changes in the dividend tax rate.⁴ Both views are controversial and abstract from agency problems.

Interestingly, agency conflicts play a central role in the analysis of the so called dividend puzzle, the empirical fact that many firms pay out dividends although this is suboptimal in the presence of dividend taxation.⁵ A number of approaches have been developed to reconcile empirical figures with financial theory. Allen and Michaely (1995) and Correia da Silva, Goergen, and Renneboog (2004) provide extensive surveys on theories addressing the dividend puzzle. Summing up, three major strands of literature exist.

First, according to the *signaling approach*, information is asymmetrically distributed on the external capital market. Corporate insiders dispose of information inaccessible to corporate outsiders and use dividends to signal their view on the firm’s future prospects. The costliness of dividends due to taxes turns dividends into a valuable signal that can be used to distinguish good from bad firms.⁶

Second, the *tax-clientele approach* captures the idea that there are different groups of investors, or different tax clienteles, some of which are liable to the dividend tax and some of which are tax-exempt. Tax payers in each clientele group hold those assets that minimize their taxable income, and firms may even choose their dividend policy such that it suits those investors they want to attract. Again, managers are assumed to be perfect agents.⁷

⁴The findings of the old or “traditional” view of dividend taxation, which has been brought forward by Fullerton and King (1984) and Poterba and Summers (1985), are based on the assumption that marginal investment in the firm is financed through new equity issues. Dividend taxation therefore increases the costs of capital, as new investors want to be compensated for the dividend tax. Contrary, the new view of dividends, which has been promoted by Auerbach (1984) and Bradford (1981), postulates that although the dividend tax does influence the firm value, it does not affect the investment decisions since retained earnings are the marginal source of investment. Investors can therefore choose only between a dividend payment or the reinvestment of profits. Ultimately, the equity is hence trapped within the firm, the dividend tax has to be paid in any case, which is why the dividend tax itself drops out of the maximization problem and does not influence investment.

⁵The notion of the dividend puzzle was coined by Black (1976).

⁶The informational content of dividends has been mentioned by Modigliani and Miller (1961) in their seminal paper on dividend policy and formalized by Bhattacharya (1979), Miller and Rock (1985), and John and Williams (1985). The empirical evidence, however, seems to speak against the signalling hypothesis as firms tend to smooth dividends rather than adjusting them to future earning prospects.

⁷This approach to the dividend puzzle has also first been mentioned by Modigliani and Miller (1961), for a survey, see Allen and Michaely (1995) and Correia da Silva, Goergen, and Renneboog (2004).

Finally, the *agency approach* adopted in this paper, first formulated by Easterbrook (1984), abandons the idea of perfect agents. It explains the dividend policy of a firm as a solution to the principal-agent problem between managers and investors. Self-interested managers with empire-building tendencies do not always pursue efficient investment strategies and do not necessarily provide outside investors with an (adequate) rate of return on the invested capital. Agency problems are most pronounced and especially difficult to deal with when managers have ample internal funds and do not need to recur to the external capital market to finance new investment projects. According to Jensen (1986), managers may even refrain from disbursing those internal funds they dispose of in excess of all efficient investment opportunities, preferring to reinvest this so called “*free cash flow*” inefficiently. In such a context, dividends may be considered as a corporate governance device that helps to align managers’ and investors’ interests. If a dividend payment can be enforced, managers have to disgorge part of the free cash flow and have less funds left to reinvest inefficiently. Regular dividend payments can force managers to finance new investment projects with external capital, subjecting themselves to stricter monitoring and disciplinary devices in order to attract new funds. Given that there are agency problems, therefore, dividends can be seen as enhancing the quality of corporate governance; and the existence of dividends can be justified even in the presence of dividend taxation.

In recent years, the agency approach has found strong support by several empirical studies. For instance, Chetty and Saez (2005), Brown, Liang, and Weisbenner (2004), Dietz and Gordon (2006), Fenn and Liang (2001) and DeAngelo, DeAngelo, and Stulz (2004), among others, all support the view that the agency theory may be crucial in the determination of dividend payments. In addition, while the overall number of dividend paying firms has decreased over the recent years, as found by Fama and French (2001), DeAngelo, DeAngelo, and Skinner (2004) note that the total amount of dividends paid from top-earning firms has increased. This indicates that those firms with the highest cash flows, that are therefore most prone to the agency problems associated with free cash flow, pay substantial dividends.

In this paper, we propose a model that illustrates how dividend taxation affects investment decisions in the presence of agency problems and how this yields predictions that differ from both the “old” and the “new” view of dividend taxation and that may be used as support for the JGTRRA. In particular, we focus on the negative correlation between dividend taxation and investment efficiency. Our idea is based on the corporate governance models of outside finance in the spirit of Myers (2000) and Tirole (2001), in which dividend payments occur because of an underlying agency problem. Investors threaten to liquidate a project if the expected return falls below a certain threshold. This threat is, however, associated with costs of collective action. Managers disburse part of the cash flow as a dividend in order to convince investors to continue investing in the project, voluntarily limiting inefficient reinvestment. At the same time, this liquidation threat is heavily exposed to changes in the dividend tax rate because a dividend tax affects its credibility: An increase in the tax rate lowers the return of collective action, thus weakening the liquidation threat. It therefore leaves more free cash flow at the managers’ discretion and indirectly increases

inefficient over-investment. Thus, the inclusion of agency problems implies that the investment efficiency decreases with a rise in the dividend tax rate.

After presenting the basic idea and the mechanism of the liquidation threat in a two period framework, the model is extended to n periods by letting the investor threaten with the liquidation of the firm repeatedly in the firm's life cycle. The optimal dividend payout is found by backward induction similar in spirit to a real options approach.⁸ This extension shows - apart from illustrating how the modeling frameworks of the corporate finance literature offer interesting and straightforward alternatives to the standard principle-agent models - that even if investors take into account all future decisions, the effect of the tax on investment efficiency remains unchanged.

The implications of the model are further tested by introducing uninformed, but learning investors, as many recent studies have recognized the importance of learning for asset pricing.⁹ In the prior literature, information uncertainty is often modeled as the information asymmetry component of cost of capital (see Diamond and Verrecchia, 1991, and Easley and O'Hara, 2004). The theoretical argument that accounting disclosure can reduce information uncertainty and cost of capital is appealing, but the empirical evidence is rather mixed and inconclusive. Contrary to most of these approaches, we study the effect of investors' learning on the capital path of a mature firm paying out dividends. We do this by assuming that the uninformed investors do not know the underlying probability distribution of the rate of return on investments. Nevertheless, they hold a prior probability that is updated after each realization. The managers know the true probabilities and, depending on the state of the capital path, offer dividends to investors in order to prevent liquidation. By means of Bayesian updating, we obtain solutions for the capital evolution and especially we show that inefficient investments decrease with uncertainty. Moreover, we find that inefficient investment with learning investors lies below inefficient investment in a full information economy,¹⁰ and, most importantly, the effect of the dividend tax on the investment efficiency remains unaltered in this setting with uncertainty. Altogether, these different theoretical frameworks illustrate that the effect of dividend taxation on the principle-agent relationship between managers and investors and thus on investment behavior is robust in theory to different setups.

Our empirical analysis confirms the model's hypotheses using a large panel of data covering the years 1980 to 2005, hence including the 2003 dividend tax cut in the United States. We use Tobin's q as a proxy for investment efficiency and account for both firm- and industry-specific effects. The investigation is based on the assumptions that agency problems drive the dividend policy of a firm.¹¹ Our results show that the reduction in the discrimination

⁸The real options analysis literature is too voluminous to cite here, we refer to the seminal paper by Myers (1977).

⁹Bernardo and Chowdry (2002) explore the implications of firms' learning about their own efficiency. Timmerman (1993) and David (1997), Veronesi (1999, 2000), Brennan and Xia (2001), Pástor and Veronesi (2003), Guidolin and Timmerman (2006), among many others, show how learning about hidden state variables, such as the dividend growth rate, has equilibrium implications on stock prices or on market-to-book ratios.

¹⁰The efficiency enhancing role of learning lies in the fact that when uncertainty is high, the amount of capital at the disposal of the manager is lower since investors demand a higher premium. When uncertainty dissolves through learning, the premium that investors demand decreases and capital and hence investment rise, approaching the level of full information.

¹¹Evidence on this assumption is vast, and especially in recent time, as DeAngelo, DeAngelo, and Stulz (2004), Brown, Liang, and Weisbenner (2004) and Chetty and Saez (2005) have shown.

against dividends as compared to capital gains has a highly significant, positive effect on investment efficiency, thus reinforcing our theoretical results and yielding support for a perpetuation of the JGTRRA in 2008. We also confirm our hypothesis that uncertainty decreases inefficient investment by proxying uncertainty by analysts' dispersion.

The contribution of this paper is threefold. *First*, this paper is, to our best knowledge,¹² the first to explicitly model the interaction of dividend taxation, investment behavior, and agency problems in a simple corporate governance framework. *Second*, this paper derives a positive relationship between taxation and inefficient investment, which stands in contrast to the existing literature. The implication of this result with respect to overall investment efficiency is found to be robust with respect to the assumptions on the information set of investors. *Third*, we perform a cross-sectional analysis by studying the investment and dividend payment behavior of 4'272 firms before and after the 2003 dividend tax cut in the United States. The data is found to confirm our model predictions.

The paper is structured as follows. In Section II we develop a theoretical model in a two-period framework that illustrates how a higher dividend tax rate may increase overall - inefficient - investments in mature firms. In Section III, the model is extended to n periods by means of a bivariate binomial tree. The relationship between changes in the tax rate, dividend payments, and investment efficiency is analyzed both in a setting with perfectly informed and uninformed, but learning investors. In Section IV, we present empirical evidence based on data retrieved from the COMPUSTAT and the Institutional Brokers Estimate System (I/B/E/S) database to show how the 2003 dividend tax cut in the United States has affected dividends and investment efficiency. Section V concludes.

¹²The possible interrelation between dividend policy, agency problems, and investment behavior is an issue that has already been touched upon by several authors. Chetty and Saez (2005), La Porta, Lopez-de-Silanes, Shleifer, and Vishny (2000) and Morck and Yeung (2005) mention in their papers the possibility that dividends mitigate agency problems and that a dividend tax may lead to an increase in inefficient overinvestment. However, none of these papers propose a simple corporate governance model to capture these effects or presents explicit empirical evidence. Dietz and Gordon (2006) present a paper that is also based on this idea, but focuses on theoretically and empirically comparing different approaches to the dividend puzzle.

II. A two-period Framework

In our model, we assume that managers have empire building preferences and do therefore always prefer to retain funds and reinvest them rather than to redistribute them to outside investors.¹³ The venture is ex-ante set up to last for two periods, which implies that the reinvestment will take place in the second period even if the expected rate of return lies below the market rate of return and a continuation is highly inefficient. Investors are, however, given the opportunity to terminate the venture prematurely after the first period in case the expected rate of return is too low. Premature liquidation is associated with costs of collective action, c . When deciding on the collective action, investors compare the payoff from collective action and premature liquidation to the expected payoffs from continuation.

Empire building managers will try to avert impending liquidation. The threat of collective action and ensuing liquidation entice them to pay out part of the free cash flow voluntarily as a dividend after the first period. This voluntary disbursement of cash increases the continuation value of the project by limiting inefficient reinvestment such that investors will be just indifferent between liquidation and continuation. Due to the costs of collective action, this still leaves some funds at the manager's disposal. The introduction of a dividend tax will decrease the investors' return to collective action, thus diminishing the power of the liquidation threat and the ability of investors to enforce dividend payments. As dividends fall, investment efficiency declines.

A. Timing

In order to illustrate the effect of dividend taxation on investment efficiency in case of empire building managers and to elucidate how the liquidation threat may entice dividend payments, we first concentrate on a two-period model with three points in time, 0, 1 and 2. At time 2, the firm¹⁴ is automatically liquidated. At time 0, the firm has a capital stock of K_0 . In the first period, investment takes place. Since we assume full depreciation, the capital stock is equal to total investments. With probability p , the return on investment is above the market rate of return and equal to $(1 + m^H r)$, with r being the market rate of return and $m^H > 1$. With probability $(1 - p)$, the return on investment is below the market rate of return and equal to $(1 + m^L r)$, with $m^L < 1$. For the sake of

¹³The assumption of empire building is rather common in the literature. Empire building is usually modeled by introducing managerial benefits of control (see Grossman and Hart, 1988) that are proportional to the total amount invested, see for example Hart and Moore (1995). In line with Hart and Moore (1995), Zwiebel (1996) and, in part of their analysis, and in line with Dewatripont and Tirole (1994), we assume that the empire building tendencies cannot be avoided by optimal contracting. There is twofold evidence in the empirical literature of empire building tendencies of management: First, the fact that diversified firms often trade at a discount is in part attributed to inefficient diversification decisions of empire building managers. The notion of the diversification discount, coined by Lang and Stulz (1994), reflects the prevalent belief that diversification may destroy value. Second, Blanchard, Lopez-de-Silanes, and Shleifer (1994) have direct empirical evidence that free cash flow is rather inefficiently deployed than paid out to shareholders.

¹⁴When using the term "firm", we actually refer to one (inefficient) investment project within a firm. While, the overall investment opportunity set of the company might encompass one or more efficient or inefficient investment projects, this does not alter the economic implications of the model.

simplicity, but without loss of generality, we assume that agents are risk-neutral. Further, since we are interested in the effect of dividend taxation on inefficient investments by empire building managers, we consider the situation where $E(1 + m^i r) < r$, i.e. the investment capital is trapped within the firm (trapped equity). In $t = 1$, investors can threaten with liquidation. We depict the course of action in the two-period model in Figure 2.

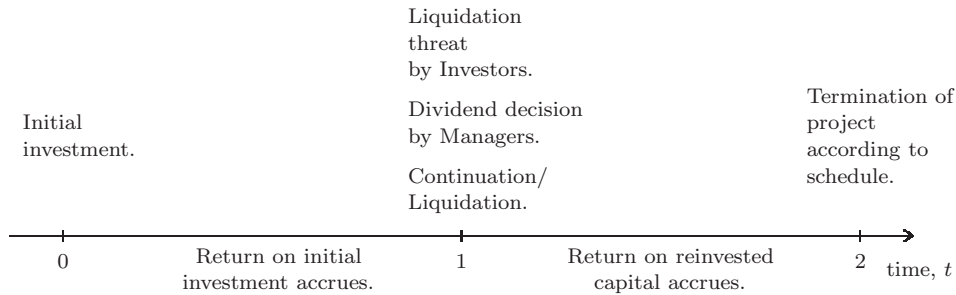


Figure 2. Course of Action – Two-Period Model

The simple threat to terminate the venture is sufficient to enforce a dividend payment and to discipline managers, a clear improvement compared to the situation in which investors have no possibility to enforce any payments in case investment opportunities are inefficient.

B. Liquidation Threat

The effectiveness of the investors' liquidation threat will depend on the cash flow that has accrued so far and on the expected return in the next period. The higher the cash flow in $t = 1$, the more credible is the liquidation threat as the costs of collective action are assumed to be constant and therefore act as a fixed cost argument. The higher the expected rate of return in the next period, the less credible is the liquidation threat. The tree in Figure 3 illustrates the possible paths of firm capital. All projects end in $t = 2$.

In $t = 1$ (nodes B and C), investors will compare the liquidation value of the project, V_{liq}^i , with the continuation value V_{con}^i given that no dividend is being paid out. The liquidation value amounts to:

$$V_{liq}^i = (1 - \tau) K_1^i - c, \tag{1}$$

with $i = \{H, L\}$, depending on which state has occurred in the first period, τ being the dividend tax rate applicable to all cash that leaves the firm, and c denoting the costs of collective action. The subindex 'liq' stands for liquidation.

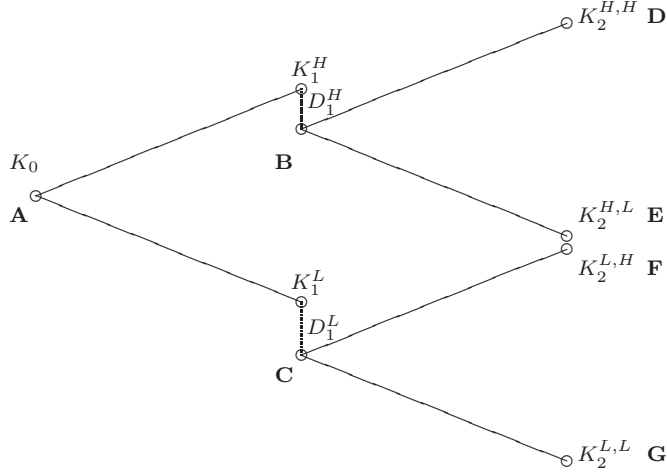


Figure 3. Evolution of Investment in the Two-Period Model

In node B , a capital of $K_1^H = (1 + m^H r)K_0$ has accrued with probability p , in node C , the capital has amounted with probability $(1 - p)$ to $K_1^L = (1 + m^L r)K_0$. If no dividend is paid out, the continuation value amounts to:

$$V_{con}^i = (1 - \tau) \left(\frac{E(1 + m^i r)}{(1 + r)} \right) K_1^i. \quad (2)$$

Again, $i = \{H, L\}$ denotes which state has occurred, and $E(1 + m^i r)$ is the expected rate of return in the next period, which is equal to $p(1 + m^H r) + (1 - p)(1 + m^L r)$. The subindex 'con' denotes continuation.

The expected rate of return in the second and last period may lie above or below the market rate of return, i.e. it may be efficient to reinvest, or it may be inefficient to do so. Anticipated inefficiency of investment does not necessarily imply that the liquidation threat is binding and that a dividend is paid out. The threshold level below which the expected rate of return has to fall in order for the liquidation threat to bind and can be derived easily as the liquidation threat binds if the following inequality holds:

$$V_{liq}^i \geq V_{con}^i. \quad (3)$$

Substituting out for V_{liq}^i and V_{con}^i and solving for $E(1 + m^i r)$ yields:

$$E(1 + m^i r) \geq (1 + r) \left(1 - \frac{c}{(1 - \tau) K_1^i} \right). \quad (4)$$

It is important to note that this threshold level does not correspond to the market rate of return: Since premature liquidation is associated with costs of collective action, investors will abstain from it in case of small deviations from the market rate of return.

There are thus two cases that can be distinguished: *First*, it may be that the liquidation threat is not binding, and the expected rate of return is consequently sufficiently high to make continuation an attractive option for investors. It is important to know that a non-binding liquidation threat is not necessarily tantamount to a return at least as high as the market interest rate: as indicated in inequality (4), it is possible that a reinvestment is inefficient, but not enough to justify the costs of collective action. *Second*, it may be that the liquidation threat is credible and binds: The expected rate of return may fall below the threshold indicated in equation (4), and the reinvestment is so highly inefficient that the liquidation value lies above the continuation value. This is the case we are most interested in, as managers will now agree to voluntarily pay out a dividend that limits inefficient reinvestment in order to increase the continuation value and prevent liquidation.

The continuation value with dividends, $V_{con,D}^i$ amounts to:

$$V_{con,D}^i = (1 - \tau) \left(\frac{E(1 + m^i r)}{(1 + r)} \right) (K_1^i - D_1^i) + (1 - \tau) D_1^i. \quad (5)$$

The size of the dividend payment is determined by the difference between the liquidation value and the continuation value with dividends and will make investors just indifferent between liquidation and continuation:

$$V_{liq}^i = V_{con,D}^i, \\ (1 - \tau) K_1^i - c = (1 - \tau) \left(\frac{E(1 + m^i r)}{(1 + r)} \right) (K_1^i - D_1^i) + (1 - \tau) D_1^i.$$

The dividend payment will have to amount to:

$$D_1^i = K_1^i - \frac{c}{(1 - \tau) \left(1 - \frac{E(1 + m^i r)}{(1 + r)} \right)}, \quad (6)$$

and the reinvestment in the second period, which is denoted by Z_1^i , will be:

$$Z_1^i = K_1^i - D_1^i = \frac{c}{(1 - \tau) \left(1 - \frac{E(1 + m^i r)}{(1 + r)} \right)}. \quad (7)$$

A binding liquidation threat thus enables investors to limit inefficient over-investment in the second period and to extract some free cash flow, although efficiency of investment cannot be reached.¹⁵

¹⁵The initial setup of the firm can easily be modeled in the way described by Myers (2000) – if investors anticipate the equity trap, they will demand a sufficient compensation ex-ante and will force managers to co-invest (potentially with human capital), claiming a share in

C. Effect of Changes in the Tax Rate

The results of the above analysis depend crucially on the liquidation threat and on the costs of collective action that make interference for small deviations from efficient investment unattractive to investors. A dividend will only be paid out if the liquidation threat binds, which implies that the liquidation value is higher than the continuation value without dividends. If a tax is levied or if the tax rate changes in that situation, the liquidation value will consequently be more affected than the continuation value without dividends. Therefore, the tax changes the effectivity of the liquidation threat and as such the dividend payment and the investment efficiency.

Our model yields results that are confirmed by empirical observations. All results contribute to the overall finding that the dividend tax is negatively correlated with investment efficiency. First of all, for a given expected rate of return, a fall in the dividend tax rate increases the amount of dividends paid out and as such limits the amount that will be inefficiently reinvested:

$$\frac{\partial D_1^i}{\partial \tau} = -\frac{c}{(1-\tau)^2 \left(1 - \frac{E(1+m^i r)}{(1+r)}\right)} < 0, \quad (8)$$

which implies that the partial derivative of $Z_1^i = K_1^i - D_1^i$ will be positively correlated with the dividend tax rate:

$$\frac{\partial Z_1^i}{\partial \tau} = \frac{c}{(1-\tau)^2 \left(1 - \frac{E(1+m^i r)}{(1+r)}\right)} > 0, \quad (9)$$

Note that this result only holds in case of inefficient reinvestment, i.e. in case $E(1+m^i r) < (1+r)$. Therefore, and most importantly, overall investment efficiency falls in case the dividend tax rises. This efficiency loss is associated with the dividend decision on the intensive margin.

Second, the extensive margin of the dividend policy of a firm, i.e. the decision to pay out a dividend or to abstain from dividend payments, depends, as we have seen above, on the expected rate of return in the second period. The threshold level below which the expected rate of return has to fall in order to enforce a dividend payment rises in our model with a fall in the dividend tax rate, the extensive margin is therefore, as confirmed by Chetty and Saez (2005), also affected by the tax change: Some firms will therefore pay out dividends for the first time if the dividend tax rate falls:

$$\frac{\partial E(1+m^i r)}{\partial \tau} = -(1+r) \frac{c}{(1-\tau)^2 K_1^i} < 0. \quad (10)$$

the firm's assets that is larger than their input. This division of the firm's assets between corporate insiders and corporate outsiders does not affect the liquidation threat or the dividend payment. In that situation, the amount put up ex-ante is decreased by a rise in dividend taxation.

Alternatively, the setup can be justified in case investors learn the true efficiency of the project after the return has accrued for the first time in the first period. The expected rate of return in our model then becomes a certain return, and the case we are interested in is the case in which the low return will accrue.

This decision at the extensive margin also has an impact on overall investment efficiency, since it lowers the threshold below which the rate of return has to fall in order for the liquidation threat to bind and a dividend payment to be enforced. It therefore increases the manager's discretion, which lowers overall investment efficiency.

Analyses of the 2003 dividend tax cut in the United States have, at least in part, yielded support for our theoretical results. Chetty and Saez (2005) show – without analyzing the effect of the tax cut on investment efficiency – that the dividend decisions at the intensive and at the extensive margin were in line with our theoretical results: They state that the tax cut has caused both a rise in dividend payments of firms traditionally paying out dividends and the initiation of dividend payments for some firms that have not distributed dividends so far.

A fall in the tax rate thus leads to a decline in the amount reinvested by those firms that pay out a dividend while leaving the amount reinvested of those firms that do not pay out a dividend unaffected. This result contradicts both the “old” and the “new” view of dividend taxation and illustrates how the inclusion of agency problems into a simple model of investment behavior and dividend taxation may change the predictions completely. It is important to note once again, however, that these results apply only to firms employing their free cash flow in an inefficient way and that are forced to pay out a dividend. When the firm is set up initially, a dividend tax rise in our model will still act in the same way predicted by the old view of dividend taxation and increase the costs of capital, thus depressing the amount of equity invested ex-ante given that the firm is financed through new equity issues.

Giving investors the possibility to liquidate the project in $t = 1$ resembles, in its basic idea, an option that investors hold and that they will want to exercise – for a call option – out-of-the-money. Investors in our setting will exercise the option to liquidate the project in case the liquidation value lies above the continuation value. By extending this model to n -periods, however, we solve for the optimal dividend payout by backward induction. This enables us not only to determine the price of this “option” at each point in time, but also to capture the effect repeated interaction between investors and managers on overall investment efficiency. It ensures that even in case investors take all of their future decisions into account when deciding on the continuation or liquidation, if there are important repercussions of future on present decisions, also then will a change in the dividend tax influence overall investment efficiency in the same way as in the two period model. Furthermore, this extension is an attempt to show how the corporate finance literature offers alternative modeling frameworks that can easily be applied in a different context and that yield interesting and straightforward results.

III. An n -period Framework

The two-period case is interesting in order to illustrate the basic mechanism and the functioning of the liquidation threat in a simple setting and to obtain a first insight into the effect of changes in the dividend tax rate on investment efficiency. What we are also interested in, however, is on the one hand the evolution of the capital stock over time in case of perfectly informed investors, and on the other hand the effect of uninformed, but learning investors on the interaction between investment efficiency and dividend taxation. By extending the time horizon, we account for the fact that shareholders do not threaten with liquidation once over the firm's life-cycle, as in the two-period model, but can do so repeatedly after each period, as if they hold an American option. In addition, allowing investors to learn as time goes by enables us to verify our theoretical results in a more realistic setting of uninformed investors, as it is unclear whether the effect of the dividend tax on the liquidation threat that our two-period model predicted remains unaltered in case of a repeated interaction with decreasing uncertainty: The continuation value differs from the 2-period case since all future decisions form a part of it, and the liquidation value is also different as it changes with the history of the capital stock. Furthermore, in reality investors are most likely to be uninformed in case of dispersed ownership, and dispersed ownership implies costs of collective action because of a free-riding problem, which is in line with our assumptions.

In the n -period framework, investors decide on liquidation repeatedly after each period. The liquidation threat induces managers to disgorge part of the cash flow in order to convince investors to continue with the project. As in the two-period setting, the manager is faced with two possible scenarios. If the liquidation value is smaller than the continuation value, liquidation will not be a credible option and hence, investors will not be able to enforce a dividend payment. If, however, the liquidation value is above the continuation value, then investors will obtain an immediate dividend payment which is invested at the risk-free rate of return. In each point of time, the dividend payment is chosen such that the investor is made indifferent between continuation and liquidation.

In an extension, we model uninformed, but learning investors in an n -period framework. The uninformed investor does not know the exact probability of a high rate of return, but he holds a prior probability and updates it after each realized return. Depending on the state in the capital path, the manager offers a dividend to the investors. When uncertainty is high, the premium demanded by the investors will be higher. As uncertainty dissolves, the part of the cash flow which is at the disposal of the manager decreases and the premium declines.

A. No Uncertainty about the Firm’s Expected Growth Rate

This subsection assumes full information about all model parameters. In the next subsection, the mean profitability is unknown to the investors and hence will serve as a comparison to the full information setting. In order to capture the interaction between managers and investors in case the project is inefficient in the n -period setting, we assume that the expected rate of return, $E(1 + m^i r)$, lies below the market rate of return, $(1 + r)$. This enables us to replicate the case of free cash flow, since this setup can be interpreted as representing just one project within an otherwise profitable firm. Reinvestment in this project is inefficient from the investors’ point of view, and this project should be aborted. Liquidation, however, can be averted through dividend payments which depend both on the expected return and on the capital accrued so far.

In order to extend the two-period case to n periods, a slightly different technique is employed that does not alter the underlying assumptions and parameters, however: The dividend is assumed to be a constant fraction d of the total capital stock¹⁶, and the manager is assumed to alter the probability with which a dividend is being paid out. Investors obtain the fraction d of the current capital with probability q , and nothing with probability $(1 - q)$. By adjusting the probability q , the manager can determine *expected* dividends and can dissuade investors from liquidating the company. This allows us to solve the model by backward induction, leaving the agency problem and the mechanism of the liquidation threat unaffected.¹⁷

In Figure 4, we depict the inefficient investment path using parameter values which correspond to values found realistic in the literature. The cost of collective action c is set to 30. The dividend rate in the high state is set to 5% and in case of the low state, no dividend is paid out. This assumption seems realistic in light of the fact that the fraction of dividend paying firms is decreasing the past few years (see Fama and French, 2001). In addition, we choose $t = 50$ years and $r = 0.05$. The results obtained by simulating the model, depicted in Figure 4, show that the project is not liquidated, although it is inefficient to carry it through. A decrease in the tax rate, however, will depress the capital stock, thus limiting the amount of capital that has been invested in the project and ensuring that investors obtain at least some part of the cash flow. The effect of the dividend tax on overall investment efficiency has therefore remained to be negative; the higher the dividend tax rate, the lower will overall investment efficiency be. This is in line with the two-period model, as a lower dividend tax rate enables investors to force managers to disgorge a larger share of the free cash flow by increasing the liquidation value of the firm. The altered liquidation threat is once again the pivotal element that drives our findings and confirms our previous results in the n -period setting.

¹⁶This assumption of a constant dividend yield with respect to the capital stock reflects the common corporate policy that firms wish to smooth their dividends over time.

¹⁷All relevant technical devices of this recursive solution can be found in the Appendix.

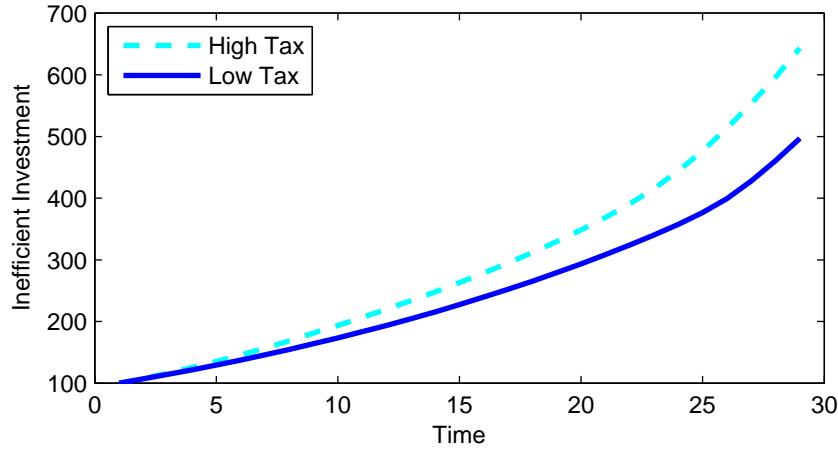


Figure 4. Inefficient Investment Path for Low and High Tax Regimes

This figure plots the inefficient investment path. We have chosen the model parameters as follows: The rate of return for the high state is 1.1, for the low state 0.90. The risk-free rate is 0.05, the tax rate in the high state is 0.45 and in the low state it is 0.10, cost of collective action are 50, the probability of a up state is 0.6. The dividend rate for the high state is 0.06 and for the low state 0. Initial capital is 100.

Allowing there to be uncertainty, i.e. allowing p , the probability with which the high rate of return accrues in the next period, to be not the result of the no-arbitrage condition, but rather a random variable that is updated after each realization, will now be a final validation of our theoretical results and the last illustration that dividend taxation does have a negative effect on investment efficiency even if the setting is more realistic. As the effect of learning on option prices is rather new in the corporate finance literature, we will provide a brief background and explicitly explain how beliefs are updated.

B. Learning

This subsection develops a framework for valuing the path of inefficient investment if the expected rate of return is not known to the investors. While we have assumed in the previous section that capital evolves according to a binomial tree with known probabilities, we now assume that the true probabilities are unknown to investors. The crucial role of information in the principal-agent problem between managers and investors has been widely acknowledged. Lambert (2001) shows that better financial reporting and/or corporate governance increase the firm value by reducing the amount that managers expropriate. Lambert, Leuz, and Verrecchia (2006) study the effect of information quality on the cost of capital and find that an increase in information quality leads to a decline in cost of capital and hence to a higher expected firm value.

Learning in binomial trees is treated in Guidolin and Timmermann (2006); they study the implications for prices when dividends evolve according to a binomial lattice.¹⁸ In our setting, dividends evolve in a similar way, but while Guidolin and Timmermann (2006) compare different kinds of learning, we focus on the effects of learning on capital and inefficient reinvestment. Similar to their conclusions, we find that the properties of capital with learning differ from the full information setting in the section before, and this has repercussions on our liquidation threat. In accordance to the results of Lambert, Leuz, and Verrecchia (2006), we find that when investors' uncertainty is high, managers can appropriate a lower amount of the payoff for their purposes as the premium demanded is higher. As uncertainty dissolves, the premium shrinks and the amount reinvested rises, slowly approaching the full information level.

We suppose that the investors do not know the true value of p and instead use the past history of outcomes of K to estimate p . In our setting, we assume that investors are Bayesian learners and have a prior distribution $f(p)$. This prior distribution is recursively updated via Bayes' law. By following conventional rules, we assume that agents have a *Beta* distribution with parameters n_0 and N_0 , i.e.

$$p \sim \text{Beta}(n_0, N_0 - n_0),$$

where n_0 and N_0 represent the mean and the variance, respectively and $n_0, N_0 - n_0 > 0$. The interpretation of this prior is that the agent has pre-sample information with n_0 of N_0 realizations being up.¹⁹ This prior is a conjugate one, hence it is ensured that the posterior probability is also a Beta distribution. The binomial setting together with the Beta distribution yields the following posterior probability:

$$p|(1 + m^H r)^j (1 + m^L r)^{t-j} K(0) \sim \text{Beta}(n_0 + j, N_0 - n_0 + t - j), \text{ where } j = 0, 1, \dots, t,$$

¹⁸In a similar setting, Runggaldier and Zaccaria (2000) treat in a special case investors' uncertainty when the stock price follows a binomial lattice and agents update their beliefs recursively.

¹⁹The assumption that $n_0, N_0 - n_0 > 0$ implies that at least one period of high growth and low growth must have been observed. If $n_0 = N_0 - n_0 = 1$, then the Beta distribution becomes uniform.

and j denotes the number of up movements. If we compare this expression with the prior distribution, then we see that n_0 is updated to $n_0 + j$ by adding the number of high growth realizations between time 0 and t , while $N_0 - n_0$ is updated to $N_0 - n_0 + (t - j)$, where $(t - j)$ is the number of low growth realizations. Note that the posterior variance increases with the number of low growth states due to learning. From Kotz, Balakrishnan, and Johnson (2000) the posterior probability can be derived in closed form:

$$p|(1 + m^H r)^j (1 + m^L r)^{t-j} K(0) = \frac{j + n_0(N_0 + n_0)}{t + n_0}. \quad (11)$$

From equation 11, we immediately derive that the posterior capital is:

$$K(t) = \sum_{t=0}^n (1 + m^H r)^j (1 + m^L r)^{t-j} \frac{j + n_0(N_0 + n_0)}{t + n_0}. \quad (12)$$

Loosely speaking, the capital path in case of uncertainty is equal to the average investment for all possible outcomes of the posterior probability p . In Figure 5, we plot the investment paths in case of learning and in case of no uncertainty. One of the key results is that uncertainty decreases inefficient investments of managers. Uncertainty induces agents to demand a higher dividend from the manager, since uncertainty is high. When the expected rate of return is low relative to the risk-free rate, the manager has to pay a higher dividend and perhaps even shut down the firm. As uncertainty dissolves, the required premium declines and the capital stock approaches the full information level. The liquidation threat thus forces managers to pay out a dividend that is even higher in case we allow for uninformed investors because of the additional premium required. Inefficient investments are hence further reduced. Most importantly, however, the tax effect still points towards the same direction, and a tax cut still increases overall investment efficiency.

We therefore concentrate on the effect of changes in the dividend tax rate on overall investment efficiency in order to find support for our theoretical finding. A confirmation of our theoretical results can be interpreted as evidence that - at least for mature firms - inefficient reinvestment declines with a tax cut, which is an implication unforeseen by both the “old” and the “new” view of dividend taxation that both do not account for the possibility of inefficient investment. In addition, an increase in investment efficiency due to a tax cut is evidence in favor of the JGTRRA of 2003 that has so far not been taken into consideration by its proponents or adversaries.

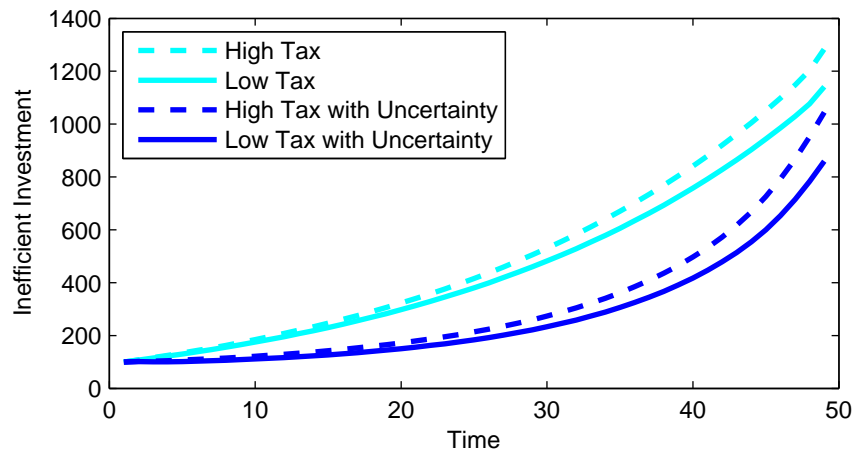


Figure 5. Inefficient Investment Path for Low and High Tax Regimes with and without Learning

This figure plots the inefficient investment path in case of no uncertainty and in case of investors' learning. We have chosen the model parameters as follows: The rate of return for the high state is 1.1, for the low state 0.90. The risk-free rate is 0.05, the tax rate in the high state is 0.35 and in the low state it is 0.15, cost of collective action are 50, the prior mean of the probability of a positive return is 6/10 (corresponding to the true probability) and prior variance is 8/10. The dividend rate for the high state is 0.06 and for the low state 0. Initial capital is 100.

IV. Empirical Evidence

A. Testable Hypotheses

In the discussion about the old and the new view of dividend taxation, various attempts have been made to support either view by empirical evidence. The results of these empirical studies seem to differ as sharply as the predictions in the theoretical models, which is most likely due both to limitations in the data and simplifications in the theoretical models. In our theoretical model, we illustrate one possible mechanism through which dividend taxation and investment behavior might be interrelated. It offers a testable alternative to the former approaches by focusing on investment efficiency. The general question that arises with our theoretical results is whether a cut in the dividend tax rate does indeed increase investment efficiency by acting on the principal-agent relationship between investors and managers. More precisely, our model delivers the following set of testable hypotheses:

Hypothesis 1. *Investment efficiency is in a positive relation to dividend-tax reductions.*

Hypothesis 2. *Investment efficiency is in a positive relation to dividend growth.*

Hypothesis 3. *Investment efficiency is in a positive relation to uncertainty about the firm's expected growth rate.*

B. Data Set and Sample

To test the three mentioned hypotheses, we use balance sheet and dividend information from the COMPUSTAT database (COMPUSTAT data items are in parentheses) and analysts' forecasts on earnings from the Institutional Brokers Estimate System (I/B/E/S) database. Further, following related studies (see Chetty and Saez, 2005), we exclude firms in the construction sector (NAICS between 22 and 23) and in the financial sector (NAICS with 52), as these two sectors are subject to special regulation and legislation. The final sample consists of 4,272 U.S. firms with data from 1980 to 2005. We choose 1980 as starting date to make our data comparable to other studies. When matching all databases together there is an unavoidable loss of data, since many firms in COMPUSTAT are not covered by I/B/E/S. Further, as noted by Hong, Lim, and Stein (2000), the intersection of the COMPUSTAT and I/B/E/S database is heavily biased towards big firms. However, according to DeAngelo, DeAngelo, and Skinner (2004), it is exactly large firms that pay out the largest portion of aggregate dividends. Thus, the sample covers precisely those firms which we are interested in and which can be associated with a dividend-growth series.

C. Investment Efficiency

In line with Lang and Litzenberger (1989) and Yoon and Starks (1995), we proxy investment efficiency by Tobin's q . Unlike, those authors, however, we use Tobin's q as a dependent variable. We follow Malmendier and Tate (2005) and calculate Tobin's q as the ratio of market value of assets to book value of assets. Market value of assets is defined as total assets (6) plus market equity minus book equity. We define market equity as common shares outstanding (25) times the year-end closing price (199). Book equity is defined as stockholders' equity (216) minus par value (130). Book value of assets is total assets. It is generally accepted that book value is subject to distortions due for example to accounting fraud. Especially during the new economy boom in 2000, the book values of some companies do not seem to provide very reliable figures. Therefore, in line with the literature, we exclude the 5% and the 95% quantiles of Tobin's q . Contrary to the literature, however, we do not use a value of q equal to unity as a cutoff value to distinguish over-investing firms from value-maximizing ones, because the existence of some free cash flow does not necessarily imply that the overall investment efficiency is below the market. In case free cash flow is kept within the firm and reinvested, it is only the profitability of the marginal project that is affected. If we assume that those projects generating the free cash flow are highly profitable, the overall investment efficiency of the firm will not drop below one just because free cash flow exists.²⁰ Therefore, limiting our investigation to firms with a value of Tobin's q below one would seriously impair our results and deprive us of those firms we are most interested in, i.e. those firms most likely to dispose of free cash flow.

D. Determinants of Tobin's q

In order to test the three hypothesis derived by our model, we need to operationalize the three variables that are assumed to influence Tobin's q : dividend-tax reductions (hypothesis I), dividend growth (hypothesis II), and uncertainty about the firm's expected growth (hypothesis III). Further, to test the robustness of the results, we consider also additional determinants of investment efficiency as proposed by the related literature.

D.1. Dividend-Tax Reductions

Following the setup of our model, in this study, we are interested in measuring dividend-tax reductions relatively to taxes on capital gains, or, in other words, the tax discrimination against dividends. For this purpose we employ the

²⁰Various empirical indicators in the literature support this idea: as the agency approach to dividends postulates, free cash flow and dividends are closely related. Those firms that pay out dividends, and hence those that seem to dispose of free cash flow, do not suffer from strategic investment inefficiency, but are rather concentrated among the most profitable and highest earning firms of the market (See DeAngelo, DeAngelo, and Skinner, 2004 and Dietz and Gordon, 2006). Had those firms not paid out dividends, their earnings would soon have outstripped their investment opportunities, as DeAngelo, DeAngelo, and Stulz (2004) calculated, increasing enormous costs of free cash flow.

tax-preference parameter developed by Poterba (2004). The dividend tax preference parameter is computed as the ratio of the dividend income (after the deduction of a weighted average marginal tax rate) and income from capital gains (after marginal capital gains tax), and further weighted with the share of corporate stock held by households at the respective period in time. Poterba (2004) thus obtains a measure for the investors' tax preference for dividend income over capital gain income, which captures the tax wedge between dividend and capital gains income, and also accounts for the degree to which this tax wedge should have influenced the dividend policy of a firm. A value below one indicates consequently discrimination against dividends. A rise in this ratio reflects an increase in investor preference for dividends from a tax perspective.

D.2. Dividend Growth

Out of the three explanatory variables of Tobin's q obtained by our model, dividend growth, d , is arguably, the easiest to calculate. For each firm in our sample, we compute a dividend-growth time series by logarithmic differences of consecutive dividend payments (12): $d_t = \ln D_t - \ln D_{t-1}$. Since the focus of our model is on mature firms that dispose of internal funds, we exclude firms that do not pay out dividends and for which no dividend growth can be calculated. Dividend payments only occur in mature firms that have accrued cash flow in excess of all efficient investment opportunities and that are reinvesting this cash flow inefficiently rather than redistributing it to outside investors. Maturity is reached once all efficient investment opportunities are exhausted, and only then will investors try to enforce the payment of a dividend.

This restriction is due to the fact that in our case, The features we strive to examine, i.e. the effect of uncertainty on dividend payments and on the amount reinvested inefficiently, are therefore conditioned on maturity and do not apply to young, efficiently investing firms without free cash flow and dividend payments.

D.3. Uncertainty about Firm's Expected Growth Rate

In order to capture the effect of uncertainty on investment efficiency in the presence of dividend taxation, a measure of uncertainty needs be introduced. Unfortunately, uncertainty about future profitability of the firm (in our model the probability of an up movement p) is unobservable and therefore difficult to measure. We argue that analysts' forecast dispersion on earnings, measured as the standard deviation of the expected earning-to-price ratios, best captures this uncertainty. In fact, a number of studies have used analysts' forecast dispersion for proxying uncertainty: Barron, Kim, Lim, and Stevens, 1998, Doukas, Kim, and Pantzalis, 2006, and Zhang, 2006. While, other proxies have been proposed in the literature, e.g. firm age, analyst coverage, dispersion in analysts' forecasts, return volatility, and cash-flow volatility, they seem less suitable in our setting. For example firm age, as proposed by Pástor and Veronesi (2003), does not seem suitable because we already restrict our analysis to mature, dividend-paying firms. The features

we strive to examine, i.e. the effect of uncertainty on dividend payments and on the amount reinvested inefficiently, are therefore conditioned on maturity and do not apply to young, efficiently investing firms without free cash flow and dividend payments. Regarding analyst coverage, there is empirical evidence that larger coverage is likely to correspond to more information available about the firm (see Hong, Lim, and Stein, 2000). However, these authors interpret larger analyst coverage as less asymmetric information in the market, which is not our interpretation.

D.4. Firm-Specific Variables

Following Lang and Stulz (1994), Bharadwaj, Bharadwaj, and Konsynski (1999), and Rajan, Servaes, and Zingales (2000), we employ, as further determinants for measuring q , five firm-specific control variables (market share, advertising expenditure, R&D expenditure, firm size, and leverage) and two industry-specific variables (industry capital intensity and industry average q). COMPUSTAT data items are again in parentheses.

- **Market Share** serves as a proxy for other firm-specific assets, such as reputation or managerial skills. We define market share as earnings before income and tax (18) of the specific firm over the sum of all accrued earnings before income and tax in the specific industry. Industry is defined as all firms with the same first two NAICS codes. We expect a positive relationship.
- **Advertising Expenditure (Sales (12) weighted)**. (45) In including advertising expenditures, we follow other empirical studies (see Montgomery and Wernerfelt (1988) and Morck and Yeung (1991)) that have included advertising expenditures in models with Tobin's q . They find the relationship to be positive.
- **R&D Expenditure (Sales (12) weighted)**. (46) Along the lines of Montgomery and Wernerfelt (1988) and Morck, Shleifer, and Vishny (1989), we expect a positive relationship. Lang and Stulz (1994) find a non-significant parameter. It is important to include a measure of R&D in case R&D expenditures are not capitalized, since this would lower replacement costs and thus increase Tobin's q in a way unrelated to investment efficiency.
- **Firm size**. The literature is divided on the relationship between firm size and Tobin's q . Lang and Stulz (1994) find a strong negative relation, whereas Rajan, Servaes, and Zingales (2000) find no significant relation between those two variables. We define firm size as the natural logarithm of the number of employees (29). In order to avoid endogeneity issues, we refrain from using total assets as a measure of size (total assets appear on the left side of the regression in the calculation of Tobin's q).
- **Leverage**. We define leverage as long-term debt (9) over total asset value. The current literature reports that higher leverage induces lower q and that higher leverage is usually associated with smaller firms (Maloney, McCormick, and Mitchell (1993) and Moeller, Schlingemann, and Stulz (2004)).

Table I
Summary Statistics for Sample Data

This Table reports descriptive statistics for the data used in the regression analysis. The data sample consists of all firm-year observations on COMPUSTAT over the period 1980-2005 that are available. Analysts' forecasts on earnings are from the I/B/E/S database. Tobin's q (measured as market value of assets over book value of assets), Market Share (Data item 18), Firm Size (Data item 29), Advertising (45) (Sales (12) weighted), R& D Expenses (46) (Sales (12) weighted), Capital Intensity (Data item 6 over 12), and Dividends (21). Uncertainty is proxied by the dispersion in analysts forecast dispersion.

	Mean	Max	Min	Median	Percentile-25	Percentile-75	StDev
Tobin's q	1.888	23.939	0.564	1.505	1.165	2.160	1.254
Firm Size	2.433	7.496	-4.075	2.494	1.281	3.610	1.678
Market Share	7.203	598.204	-837.093	1.122	0.230	4.927	38.377
Capital Intensity	0.915	8.900	0.146	0.819	0.624	1.074	0.489
Advertising	0.036	0.376	0.000	0.020	0.011	0.043	0.044
R&D	0.034	2.118	0.000	0.019	0.005	0.049	0.052
Leverage	0.161	1.214	0.000	0.147	0.060	0.233	0.130
Dividend Growth	0.091	5.999	-7.757	0.072	0.004	0.172	0.453

D.5. Industry-Level Variables

Industry-level variables represent characteristics of the industry impact on the performance of firms in the industry.

- **Industry Capital Intensity.** To comprehend the effects of entry barriers on firm performance, we include industry capital intensity in our models. Capital intense firms face fewer competitors, which should act positively on Tobin's q . We define capital intensity as the ratio of total assets (6) to total sales (12).
- **Industry Average q .** Effects on brand equity. We measure the industry average as the mean of q of all firms in the same industry, where industry is again defined as firms with the same first two NAICS. Since the relationship between the industry average q and the firm specific q is extremely weak due to the large number of firms in each industry, in line with Bharadwaj, Bharadwaj, and Konsynski (1999), we do not expect there to be an endogeneity problem.

Our industry-specific variables are included in order to account for the fact that investment opportunities differ across sectors. Including the industry average q , for example, helps us to capture macroeconomic effects that influence investment efficiency in certain sectors and other unique industry characteristics not adequately captured by other control variables. This is especially important because we have pooled data from multiple industries in our sample. Table I provides summary statistics on the data used. The final sample comprised of 4,272 firms over the 25 years. The average Tobin's q is approximately 1.99 which corresponds in terms of magnitude to the values found in the literature. The firms in the sample have an average spending in R&D and advertising of around 3 percent. The average dividend growth is around 9 percent.

In Table II we present the results for yearly cross-sectional panel regressions. The regression coefficients are consistently estimated with OLS, but the standard errors we use to compute t -statistics are corrected for autocorrelation and heteroskedasticity. To circumvent problems due to unit roots in the data, we run Phillips-Perron-Tests for each time-series and reject the null hypothesis of a unit root in the data. We also check for multicollinearity with the variance inflation factor and find that collinearity should not be an issue in our regressions.

E. Results

The coefficients for tax preference, dividend growth, and uncertainty are economically and statistically significant and have the predicted signs. Tax preference, dividend growth, and uncertainty are in a positive relation to Tobin's q , moreover, these variables explain 9% of the total variation. We also note that the coefficients remain fairly stable across all regression, whereas other coefficients can be quite variable. We note that the firm size coefficient is statistically significant and negative. This speaks against the free-cash flow hypothesis which says that firm size should be negatively related to Tobin's q . Firm size is said to proxy, among other things, information asymmetry between the manager and the investors. With this in mind, the intuition is that the larger the asymmetry is within the firm, the less efficient investments will be, which is in line with our theoretical model. Advertising and R&D are positive and statistically significant. However, the reason why we do not take it into consideration for all our regressions is due to the limited amount of data available arising from merging of the data. Both advertising and R&D had a number of missing values, since few firms report these numbers in their annual reports.²¹ Industry average Tobin's q is positive, except for two cases, which indicates that firms benefit from being in industries with higher q ratios on average. In summary, our results in terms of control variables are consistent with the findings of previous empirical studies (see Montgomery and Wernerfelt, 1988 and Lang and Stulz, 1994). Overall, the explanatory power of our regressions is quite high. We also note that the difference between the adjusted R^2 with and without dividend growth can be as large as 10%. When we run the regression for significant values only, we find that the adjusted R^2 is 20%. Direct comparisons of our results to the literature are not available, since most papers use a year-by-year regression, moreover, no paper so far has studied the effect of dividends and uncertainty on Tobin's q on a firm-by-firm basis.

²¹The average number of observations is 22,678 and the number of observations for advertising, dividend growth rate, and uncertainty is only 7,054.

Table II
OLS Panel Regression for Tobin's q

For each year between 1980 and 2005, Tobin's q is regressed cross-sectionally on dividend growth, uncertainty, proxied by the dispersion in analysts' forecasts, leverage, firm size, market capitalization, market share, industry average Tobin's q , advertising, research and development, and tax preference which is estimated in Poterba (2004). The t -statistics are autocorrelation and heteroskedasticity corrected. \bar{R}^2 and \bar{R}_{exDiv}^2 denote the adjusted R^2 with an without dividend growth, respectively. The number of observations taken into account for the cross-sectional analysis is denoted by N . ***, **, and * denote significance on the 1%, 5%, and 10% level, respectively.

Constant	Firm Size	Market Share	Ind. Avg. Tobin's q	Capital Intensity	Advertising	R&D	Leverage	Dividend Growth	Uncertainty	Tax Preference	\bar{R}^2	\bar{R}_{exDiv}^2	N
1.692*** (44.401)								0.184*** (2.701)			0.01		35'692
1.931*** (43.831)									0.005*** (3.701)		0.02		52'142
1.502*** (26.692)								0.224*** (2.578)	0.009*** (6.725)		0.07		20'068
1.630*** (3.601)								0.188*** (2.789)	0.007*** (4.341)	2.554*** (11.678)	0.09	0.06	20'068
1.616*** (26.211)	-0.074*** (-3.909)							0.241*** (3.078)	0.010*** (8.036)		0.12	0.09	19'505
1.628*** (26.113)	-0.089*** (-4.310)	0.004** (2.051)						0.238*** (3.029)	0.010*** (7.954)		0.13	0.09	19'376
1.627*** (26.069)	-0.089*** (-4.308)	0.004** (2.048)	-0.035 (0.167)					0.237*** (3.007)	0.010*** (7.951)		0.13	0.09	19'376
1.419*** (14.576)					3.274** (2.189)			0.378** (2.358)	0.011*** (4.916)		0.14	0.04	7'054
1.772*** (20.774)	-0.098*** (-4.649)	0.004** (2.216)	-0.012 (0.219)	-0.106** (-2.392)				0.231*** (2.914)	0.009*** (7.633)		0.13	0.10	19'376
1.644*** (12.934)	-0.093*** (-3.498)	0.002 (1.372)	0.149 (0.450)	-0.168* (-1.655)		6.679*** (5.369)		0.269** (2.506)	0.010*** (6.085)		0.20	0.13	10'906
1.849*** (13.823)	-0.073*** (-2.903)	0.002 (1.151)	0.138 (0.445)	-0.066 (-0.587)		5.211*** (4.011)	-1.625*** (-4.185)	0.249** (2.417)	0.009*** (5.653)		0.23	0.15	10'877
1.943*** (25.364)	-0.069*** (-3.653)						-1.609*** (-6.586)	0.220*** (2.939)	0.009*** (7.176)		0.17		19'471
-0.613*** (-3.482)	-0.065*** (-3.172)	0.002 (0.823)	0.525 (0.973)	-0.040 (-0.938)		5.399*** (4.711)	-1.667*** (-11.125)	0.219** (6.271)	0.008*** (7.099)	2.871*** (13.013)	0.22	0.20	10'877
-0.651*** (-3.758)	-0.057*** (-3.456)					5.383*** (4.754)	-1.716*** (-12.143)	0.225*** (6.440)	0.008*** (7.324)	2.877*** (13.154)	0.20	0.17	19'471

F. Firm Size Sub-Samples

One potential concern with our findings so far is that the results may be attributable to an unusual set of firms that are not of first order economic significance. As argued by DeAngelo, DeAngelo, and Skinner (2004), dividends are concentrated among large and profitable firms. Hence, if our results were found to hold only among the small firms that typically pay little dividends, but not among large firms that are the dominant dividend payers, then it would be difficult to argue that dividend payouts, tax issues, and uncertainty are important control variables. Moreover, Pástor and Veronesi (2003) argue that uncertainty should play a more dominant role for small and less established firms. We therefore believe it should be important to examine the relation between our main variables across sub-samples sorted by firm size. To this end, we stratify our sample into three groups. The low (high) firm size bin corresponds to the lower (higher) 33% quantile. We then run the full regression and the regression with significant values only within each firm size bin as in Table II. In Table III we report the results on our regressions. We note that across the different firm size bins, the coefficients are fairly consistent. More importantly, dividend growth, uncertainty, and tax preference are significant and have the correct sign. However, we note that the regression for the large firms outperforms the other two regressions almost by double in terms of adjusted R^2 . This effect may be driven by the fact that there are fewer firms among the low and average firm size group. In summary, our firm size sub-sample analysis thus suggests that our previous results are not mainly driven by large firms.

Table III
Sub-Sample OLS Panel Regressions

For each year between 1980 and 2005, Tobin's q is regressed cross-sectionally on dividend growth, uncertainty, proxied by analysts' forecast dispersion, leverage, firm size, market capitalization, market share, industry average Tobin's q , advertising, research and development, and tax preference for different levels of firm size. The t -statistics are autocorrelation and heteroskedasticity adjusted. \bar{R}^2 denotes the adjusted R^2 . ***, **, and * denote significance on the 1%, 5%, and 10% level, respectively.

	Firm Size					
	Small		Medium		Large	
Constant	-4.861 (-0.608)	-2.755 (-0.566)	-0.979 (-1.355)	-1.101 (-1.474)	-0.616*** (-3.753)	-0.591*** (-2.892)
Firm Size	-0.642 (-2.306)	-0.233 (-0.937)	-0.357*** (-5.006)	-0.349*** (-4.595)	-0.040*** (-4.705)	-0.038*** (-4.801)
Market Share	-0.007 (-1.282)		-0.001 (-0.130)		0.002*** (6.397)	
Industry Avg. q	0.416 (0.629)		0.912*** (4.239)		0.393*** (3.438)	
Capital Intensity	-0.027 (-1.086)		-0.017 (-0.235)		-0.116*** (-4.756)	
R&D	3.426 (0.651)	3.383 (0.753)	0.646 (1.064)	0.684 (1.273)	8.157*** (12.207)	7.825*** (28.525)
Leverage	4.119*** (3.99)	-3.936*** (-2.926)	-2.064*** (-5.238)	-2.119*** (-7.817)	-1.337*** (-9.656)	-1.457*** (-17.323)
Dividend Growth	0.342** (1.989)	0.308** (1.969)	0.211** (1.961)	0.208*** (3.186)	0.211*** (6.608)	0.220** (9.125)
Uncertainty	0.003* (1.745)	0.003* (1.659)	0.006*** (6.107)	0.006*** (6.010)	0.008*** (16.179)	0.008*** (30.084)
Tax Preference	7.128* (1.780)	5.601 (1.003)	3.619*** (4.178)	3.766*** (4.245)	2.703*** (13.559)	2.587*** (10.626)
\bar{R}^2	0.12	0.10	0.12	0.12	0.24	0.24
N	177	182	1'491	1'500	9'209	9'307

V. Conclusion

The models proposed in this paper investigate the interaction of dividend taxation, investment efficiency, and agency problems in a simple corporate governance framework. As a key result, we show that a fall in the dividend tax rate reduces inefficient investment. This result stands in contrast to both the old and the new view of dividend taxation. Managers with empire building preferences use dividends to dissuade investors from liquidating inefficient projects. A fall in the dividend tax rate improves corporate governance and mitigates agency problems, by the strength of the liquidation threat of investors.

We first introduce a very straightforward two-period model of over-investment and dividend taxation, in which investors are able to enforce a dividend payment by threatening managers with liquidation. This liquidation threat becomes binding as soon as investment efficiency is too low, i.e. as soon as the expected rate of return falls below a certain threshold which the existence of costs of collective action forces below the market rate of return. In this setting, a fall in the dividend tax rate leads to a rise in dividend payments, a fall in the amount reinvested (inefficiently) in the next period, and a rise in the threshold level of the expected rate of return below which the liquidation threat is binding. This rise in the threshold level implies that some firms may even be forced to initiate dividend payments for the first time and that overall investment efficiency is increased.

The economic implications of the presented model are found to be robust toward several settings. In order to capture the fact that equity owners can decide whether or not to liquidate a firm or a project at multiple dates and not just once over the firm's life cycle, we extend our model to n periods. Although the liquidation threat is affected by the change in the time structure, the effect of the dividend tax on the liquidation threat and therefore on investment efficiency remains unchanged. Allowing for learning investors with uncertainty about the firms' expected return does not alter the positive relationship between dividend taxes and investment inefficiency, which further reinforces our findings. In fact, uncertainty is found to have a positive impact on investment efficiency via an additional premium which investors require in order to refrain from liquidating the firm.

In the empirical analysis, we test the hypotheses obtained from our theoretical model. In particular, we test the hypothesis by considering Tobin's q as a proxy for investment efficiency and relating it to tax preferences toward dividends, dividend growth, and uncertainty. We find that, even when controlling for other variables, all coefficients reflect the predictions of our model and are statistically significant.

Overall, our results suggest that for those firms for which agency problems play an important role in the determination of the dividend policy, a fall in the dividend tax rate is beneficial to investment efficiency. In fact, the dividend tax cut seems to lower the discretionary cash flow; the overall investment efficiency rises. This finding is important both for the general treatment of dividends as taxable income and for the discussion of perpetuating the (so far)

temporary dividend tax cut in the U.S. economy that forms part of the JGTRRA (2003). This paper sheds new light on the ongoing discussion of the “old” and the “new” view of dividend taxation and on the interaction between agency problems, dividend taxation, and investment behavior. In light of the recent evidence pointing towards the crucial role of agency conflicts in the determination of dividend policies, the explicit modeling of agency issues when studying the impact of dividend taxation on efficient investments appears to be a due contribution to the existing literature.

A. Solving the n -period Model

The procedure for solving the n -period model relies on backward induction and consists of two steps: (i) setup of a tree and (ii) backward induction.

A. Tree Setup

The evolution of the firm capital (invested capital) is modeled as a bivariate binomial tree. The recombining property of the tree is ensured by the fact that dividends are defined as percentages of the current firm capital.²² At each node, the tree branches into four subsequent nodes, depending on the rate of return on investments $(1 + m^i r)$ and on whether or not dividends are actually paid out. Table IV shows the four possible subsequent states of the world together with the resulting capital and the associated probability. Each node in the tree is unambiguously identified

Table IV
Branching of the Bivariate Binomial Tree

State i	Dividends	ROI	K_{t+1}	Probability of State i
1	no	high	$(1 + r \cdot m^H) \cdot K_t$	$p \cdot (1 - q)$
2	yes	high	$(1 + r \cdot m^H)(1 - \bar{d}) \cdot K_t$	$p \cdot q$
3	no	low	$(1 + r \cdot m^L) \cdot K_t$	$(1 - p) \cdot (1 - q)$
4	yes	low	$(1 + r \cdot m^L) \cdot (1 - \bar{d}) \cdot K_t$	$(1 - p) \cdot q$

by the triple (i, j, t) , where i is the number of past high returns, j is the number of times dividends were paid out, and t is a time index indicating the number of time steps since the initial investment. Figure 6-A displays the branching of an arbitrary node $K(i, j, t)$. The tree branches until maturity, $t = n$, is reached.

B. Backward Induction

The backward induction step consists of setting up an equally dimensioned tree for the continuation value, V . This tree is build by starting from the terminal nodes of the tree and working backwards. Again, each node of the tree is unambiguously identified by the triple (i, j, t) . The capital obtained by investors in the terminal nodes of the tree, is determined as $V(i, j, n) = K(i, j, n) \times (1 - \tau)$. No liquidation costs arise because at the end date, liquidation is the

²²Recombining trees are computationally appealing because the number of total nodes is still manageable even for a high number of time steps.

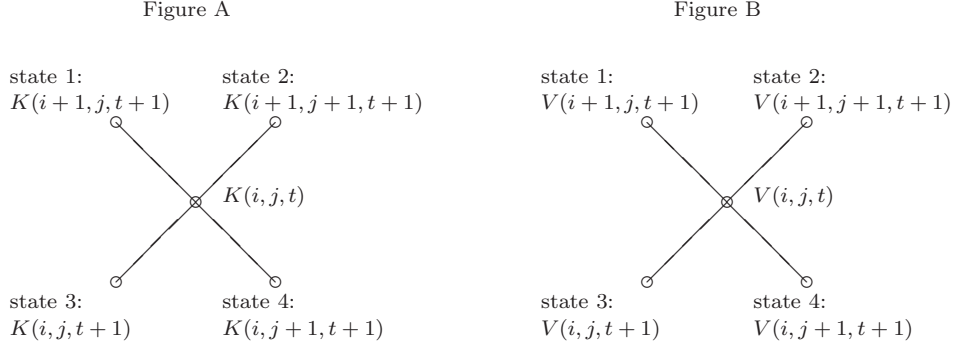


Figure 6. Branching of the Bivariate Binomial Tree

This figure shows the branching of the bivariate binomial tree for the invested capital (Figure A) and for the continuation value (Figure B). Each node in the tree is unambiguously identified by the triple (i, j, t) , where i is the number of past high returns, j is the number of times dividends were paid, and t is a time index indicating the number of time steps since the initial investment.

outcome of a prearranged agreement rather than the consequence of collective action. As depicted in Figure 6-B, in all prior nodes the continuation value is determined by backward induction as

$$\begin{aligned}
 V(i, j, t) = & \frac{1}{1+r} [p \cdot (1-q) \cdot V(i+1, j, t+1) + \\
 & p \cdot q \cdot V(i+1, j+1, t+1) + \\
 & (1-p) \cdot (1-q) \cdot V(i, j, t+1) + \\
 & (1-p) \cdot q \cdot V(i, j+1, t+1)].
 \end{aligned}$$

More precisely, the probability q is set in such a way that the continuation value equals the liquidation value, $K(i, j, t) \cdot (1 - \tau) - c$. In each node, three outcomes are attainable and optimality conditions need to be checked:

1. If $q \in [0, 1]$ the manager offers a dividend compensation that persuades the investor to refrain from liquidation;
2. If $q < 0$ the liquidation value is in any case lower than the continuation value and no dividend will be paid out by managers. The probability q is set equal to zero;
3. If $q > 1$ the liquidation value is always higher than the continuation value and managers cannot avoid liquidation.

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