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**Valuation with Personal Taxes
under Different Financing and Dividend Policies**

Dissertation

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1 Introduction

1.1 Motivation and objectives

The valuation of firms is one of the topics that valuation theorists and practitioners have addressed since the early stages of economic sciences. Firm valuations are conducted regularly using discounted cash flow (DCF) models, in which expected cash flows are discounted at capital-market-based cost of capital. In this regard, one of corporate finance's fundamental insights is that, under debt financing, the consideration of corporate taxes enhances the equity market value (Modigliani & Miller, 1958, 1963). Besides corporate taxes, there is a prevailing consensus that personal taxes also matter when determining the equity market value, because cash dividends are taxed differently than capital gains (e.g., Miller, 1977; Dempsey, 1996). Hence, overall, the consideration of taxes in valuation models is a much-discussed topic and builds the core of this thesis.

Since the seminal studies by Modigliani and Miller (1958, 1963), it has become evident that debt financing provides tax shields due to the corporate tax deductibility of interests. The relevant cost of capital to discount these tax shields for determining their market value is closely related to the riskiness of the firm's debt. Thus, a firm's financing policy needs to be considered further as it specifies how the firm determines its debt levels. In this respect, most valuation literature refers implicitly or explicitly to the following two pure financing policies: passive debt management and active debt management. Passive debt management is characterized by predetermined debt levels, whereas active debt management sets deterministic capital structure targets for future periods (Miles & Ezzell, 1980, 1985; Harris & Pringle, 1985). Thus, under passive debt management, debt levels are set independently of future developments, while, under active debt management, debt levels are adjusted in each period to the current firm values to adhere to the predetermined capital structure targets. As a result, the tax shields' appropriate cost of capital is, generally, lower under passive debt management than under the active one. Consequently, the equity market value is generally higher under passive debt management. Therefore, the choice of financing policy has an influence on the level of equity market value.

Besides the two above-mentioned pure financing policies, there also exist other financing policies to be considered, such as those that represent a combination of passive and active debt management (e.g., Dierkes & Schäfer, 2016; Ruback, 2002), are based on book values (e.g., Fernandez, 2008; Scholze, 2008), or are cash flow oriented (e.g., Kruschwitz & Löffler, 2006). Note that each of these financing policies generally has different implications for the appropriate discount rate of the tax shields. In this respect, this thesis only considers passive and active debt managements, as they represent the two most referenced financing policies in valuation literature and practice.

In both prior literature and corporate valuation practice, it is agreed that, besides corporate taxes, personal taxes also matter when determining the equity market value (e.g., Heintzen et al., 2008; Institut der Wirtschaftsprüfer [IDW], 2008). However, it is not feasible to account for each individual personal tax regime in valuation models, which is mainly due to information restrictions. Thus, most valuation literature including personal taxes refers implicitly or explicitly to a representative equity and debt investor (e.g., Dempsey, 2017). In principle, equity investors are obligated to pay taxes on received cash dividends and realized capital gains, whereas debt investors pay taxes on received interests. The consideration of a cash dividend and an interest tax rate in valuation models is rather straightforward. Particularly, it proves a problem of accounting for the capital gains tax rate, whereby it is commonly assumed that capital gains correspond to changes in market values in DCF models (e.g., Clubb & Doran, 1992). The problem of accounting for the capital gains tax rate arises because investments in shares are usually long term, and thus the corresponding capital gains taxes are, normally, not realized immediately. Accordingly, capital gains taxes can be deferred, thereby leading to a tax advantage when compared with the taxes payable on cash dividends (Bailey, 1969; Amoako-Adu, 1983; Wiese, 2007; Brealey et al., 2017). Consequently, the tax rate on effective capital gains to be used in DCF models is lower than that on cash dividends.¹

The differentiated consideration of the personal taxation of equity investors allows accounting for the firm's dividend policy. Dividend policy is defined as the decision about how much of the cash flow available for distribution is distributed to equity investors and how much is retained by the firm. The distributed cash flow is taxed at the cash dividend tax rate, while the retained cash flow is taxed at the effective capital gains tax rate. Thus, equity market value increases the more a firm engages in retaining cash flows, because the tax rate on cash dividends exceeds the effective capital gains tax rate. Hence, dividend policy, in addition to the financing policy, affects the level of equity market value (Miller & Modigliani, 1961; Rashid & Amoako-Adu, 1987, 1995; Dempsey, 2001; Scholze, 2008; Kuhner & Maltry, 2017). In this context, most valuation literature refers to a relatively simple dividend policy, which assumes the full distribution of cash flows to equity investors (residual dividend policy; e.g., Clubb & Doran, 1992; Dempsey, 2001; Diedrich & Dierkes, 2015). Moreover, further strategies when determining dividends might be considered, such as a yield-oriented or value-based dividend policy (Diedrich & Dierkes, 2017).

In this thesis, we abstract from the assumption of the residual dividend policy. This policy might not reflect the reality, as managers hold back cash flows for additional investments and exploit the personal tax advantage of retained cash flows over cash dividends. Accounting for this fact, it may be more appropriate to expect that only a certain percentage ratio of the available cash flow is distributed to equity investors, and the residual is retained by the firm (earnings-based

¹ In this regard, the effective capital gains tax rate is often set as equal to half of the cash dividend tax rate.

dividend policy).² In this case, assumptions are needed about the use of retained cash flows by the firm. Regarding this, two approaches are usually considered. Previous German literature often assumes that the retained cash flows are invested in investment projects whose value contributions equal the initial invested cash flows. Consequently, considerable research has been conducted on the return by which these investments remain value-neutral (e.g., Tschöpel et al., 2010). Conversely, international literature assumes that retained cash flows are used for share repurchases (Rashid & Amoako-Adu, 1987, 1995). It must be noted that the personal tax implications of cash flow investments in value-neutral projects and of share repurchases are the same, because they are both subject to the effective capital gains tax rate.

Theoretical research in the area of corporate valuation is often concerned with deriving appropriate adjustment formulas for the relationship between the firm's unlevered and levered costs of equity. This is mainly motivated by the fact that, in principle, closed-form mathematical solutions are derived that enable high comparability and interpretability. Consistent and theoretically sound derivations of adjustment formulas are especially important, as the cost of the equity level has a high impact on the ultimate firm value, which becomes particularly obvious when calculating the firm's terminal value. Additionally, adjustment formulas build the core for the unlevering and relevering of beta factors in corporate valuation practice. Besides the financing policy, dividend policy, and personal taxes, the adjustment formulas depend on other contributing factors, namely, the forecast horizon and assumed default risk of debt. In this respect, the forecast horizon is usually split into an explicit forecast period and a subsequent steady state. In an explicit forecast period, the expected cash flows are determined based on detailed calculations, whereas in a steady state, they increase at a constant growth rate. Regarding the default risk of debt, this thesis generally simplifies it by assuming that the debt is risk-free.

Overall, the present thesis further develops the valuation literature regarding the integration of personal taxes and dividend policy in valuation models. A problem of special interest is the simultaneous consideration of the financing and dividend policy of the firm under corporate and personal taxes. This problem is recognized by several other authors, such as Fama and French (1998), who state in one of their prestigious studies, "In short, good estimates of how tax treatment of dividend and debt affect the cost of capital and firm value are a high priority for research in corporate finance" (p. 819). Cooper and Nyborg (2004) concur with this by stressing that "A common source of confusion and disagreement in corporate finance is the effect of taxes on valuation and rates of return" (p. 2). In light of Fama and French's research call and the ongoing uncertainties about the effect of taxes on valuation, this thesis aims to provide a number of new insights by developing consistent and theoretically sound valuation

² Accordingly, the residual dividend policy can be seen as a special case of an earnings-based dividend policy.

models that account for the firm's financing and dividend policy. To achieve this, we conduct four studies. Figure 1 summarizes the objectives and structure of the thesis.

Research Question			
What implications do different financing and dividend policies have on valuation models with personal taxes?			
Formal-Analytical Studies			Simulation Study
1 Terminal value calculation with constant payout ratio and active debt management	2 Valuation with share repurchases and personal taxes	3 Valuation, personal taxes, and dividend policy under passive debt management	4 Unlevering and relevering with "wrong" adjustment formulas – How bad is that?
Disclosure of effects from a change from a residual to earnings-based dividend policy	Impact of share repurchases on the cost of equity under active debt management	Impact of retained cash flows on the cost of equity under passive debt management	Valuation error if the "wrong" adjustment formula is used
Working paper	Working paper	Working paper	Published in "Die Wirtschaftsprüfung"

Figure 1: Objectives of the thesis.

1.2 Content

This thesis proceeds as follows. It comprises four studies on firm valuation under different financing and dividend policies in consideration of personal taxes. The first study examines the terminal value calculation with a constant payout ratio under active debt management (Chapter 2). The second study investigates the valuation with share repurchases and personal taxes (Chapter 3). The third study refers to the development of valuation models, accounting for the dividend policy and passive debt management (Chapter 4). The fourth study examines the valuation error when applying the “wrong” adjustment formula (Chapter 5). Chapter 6 concludes.

Study 1: Terminal value calculation with constant payout ratio and active debt management (Chapter 2)

The terminal value of a firm accounts for a high proportion of the ultimate firm value and thus should be calculated carefully. Hence, the first study begins by presenting the characteristics underlying the steady state. Subsequently, the valuation models of the flow to equity (FtE) and free cash flow (FCF) approaches are determined under a residual dividend policy and active debt management. Then, the study analyzes the changes that result if cash flows are retained. Specifically, it is seen that even under the assumption of value-neutral investments, firm value increases due to the difference between the effective capital gains tax rate and cash dividend tax rate. Under active debt management, this tax-based value increase leads to an additional debt financing to ensure adherence to the predetermined capital structure target. This additional debt financing implies additional interests, tax shields, and changes in the debt market value, which affect different parts of the valuation model. In this context, the corporate valuation standard IDW S 1 refers to a study by Tschöpel et al. (2010), whose valuation model does not account for the additional debt financing effects resulting from the assumption of active debt management. By using simulations, it is shown that the value contribution of the earnings-based dividend policy is overestimated by more than 25%, on average, when applying the valuation model by Tschöpel et al. (2010).

Study 2: Valuation with share repurchases and personal taxes (Chapter 3)

The second study considers that share repurchases have become an important alternative for distributing cash flows to equity investors. Therefore, it starts by developing the unlevered firm’s valuation model if cash dividends and share repurchases occur in the same period, assuming an explicit forecast period and a subsequent steady state. Particularly, it is shown that firm value increases with an increase in the firm’s participation in share repurchases, which is attributed to the tax advantage that share repurchases provide when compared with cash dividends. In the following section, the valuation model of a levered firm is solved under active

debt management by accounting for additional debt financing effects, which were revealed in the first study. The derived valuation model follows the FtE approach. Subsequently, the impact of share repurchases on the cost of equity is depicted by deriving adjustment formulas, following the different debt adjustment assumptions by Miles and Ezzell (1980, 1985) and Harris and Pringle (1985). It is worth noting that share repurchases have no impact on the underlying cost of equity in the Harris and Pringle case. This is not the case regarding the debt adjustment assumptions of Miles and Ezzell. Eventually, by using simulations, it is demonstrated that a valuation model that only assumes cash dividends significantly underestimates the equity market value when compared with a valuation model that considers both cash dividends and share repurchases.

*Study 3: Valuation, taxes, and dividend policy under passive debt management
(Chapter 4)*

Contrary to the first and second studies, which assume active debt management, the third study assumes passive debt management. It starts by developing the unlevered firm's valuation model accounting for a firm's dividend policy by assuming an explicit forecast period and a steady state. Then, the levered firm's valuation model is derived according to the FtE approach. Specifically, the valuation model includes a blended personal tax rate encapsulating all the effects resulting from retentions and cash dividends. In existing literature, how this blended tax rate is determined and how dividend policy affects this tax rate generally remains open. Subsequently, the impact of dividend policy on the cost of equity is disclosed by deriving adjustment formulas for an explicit forecast period and steady state. Practitioners should note that the unlevering of beta factors assuming a steady state requires information about the cash dividend ratios of the reference companies. Eventually, relevance of the derived valuation model is emphasized by using simulations. Depending on the level of the cash dividend ratio, the average valuation underestimation is approximately 7.6% when compared with a valuation model, which assumes full distribution of the available cash flows to equity investors under otherwise identical assumptions.

*Study 4: Unlevering and Relevering with "wrong" adjustment formulas – How bad is that?
(Chapter 5)*

Contrary to the other three studies, this study is written in German. The study will demonstrate which valuation errors occur if the adjustment formula used in valuation models does not reflect the actual valuation case. In this respect, the corporate valuation standard IDW S 1 refers to Modigliani and Miller's (1963) adjustment formula, which is only suitable if the firm pursues passive debt management and has reached a steady state in which new investments equivalent

to the depreciations are undertaken. Moreover, the valuation practice often accounts for personal taxes only in the numerator of DCF models and uses pre-personal tax adjustment formulas for determining the cost of capital. Therefore, the fourth study first depicts the correct adjustment formulas based on the capital asset pricing model (CAPM) depending on the forecast horizon, financing policy, incorporation of personal taxes, and default risk of debt. Subsequently, the valuation error is highlighted by using simulations when the “wrong” adjustment formula applies. Results of the simulations show that severe valuation errors can occur if the adjustment formula does not match the actual valuation case. Thus, valuation practitioners should be more conscious about which adjustment formula to use.

2 Terminal value calculation with constant payout ratio and active debt management

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Abstract

Due to the possible deferral of capital gains taxes, retaining earnings provide a tax advantage compared to distributing them. Because of this, the calculation of the terminal value is often based on the assumption of an exogenously determined payout ratio. The present study considers this assumption and develops a valuation model for the case in which the firm pursues an active debt management, that is, adopts a financing policy based on market values. The terminal value is determined under both free cash flow and flow to equity approaches. Overall, it is shown that the valuation formula used in standard practice does not take into account all the financial effects caused by the retention of earnings. A simulation of the valuation error highlights that the value contribution of the dividend policy is overestimated by more than 25% on average. This result points out the need to carefully rethink the currently employed approaches to terminal value calculation.

Keywords: Valuation, terminal value, dividend policy, constant payout ratio, financing policy

JEL Classification: G32, H20, M41

2.1 Introduction

Theorists and practitioners have dealt with terminal value calculation since the early stages of the applied valuation theory. All relevant studies implicitly or explicitly assume that the valuation object reaches a steady state at the end of the explicit forecast period. In the steady state, the expected free cash flow and the expected values of all other relevant variables such as EBIT and capital expenditures increase at a constant and uniform growth rate (Aders & Schröder, 2004; Penman, 2013; Koller et al., 2015). Recently, considerable attention has been paid to whether the dividend policy in the steady state is accurately taken into account. The issue arises because the tax system in many countries (e.g., Germany) results in a tax advantage of retained earnings over dividends. Consequently, the market value of the firm increases with the proportion of retained earnings, provided that the value effect of additional investments equals at least the invested amount. Because of this, a full distribution of available earnings is not plausible. The dividend policy emerges as a potential tool to actively increase the shareholder value. This idea gains even more significance as dividend policy is also an important instrument to persuade external investors of the business model sustainability (signaling) (e.g., Kruschwitz & Löffler, 2006; Brealey et al., 2017; and Berk & DeMarzo, 2017).

As the dividend policy in the explicit forecast period is simultaneously determined with the investment and financing policy, the analysis of the steady state requires some simplifying assumptions. As a result, only part of the expected earnings translates into dividends. Earnings are held back for two purposes. First, due to inflation, the price of investment goods increases, and earnings are partly used for reinvestments. As a consequence, the balance sheet total increases whereas capacities remain constant, which indicates an inflation-based growth. Second, earnings are used to build up capacity. This also produces an increase in the balance sheet total, indicating the real firm growth. In both cases, the foregoing dividends represent a financial contribution of shareholders, complemented by additional debt financing in order to maintain the intended capital structure if the firm pursues an active debt management. Together, inflation-based and real growth build up the nominal growth rate at which all relevant figures increase (Friedl & Schwetzler, 2010; Penman, 2013).

We define a residual dividend policy as the full distribution of earnings after all investments are carried out in the above sense. Given this policy, in the steady state the expected dividends make up a constant proportion of expected earnings. However, if this proportion is higher than the usual dividend payout ratio in the industry, even more earnings might be retained to exploit the tax advantage of retained earnings over dividends. As a consequence, a lower proportion of earnings compared to a residual dividend policy is distributed to shareholders (earnings-based dividend policy). In this case, additional assumptions on the investments financed by the additional retained earnings are clearly needed. The simplest assumption is that these investments

remain value neutral, that is, the value contribution of the additional investment equals the initial invested amount (IDW, 2008, 2014). If taxes on dividends are higher than those on capital gains, the additional earnings retention leads to a tax advantage for shareholders, resulting in a higher market value of the firm in prior periods even if the market value at the time of investment remains unaffected.

The present study considers a valuation model to investigate the effects of additional earnings retention. Although the main focus is on the flow to equity approach, which is often used in practice of valuation, the consequences for the terminal value calculation are also derived with regard to the free cash flow approach, which allows valuation in this case without circularity problems. It is assumed that the firm reaches a steady state at the end of the explicit forecast period and pursues an active debt management. Thus, the theoretical setting is in line with the existing literature. The problem of special interest is the relationship between the dividend and the financing policy. Under active debt management and earnings-based dividend policy, the additional retained earnings lead to a debt financing adjustment. This in turn causes effects that have not been examined thoroughly in the literature so far. Against this background, the central result of this study is a valuation model that includes these effects consistently. In order to illustrate the relevance of our results, we perform a simulation analysis to estimate the average valuation error by applying the standard terminal value formula. Specifically, it is shown that the personal tax advantage of an earnings-based dividend policy is overestimated by more than 25%. As for the total terminal value, the overestimation amounts to 2% on average and to a maximum of 5%. Due to the high proportion of the terminal value to the total market value of the firm, the effect should not be ignored.

The literature dealing with terminal value calculation is variegated. By deriving the formula for the valuation of a uniformly increasing cash flow, Gordon and Shapiro (1956) provide a starting point. Bradley and Jarrell (2008, 2011) and Friedl and Schwetzler (2009, 2010, 2011) consider inflation-based and real growth in a valuation model without personal taxes. The literature most closely related to our study has been developed since 2000 (Wagner et al., 2004, 2006; Wiese, 2005; Schwetzler, 2005; Meitner, 2008). This literature stream tends to assume a predetermined payout ratio in the steady state and value neutrality of additional investments. Most studies aim to identify the rate of return that keeps additional investments value neutral (Wagner et al., 2006; Tschöpel et al., 2010; Pawelzik, 2010). Other contributions directly assume value neutrality of additional investments without questioning the rate of return (Diedrich, 2013). Highly relevant for practitioners is the Standard IDW S 1, which requires the determination of a payout ratio based on alternative investment possibilities in the same industry. If this ratio is lower than that from a residual dividend policy, an earnings-based dividend policy and a value neutral investment of additional retained earnings shall be assumed. In this regard, the auditors' hand-

book explicitly refers to the study by Tschöpel et al. (2010), whose approach has been implemented in practice. We claim that this approach does not take into account the additional financing effects that are the object of our analysis.

The remainder of this paper is organized as follows. Section 2 presents the assumptions underlying the steady state. Subsequently, given a residual dividend policy and an active debt management, the valuation model under both the flow to equity and the free cash flow approach is determined, whereby inflation-based and real growth constitute the nominal growth rate. The consequences of additional retained earnings are analyzed for one period in Section 3. In Section 4, a valuation model where additional retained earnings are made in each period of the steady state is derived. Based on this model, the relevant valuation model under the flow to equity and the free cash flow approach is derived. In Section 5, the practical relevance of the derived valuation model is illustrated through simulations, and the differences between our model and the standard terminal value formula are pointed out. Section 6 concludes by summarizing the most relevant results.

2.2 Terminal value calculation with a residual dividend policy

We assume that the valuation object reaches a steady state at the end of the explicit forecast period, in which the firm undertakes replacement and expansion investments. These investments lead to a constant increase of all relevant parameters.³ With nominal net investments in period t , NI_t , we obtain the book value of the invested capital IC_t

$$IC_t = IC_{t-1} + NI_t \quad \text{for } t = T+1, T+2, \dots, \quad (1)$$

where period T indicates the beginning of the steady state phase. The free cash flow FCF_t is defined as:

$$FCF_t = NOPLAT_t - NI_t \quad \text{for } t = T+1, T+2, \dots \quad (2)$$

$NOPLAT_t$ is the net operating profit less adjusted taxes (NOPLAT) in period t , which includes the taxes of the unlevered firm. The operating profit OP_t corresponds to the difference between NOPLAT and the debt interest I_t , plus the tax shield TS_t :

$$OP_t = NOPLAT_t - I_t + TS_t \quad \text{for } t = T+1, T+2, \dots \quad (3)$$

³ For the description of the steady state see Aders and Schröder (2004), Koller et al. (2015), and Diedrich and Dierkes (2015), as well as Penman (2013) and Friedl and Schwetzler (2010).

The debt interest I_t corresponds to the product of the cost of debt kd , which is constant in the steady state, and the market value of debt D_{t-1} at the beginning of the period. We assume that D_{t-1} equals the debt book value in the steady state. The tax shield TS_t is calculated by multiplying debt interest by the corporate tax rate τ .⁴

Equations (1), (2), and (3) only provide definitions. To determine the characteristic growth of all relevant values in the steady state, we add two assumptions. First, the expected net investments, which are necessary for an inflation-based and a real growth, is assumed to make up a constant proportion n of the expected NOPLAT:

$$E[\widetilde{NI}_t] = E[\widetilde{NOPLAT}_t] \cdot n \quad \text{for } t = T+1, T+2, \dots \quad (4)$$

Second, we assume that the NOPLAT reflects a constant return on the invested capital (ROIC):

$$E[\widetilde{NOPLAT}_t] = ROIC \cdot E[\widetilde{IC}_{t-1}] \quad \text{for } t = T+1, T+2, \dots \quad (5)$$

Note that the two assumptions are formulated in terms of expectations. Thus, the constant ROIC in (5) does not necessarily correspond to the ROIC obtained in the subsequent period. In addition, a different proportion n of the realized NOPLAT could be used for net investments.

Given (4) and (5), the expected free cash flow and all other relevant values increase at a constant nominal growth rate w . Eventually, w can be traced back to inflation and real growth:⁵

$$w = ROIC \cdot n \quad (6)$$

Assuming a constant cost of capital, the market value of the firm increases over time at the nominal growth rate in (6). Given the active debt management and the constant capital structure, this growth holds also for the market value of debt. This in turn enables us to specify the expected retained earnings $E[\widetilde{RE}_t]$ in period t :

$$E[\widetilde{RE}_t] = E[\widetilde{NI}_t] - w \cdot E[\widetilde{D}_{t-1}] \quad \text{for } t = T+1, T+2, \dots \quad (7)$$

The second term on the right-hand side of (7) represents the growth of the market value of debt in period t . Deducting the retained earnings RE_t from the operating profit OP_t^r yields the flow to equity FTE_t^r :

$$E[\widetilde{FTE}_t^r] = E[\widetilde{OP}_t^r] - E[\widetilde{RE}_t] \quad \text{for } t = T+1, T+2, \dots \quad (8)$$

⁴ We assume that the interest on debt is fully deductible from taxable income. If it is only partially deductible, the appropriate tax rate of this tax base is used.

⁵ Note that $w = ROIC \cdot n = (I+g) \cdot (I+\pi) - I$, where g is the real growth rate and π is inflation. See Diedrich and Dierkes (2015), Penman (2013), and Friedl and Schwetzler (2010).

The index r indicates that the relevant values relate to the residual dividend policy. Obviously, the expected flow to equity also grows at the growth rate w . Distributed to equity investors it is subject to taxation at the personal rate s_d .

By keeping operating risk, capital structure, and dividend policy unchanged, a constant cost of equity $ke_r^{\ell,s}$ is used to compute the market value of the firm. Hence, under a flow to equity approach that accounts for personal taxes, the terminal value becomes:⁶

$$E[\tilde{E}_T^{\ell,r}] = \frac{E[\widetilde{FtE}_{T+1}^r] \cdot (1 - s_d) + E[\tilde{E}_{T+1}^{\ell,r}] - (E[\tilde{E}_{T+1}^{\ell,r}] - E[\tilde{E}_T^{\ell,r}]) \cdot s_g}{1 + ke_r^{\ell,s}}. \quad (9)$$

As we assume that capital gains reflect changes in market values, the last term in (9) defines the capital gains taxation, where s_g depicts the effective capital gains tax rate. As the expected market value of equity must increase at the growth rate w ($E[\tilde{E}_{T+1}^{\ell,r}] = (1 + w) \cdot E[\tilde{E}_T^{\ell,r}]$), Equation (9) can be rearranged as follows:

$$E[\tilde{E}_T^{\ell,r}] = \frac{E[\widetilde{FtE}_{T+1}^r] \cdot (1 - s_d)}{ke_r^{\ell,s} - w \cdot (1 - s_g)}. \quad (10)$$

Given equation (10), it is now possible to compute the terminal value according to the flow to equity approach. However, equation (10) entails circularity problems: the forecast of the expected flow to equity $E[\widetilde{FtE}_{T+1}^r]$ needs the forecast of the expected tax shield $E[\widetilde{TS}_{T+1}^r]$ and thereby the forecast of the expected debt market value $E[\tilde{D}_T]$. With an active debt management the capital structure is predetermined, and thus the knowledge of $E[\tilde{D}_T]$ implies the knowledge of $E[\tilde{E}_T^{\ell,r}]$, which is yet to be calculated.

To obtain the terminal value under the free cash flow approach, we consider the relationship between the flow to equity and the free cash flow:

$$E[\widetilde{FtE}_{T+1}^r] = E[\widetilde{FCF}_{T+1}^r] - kd \cdot E[\tilde{D}_T] \cdot (1 - \tau) + w \cdot E[\tilde{D}_T]. \quad (11)$$

The last term in (11) takes explicitly into account that the debt market value increases at the growth rate w . This entails the necessity to issue a corresponding amount of debt in every period. Taking into account the assumption of an active debt management, which implies

⁶ For discounted cash flow approaches see Ballwieser and Hachmeister (2016) and Kruschwitz and Löffler (2006). For a focus on the concept of personal taxes in discounted cash flow approaches see Diedrich and Dierkes (2015, 2017).

$(1 - \Theta) \cdot E[\tilde{D}_T] = \Theta \cdot E[\tilde{E}_T^{\ell,r}]$ and $E[\tilde{E}_T^{\ell,r}] = (1 - \Theta) \cdot E[\tilde{V}_T^{\ell,r}]$ with Θ representing the debt ratio, we obtain:

$$E[\tilde{V}_T^{\ell,r}] = \frac{E[\widetilde{FCF}_{T+1}^r] \cdot (1 - s_d)}{(1 - \Theta) \cdot (ke_r^{\ell,s} - w \cdot (1 - s_g)) + \Theta \cdot (kd^s \cdot (1 - \tau) - w \cdot (1 - s_d))} . \quad (12)$$

Equation (12) can be used to calculate the terminal value according to the free cash flow approach. The numerator comprises the free cash flow, which is distributed to investors of a fully equity-financed firm, minus the personal tax rate on dividends. The capital gains taxation is included in the growth rate reduction $w \cdot (1 - s_g)$ at the denominator. As standard in the free cash flow approach, the effects of debt financing are fully embodied in the cost of capital. It reflects two aspects. First, the cost of capital relates to the tax deductibility of interests, which increases the amount that can be distributed to equity investors. Specifically, tax deductibility is captured by the cost of debt after personal and corporate taxes, $kd^s \cdot (1 - \tau) = (1 - s_d) \cdot kd \cdot (1 - \tau)$. Second, debt issuance replaces a reduction in dividend payments. While the latter is tax-relevant for equity investors, debt provision has no fiscal consequences for debt investors. The resulting effect is measured by the growth rate reduction $w \cdot (1 - s_d)$. The advantage of determining the terminal value with the free cash flow approach in (12) is that the market value at the beginning of the steady state can be calculated without circularity problems.

2.3 Effects on value of one-time additional retained earnings

Based on the terminal value model of the previous chapter, we now investigate how results change if we assume an earnings-based dividend policy. To illustrate the overall effects of additional retained earnings, we firstly assume one-time additional earnings retention x_{T+1}^I in period $T + 1$. Thus, x_{T+1}^I adds up to the retained earnings RE_{T+1} in (7), which were held back because of the financing of inflation-based and real growth. Similarly to RE_{T+1} , x_{T+1}^I serves as an equity financial contribution for additional investments and is complemented by additional debt to maintain the capital structure constant in the steady state. In line with IDW S 1, we assume that the additional investments do not generate additional value. Thus, x_{T+1}^I corresponds to the value increase $\Delta E_{T+1}^{\ell,I}$ in period $T + 1$. Hence, value neutrality is given if the following holds:

$$\widetilde{\Delta E}_{T+1}^{\ell,I} = \tilde{x}_{T+1}^I . \quad (13)$$

Notice that for value neutrality it is not necessary that the risk related to the additional investments corresponds to that of the existing investment program. So for example retained earnings can be also invested in risk-free securities. Additionally, the value neutrality of additional investments can be complemented with specific conditions. For example, it can be assumed that the additional expected operating profit $E[\widetilde{\Delta OP}_{t+1}^I]$ reflects a constant return (ROE) on the additional invested equity $E[\widetilde{\Delta IE}_t^I]$:⁷

$$E[\widetilde{\Delta OP}_{t+1}^I] = ROE \cdot E[\widetilde{\Delta IE}_t^I] \quad \text{for } t = T+1, T+2, \dots \quad (14)$$

The distribution of a constant proportion q of the additional operating profit generates additional flow to equity:

$$E[\widetilde{\Delta FTE}_{t+1}^I] = q \cdot E[\widetilde{\Delta OP}_{t+1}^I] \quad \text{for } t = T+1, T+2, \dots \quad (15)$$

According to the retention of $(1-q) \cdot E[\widetilde{\Delta OP}_{t+1}^I]$ additional equity is invested. The change in book value of the additional invested equity in period $t+1$ can be expressed as follows:

$$E[\widetilde{\Delta IE}_{t+1}^I] = E[\widetilde{\Delta IE}_t^I] + (1-q) \cdot E[\widetilde{\Delta OP}_{t+1}^I] \quad \text{for } t = T+1, T+2, \dots, \quad (16)$$

where $\Delta IE_{T+1}^I = x_{T+1}^I$ holds. It can be shown that all relevant values denoted by Δ increase at the same growth rate w^z :

$$w^z = (1-q) \cdot ROE. \quad (17)$$

Finally, we assume that the additional investments have the same operating risk as the existing investment program. With cost of equity $ke_I^{\ell,s}$, we obtain the value increase in period $T+1$:

$$\Delta E_{T+1}^{\ell,I} = \frac{ROE \cdot x_{T+1}^I \cdot q \cdot (1-s_d) - s_g \cdot (E[\widetilde{\Delta E}_{T+2}^{\ell,I}] - \Delta E_{T+1}^{\ell,I}) + E[\widetilde{\Delta E}_{T+2}^{\ell,I}]}{1 + ke_I^{\ell,s}}. \quad (18)$$

Because $E[\widetilde{\Delta E}_{T+2}^{\ell,I}] = (1 + w^z) \cdot \Delta E_{T+1}^{\ell,I}$, it follows:

$$\Delta E_{T+1}^{\ell,I} = \frac{ROE \cdot x_{T+1}^I \cdot q \cdot (1-s_d)}{ke_I^{\ell,s} - w^z \cdot (1-s_g)}. \quad (19)$$

As to equation (13), the additional retained earnings are value neutral if the following holds:

⁷ The argumentation is analog to the previous chapter. However, it refers to the return on equity and not to the return on invested capital to make the following comparison with similar studies in the literature possible.

$$x_{T+I}^I = \frac{ROE \cdot x_{T+I}^I \cdot q \cdot (1 - s_d)}{ke_I^{\ell,s} - w^z \cdot (1 - s_g)}. \quad (20)$$

By considering that $w^z = (1 - q) \cdot ROE$, the return on equity under given value neutrality yields:

$$ROE = \frac{ke_I^{\ell,s}}{1 - q \cdot s_d - (1 - q) \cdot s_g}. \quad (21)$$

This result is in line with the explanations in the handbook of auditors (note 412), which refer to Tschöpel et al. (2010).⁸ The ROE, which in our setting depicts the return on the invested equity, is derived as the cost of equity before taxes in the handbook of auditors. It is shown that the value of an initially available financial amount remains unchanged as long as the return of additional investments complies with (21).⁹ Precisely this was shown in the above analysis for the case that the available amount at the beginning of the observation period equals the additional retained earnings in period $T + I$. Therefore, the example in the handbook of auditors serves as a clarification of the above mentioned relationships from which it becomes obvious that the same understanding underlies the handbook of auditors with regard to value neutrality.

So far, only the value effect of the additional retained earnings in period $T + I$ was subject of investigation. In order to determine the effect on value in period T , we need to consider that the change in distribution x_{T+I}^I and the value increase in equity $\Delta E_{T+I}^{\ell,I}$ have an effect on personal taxation of equity investors. If dividends are taxed at s_d and changes in market values at s_g , we obtain the following value effect in comparison to a residual dividend policy:

$$E[\widetilde{\Delta E_T^{\ell,I}}] = \frac{-E[\widetilde{x_{T+I}^I}] \cdot (1 - s_d) + E[\widetilde{\Delta E_{T+I}^{\ell,I}}] - s_g \cdot (E[\widetilde{\Delta E_{T+I}^{\ell,I}}] - E[\widetilde{\Delta E_T^{\ell,I}}])}{1 + ke_I^{\ell,s}}. \quad (22)$$

(22) holds under the assumption that $ke_I^{\ell,s}$ is suited for the assessment of the value effect.

⁸ See also Pawelzik (2010). When comparing the models by Tschöpel et al. (2010) and Pawelzik (2010), one needs to consider that a full distribution in the former corresponds to a residual distribution in the latter, in which retained earnings are made to finance the inflation-based growth. Differently from this work, a possible real growth is not considered in any of those studies.

⁹ Given value neutrality, the ROE corresponds to the cost of equity before taxes, as the additional invested amount in (20) can be obtained if the cash flows before taxes discount at the ROE as the cost of equity before taxes:

$$\frac{ROE \cdot x_{T+I}^I \cdot q}{ROE - w^z} = \frac{ROE \cdot x_{T+I}^I \cdot q}{ROE - (1 - q) \cdot ROE} = x_{T+I}^I$$

Plugging (13) in (22) and solving for $E[\widetilde{\Delta E}_T^{\ell, I}]$ yields:

$$E[\widetilde{\Delta E}_T^{\ell, I}] = \frac{E[\widetilde{x}_{T+I}^I] \cdot (s_d - s_g)}{1 + ke_I^{\ell, s} - s_g}. \quad (23)$$

Equation (23) shows that the additional retention of earnings leads to a value increase in previous periods, even if the respective additional investments are invested in value neutral projects. This occurs whenever dividends are taxed differently than changes in market values, which is a common assumption in corporate valuation practice. Only if the personal tax rates s_d and s_g are identical and additional retained earnings are invested in value neutral projects, value neutral investments do not have a value effect in previous periods. Beyond the scope of (23), the assumption of an active debt management induces additional financing effects. We will explicitly address this issue in the next section.

2.4 Terminal value calculation under an earnings-based dividend policy

In the following, we investigate how the terminal value calculation in (10) and (12) changes if additional earnings are retained not only one-time but in every period of the steady state. We assume that the flow to equity under an earnings-based dividend policy is determined as $FTE_t^e = q \cdot OP_t^e$, with the payout ratio $q \leq 1$. The index e denotes the earnings-based dividend policy. Hence, at the valuation date, $E[\widetilde{FTE}_t^e] = q \cdot E[\widetilde{OP}_t^e]$ holds. The expected dividend is composed of a deterministic and fixed proportion of the expected earnings. The latter holds also under a residual dividend policy: based on the steady state assumptions, we also obtain $E[\widetilde{FTE}_t^r] = q^r \cdot E[\widetilde{OP}_t^r]$, with $q^r \leq 1$. However, this only depicts a relationship between expected values and does not imply that the firm distributes a fixed proportion of its actual earnings in every period. If $q^r = q$, it follows that $E[\widetilde{OP}_t^r] = E[\widetilde{OP}_t^e]$, because differences between OP_t^e and OP_t^r only result from additional retained earnings.

If q and q^r are different, an additional amount $E[\widetilde{x}_t]$ is retained. It must be specified so that, given all the effects of the earnings-based dividend policy, the payout ratio equals q . From the steady state assumptions, the ratio of $E[\widetilde{x}_t]$ and $E[\widetilde{FTE}_t^r]$ is constant and known with certainty at the valuation date. Thus, the additional retained earnings as well as $E[\widetilde{FTE}_t^r]$ increase at the growth rate w . Complemented with additional debt the additional retained earnings are used to finance additional investments according to the pattern that was described in the previous

section. Thus, it might be expected that the terminal value has to be computed as per the following valuation model:

$$E[\tilde{E}_t^{\ell,e*}] = \frac{E[\widetilde{FtE}_{t+1}^r] \cdot (1 - s_d) + E[\tilde{x}_{t+1}] \cdot (s_d - s_g) - s_g \cdot (E[\tilde{E}_{t+1}^{\ell,e*}] - E[\tilde{E}_t^{\ell,e*}]) + E[\tilde{E}_{t+1}^{\ell,e*}]}{1 + ke^{\ell,s}} \quad \text{for } t = T, T+1 \dots \quad (24)$$

$ke^{\ell,s}$ depicts the cost of equity suited to the earnings-based dividend policy with payout ratio q . The tax saving in period $t+1$ appears at the numerator of (24), and results from the additional retained earnings. As $E[\widetilde{FtE}_t^r]$ and $E[\tilde{x}_t]$ increase at the growth rate w , we obtain:

$$E[\tilde{E}_{t+1}^{\ell,e*}] = (1 + w) \cdot E[\tilde{E}_t^{\ell,e*}] \quad \text{for } t = T, T+1 \dots \quad (25)$$

Inserting (25) in (24) and solving for $E[\tilde{E}_T^{\ell,e*}]$ yields:

$$E[\tilde{E}_T^{\ell,e*}] = \frac{E[\widetilde{FtE}_{T+1}^r] \cdot (1 - q^z \cdot s_d - (1 - q^z) \cdot s_g)}{ke^{\ell,s} - w \cdot (1 - s_g)}. \quad (26)$$

Equation (26) is commonly used in the literature (see for example Meitner 2008) and is also prevalent in practice. The above derivation requires $q^z = (E[\widetilde{FtE}_t^r] - E[\tilde{x}_t]) / E[\widetilde{FtE}_t^r]$. In this respect, the existing literature sets $q^z = q / q^r$. However, neither this nor (24) consider the value effects deriving from switching from a residual to an earnings-based dividend policy. Such effects, which were depicted in the last chapter, reduce the debt ratio, so that additional debt must be issued in order to maintain the predetermined capital structure as indicated by the active debt management. The additional debt issue leads to a higher potential distribution, additional interests, and tax shields in the upcoming periods, resulting in a deviation of $E[\widetilde{OP}_t^e]$ and $E[\widetilde{OP}_t^r]$.

In the following, these complex effects of additional retained earnings are captured within a recursive approach.

Specifically, the added market value $E[\widetilde{\Delta E}_T^{\ell,e}]$ at the beginning of the steady state is:

$$\begin{aligned}
& E[\widetilde{\Delta E}_T^{\ell,e}] \\
& \quad \text{reduction of dividends} \quad \text{additional interests after corporate taxes} \quad \text{additional distribution due to change in market value of debt} \\
& = \frac{(-E[\widetilde{x}_{T+1}] - kd \cdot L \cdot E[\widetilde{\Delta E}_T^{\ell,e}] \cdot (1-\tau) + L \cdot (E[\widetilde{\Delta E}_{T+1}^{\ell,e}] - E[\widetilde{\Delta E}_T^{\ell,e}]) \cdot (1-s_d))}{1 + ke^{\ell,s}} \quad (27) \\
& \quad \text{value contribution of additional retained earnings} \\
& + \frac{E[\widetilde{x}_{T+1}] \cdot (1-s_g) - (E[\widetilde{\Delta E}_{T+1}^{\ell,e}] - E[\widetilde{\Delta E}_T^{\ell,e}]) \cdot s_g + E[\widetilde{\Delta E}_{T+1}^{\ell,e}]}{1 + ke^{\ell,s}}
\end{aligned}$$

$E[\widetilde{FtE}_{T+1}^r]$ increases at the growth rate w , and thus the same growth rate holds for the added market value under an earnings-based dividend policy. Inserting $E[\widetilde{\Delta E}_{T+1}^{\ell,e}] = (1+w) \cdot E[\widetilde{\Delta E}_T^{\ell,e}]$ in (27) and solving for $E[\widetilde{\Delta E}_T^{\ell,e}]$, we obtain:

$$E[\widetilde{\Delta E}_T^{\ell,e}] = \frac{E[\widetilde{x}_{T+1}] \cdot (s_d - s_g)}{ke^{\ell,s} - w \cdot (1-s_g) + L \cdot (1-s_d) \cdot (kd \cdot (1-\tau) - w)} \quad (28)$$

$E[\widetilde{x}_t]$ is set in such a way that the deterministic payout ratio is q at firm level. Note that, compared to the residual dividend policy, the additional interests and tax shields resulting from the additional debt lead to a reduction of the operating profit. Furthermore, the expected dividend $E[\widetilde{Div}_t^e]$ under an earnings-based dividend policy accounts for additional interests and tax shields as well as additional distributions related to the change in debt as for the payout ratio q , we obtain:

$$q = \frac{E[\widetilde{Div}_{T+1}^e]}{E[\widetilde{OP}_{T+1}^e]} = \frac{E[\widetilde{FtE}_{T+1}^r] - E[\widetilde{x}_{T+1}] - kd \cdot L \cdot E[\widetilde{\Delta E}_T^{\ell,e}] \cdot (1-\tau) + w \cdot L \cdot E[\widetilde{\Delta E}_T^{\ell,e}]}{E[\widetilde{OP}_{T+1}^r] - kd \cdot L \cdot E[\widetilde{\Delta E}_T^{\ell,e}] \cdot (1-\tau)} \quad (29)$$

Solving (29) for $E[\widetilde{x}_t]$ and inserting in (28) yields:

$$E[\widetilde{\Delta E}_T^{\ell,e}] = \frac{(E[\widetilde{FtE}_{T+1}^r] - q \cdot E[\widetilde{OP}_{T+1}^r]) \cdot (s_d - s_g)}{ke^{\ell,s} - w \cdot (1-s_g) + L \cdot (kd \cdot (1-\tau) \cdot (1-q \cdot s_d - (1-q) \cdot s_g) - w \cdot (1-s_g))} \quad (30)$$

Thus, the terminal value under an earnings-based dividend policy is the sum of two components

which are associated with the flow to equity and retained earnings, respectively:

$$E[\widetilde{E}_T^{\ell,e}] = \frac{E[\widetilde{FtE}_{T+1}^r] \cdot (1-s_d)}{ke^{\ell,s} - w \cdot (1-s_g)} + \frac{(E[\widetilde{FtE}_{T+1}^r] - q \cdot E[\widetilde{OP}_{T+1}^r]) \cdot (s_d - s_g)}{ke^{\ell,s} - w \cdot (1-s_g) + L \cdot (kd \cdot (1-\tau) \cdot (1-q \cdot s_d - (1-q) \cdot s_g) - w \cdot (1-s_g))} \quad (31)$$

Equation (31) indicates that an earnings-based dividend policy is accompanied by an added market value even if the additional investments remain value neutral at the investment date. Furthermore, it becomes clear, that the value increases only stem from different personal taxation of dividends and changes in market values. If dividends are taxed as changes in market values, the terminal value is independent of the dividend policy. This corresponds to the result by Miller and Modigliani (1961) about the irrelevance of the dividend policy.

The added market value to equity investors requires a corresponding debt issue, which follows the predetermined capital structure of the active debt management. Given the overall value effect $E[\widetilde{AV}_T^{\ell,e}] = E[\widetilde{AE}_T^{\ell,e}] \cdot (1+L)$, the terminal value under an earnings-based dividend policy according to the free cash flow method yields:

$$E[\widetilde{V}_T^{\ell,e}] = \frac{E[\widetilde{FCF}_{T+1}^r] \cdot (1-s_d)}{(1-\Theta) \cdot (ke^{\ell,s} - w \cdot (1-s_g)) + \Theta \cdot (kd^s \cdot (1-\tau) - w \cdot (1-s_d))} + (1+L) \cdot \frac{(E[\widetilde{FtE}_{T+1}^r] - q \cdot E[\widetilde{OP}_{T+1}^r]) \cdot (s_d - s_g)}{ke^{\ell,s} - w \cdot (1-s_g) + L \cdot (kd \cdot (1-\tau) \cdot (1-q \cdot s_d - (1-q) \cdot s_g) - w \cdot (1-s_g))} \quad (32)$$

Through equations (31) and (32), the terminal value at the beginning of the steady state can be calculated within the flow to equity and the free cash flow approach. First, the (total) market value that is associated with the free cash flow has to be determined. Afterwards, the flow to equity $E[\widetilde{FtE}_{T+1}^r]$ as well as the operating profit $E[\widetilde{OP}_{T+1}^r]$ will be known. This allows to compute the added market value under an earnings-based dividend policy.

2.5 Analysis of valuation errors

To determine the relevance of the above analysis, we compare equation (31) with the valuation model used in practice (equation (26)). First, we rearrange terms in (26) and obtain:

$$E[\widetilde{E}_T^{\ell,e*}] = \frac{E[\widetilde{FtE}_{T+1}^r] \cdot (1-s_d)}{ke^{\ell,s} - w \cdot (1-s_g)} + \frac{\left(1 - \frac{q}{q^r}\right) \cdot E[\widetilde{FtE}_{T+1}^r] \cdot (s_d - s_g)}{ke^{\ell,s} - w \cdot (1-s_g)}. \quad (33)$$

As the terminal value models (31) and (33) do not differ with regard to the first part of the right hand side in (33), we concentrate the analysis of valuation errors on the second part. Specifically, we derive the valuation error when (33) is used instead of (31). For this purpose, we determine the percentage valuation error p , which is related to the application of (33):

$$p = \frac{E[\widetilde{\Delta E}_T^{\ell,e*}] - E[\widetilde{\Delta E}_T^{\ell,e}]}{E[\widetilde{\Delta E}_T^{\ell,e}]} = \frac{L \cdot (kd \cdot (1-\tau) \cdot (1-q \cdot s_d - (1-q) \cdot s_g) - w \cdot (1-s_g))}{ke^{\ell,s} - w \cdot (1-s_g)}. \quad (34)$$

The consequences of the financing effects, neglected in the valuation model used so far, are depicted at the numerator of (34). More in detail, if the numerator is positive, the terminal value is overestimated. An underestimation is also possible, but it requires an atypical high growth rate w compared to the cost of debt kd . Thus, the calculation of the terminal value in (26) is usually accompanied by its overestimation. The percentage valuation error is, ceteris paribus, larger, the smaller the payout ratio q , the corporate tax rate τ , the growth rate w , as well as the higher the leverage L and the cost of debt kd .¹⁰

In order to gain an indication of the expected average valuation errors, 2,000,000 valuation cases were simulated, which differ by payout ratio q , cost of equity $ke^{\ell,s}$, cost of debt kd , leverage L , corporate tax rate τ , and growth rate w . We assume that all these variables are independent of each other and uniformly distributed in the following intervals:

$$q \in [30\%; 60\%], \quad ke^{\ell,s} \in [8\%; 10\%], \quad kd \in [4\%; 6\%], \quad L \in [0.4; 2], \quad \tau \in [25\%; 35\%], \\ w \in [0.5\%; 2\%].$$

The dividend tax rate s_d and the capital gains tax rate s_g are 26.375% and 13.188%, respectively.¹¹ Based on these assumptions, the simulation leads to the following probability distribution of the valuation error (Figure 2).

¹⁰ These statements can be verified by computing the corresponding partial derivatives.

¹¹ The tax rate on dividends corresponds to the so called “Abgeltungsteuersatz” plus the “Solidaritätszuschlag” in Germany. The tax rate on changes in market values is set equal to the half of the tax rate on dividends.

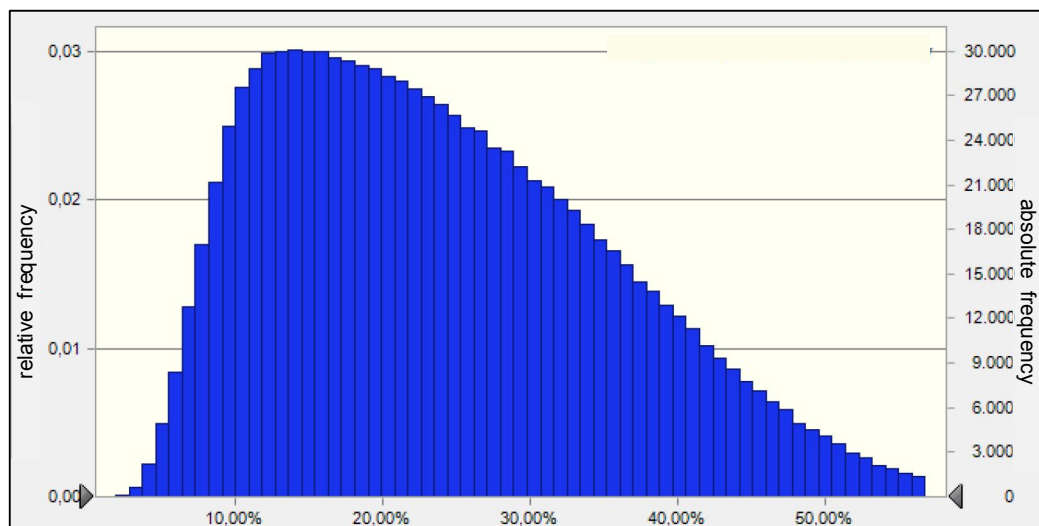


Figure 2: Frequency distribution of the percentage valuation error.

Eventually, the application of the standard model (26) always brings to an overestimation of the terminal value. The average percentage valuation error is 26.4%; the minimum and maximum valuation errors are, respectively, 2.1% and 81.3%; the standard deviation is 12.8%. The sensitivity analysis shows that the error is explained for 69.6% by the leverage and 14.9% by the cost of debt. Therefore, the application of the terminal value model (26) can lead to a serious overestimation of the added market value under an earnings-based dividend policy, especially if the firm has a high leverage and bad financial conditions. Even though the valuation error is relatively small compared to the full terminal value - additional simulations show an overestimation by an average of approximately 2% and a maximum overestimation by over 5% - it remains significant because of the high proportion of the terminal value to the market value of the firm.

2.6 Conclusions

Theorists and practitioners of corporate valuation have been intensively debating on the appropriate way to calculate the terminal value of a firm. Some of the issues that must be dealt with in this context relate to the firm dividend policy in the steady state. In the simplest case, a residual dividend policy is adopted: the firm retains earnings according to inflation-based and real growth as far as reflected in the growth rate. However, depending on the conditions in each case, an earnings-based dividend policy might be better suited for valuation. A useful device is the assumption that the retention of additional earnings remains value neutral at the time of the investment. By examining how dividend and financing policy are consistently considered, this study shows that the additional retained earnings increase the value in periods prior to the investment even under the value neutrality assumption. The value effect leads to additional debt

financing, provided that the firm pursues an active debt management. Consequently, additional interests and tax shields arise, and firm earnings change.

The central result of this study is the development of a terminal value formula that considers the discussed effects consistently. The proposed formula differs from that used in corporate valuation practice in Germany. Conceptually, it becomes evident that the assumed financing and dividend policy is not implemented consistently in the standard terminal value model. From a practical perspective it is important that the terminal value is regularly overestimated. Depending on the parameters, the valuation error regarding the value contribution of an earnings-based dividend policy is above 50% in extreme cases. Even compared to the full terminal value, such error remains significant. Overall, the results of this study suggest rethinking the valuation practice on the terminal value.

3 Valuation with share repurchases and personal taxes¹²

Ralf Diedrich, Stefan Dierkes, and Johannes Sämpelmann

Abstract

We derive a consistent valuation approach integrating the interdependent effects of cash dividends, share repurchases, and active debt management while considering personal taxes. Additionally, we identify effects of share repurchases on the cost of equity by deriving appropriate adjustment formulae. Furthermore, we run simulations to investigate the valuation differences caused by distribution of excess cash via cash dividends or share repurchases. The results show that share repurchases have a significant positive effect on equity market value.

Keywords: Valuation, share repurchases, cash dividends, active debt management, cost of equity, equity market value, personal taxes

JEL Classification Codes: G32, H20, M41

¹² Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3314164.

3.1 Introduction

Firms can use excess cash either for paying dividends or for share repurchases. The latter have become increasingly important since the early 1980s and, nowadays, have nearly the same magnitude as cash dividends (Brealey et al., 2017; Grullon & Michaely, 2002; Skinner, 2008). The reasons for this are manifold: perceived stock undervaluation, signaling effects, maintenance of financial flexibility, management of the “earnings per share” ratio, tax considerations, etc. (e.g., Brav et al., 2005; Skinner, 2008). Among these reasons, tax considerations are of particular importance to the firm’s choice about the distribution of excess cash to shareholders (Bierman & West, 1966; Jacob & Jacob, 2013). Share repurchases lead to stock price appreciation and thus to capital gains, which are taxed in a different way than cash dividends. In the past, the tax rate on capital gains used to be lower than that on cash dividends (e.g., Bierman & West, 1966, 1968; Elton & Gruber, 1968a, 1968b). Nowadays, many countries such as the US and Germany tax cash dividends and capital gains equally. However, as shares represent long-term investment, capital gains are typically not realized immediately. Therefore, capital gains can be deferred, which leads to a tax advantage (Berk & De Marzo, 2017; Brealey et al., 2017). Consequently, the effective tax rate on capital gains is lower than the tax rate on dividends, so that distribution of excess cash via dividends or share repurchases becomes relevant for the market value of equity.¹³

In this study, we examine the effects of cash dividends and share repurchases on the equity market value of a firm. In line with common valuation frameworks, we derive a discounted cash flow valuation model starting from a set of assumptions on the underlying financing strategy. Since debt financing provides a corporate tax advantage, the choice of a firm’s financing strategy (i.e., passive or active debt management) has an effect on the value of tax shields and thus on the equity market value (Modigliani & Miller [MM], 1958, 1963; Miles & Ezzell [ME], 1980, 1985; Harris & Pringle [HP], 1985).¹⁴ Passive debt management is characterized by predetermined debt levels, whereas active debt management presumes predetermined targets for the capital structure. In this analysis, we assume active debt management as ME and HP. While ME adjust the capital structure only at the beginning of a period, HP allow for a continuous adjustment. The respective assumptions influence the tax shields’ discount rate and, thereby, the equity market value. Linking these assumptions to the taxation consequences of the choice on excess cash use (i.e., cash dividends or share repurchases) leads to a valuation model that has not been investigated in the literature so far.

The tax advantage of share repurchases over cash dividends has been first addressed by Elton and Gruber (1968a), Bierman and West (1966), Brigham (1966), and Robichek and Myers

¹³ The optimal dividend policy would imply that a firm pays no cash dividends at all. However, cash dividends are still made for signaling purposes and several other reasons (Black, 1976).

¹⁴ Note that MM (1958, 1963), ME (1980, 1985) as well as HP (1985) abstract from personal taxes.

(1965). Bierman and West (1966) assume – as we do – that a predetermined cash dividend ratio is used for the distribution of excess cash among dividends and share repurchases. Differently from our analysis, the authors do not make any assumption on the financing strategy and do not specify the underlying cost of equity. Consequently, they do not account for additional financing effects resulting from active debt management nor derive an adjustment formula for the cost of equity. Rashid and Amoako-Adu (1987), (1995) address the effect of share repurchases on the equity market value in a common valuation framework. They assume that excess cash is distributed to equity investors according to a predetermined dividend payout ratio based on earnings. The retained cash is used for share repurchases to ensure that investment and financing decisions remain independent. In more detail, in the first study, the authors develop the relevant valuation calculus for the adjusted present value approach while assuming a steady state with inflation-based growth and passive debt management. They then extend the study to derive an adjustment formula for the cost of equity, which also allows the application of the flow to equity approach. As these studies assume passive debt management, they are only partially comparable with ours.

Our contribution to the existing literature is threefold. First, we derive the valuation model for a firm that simultaneously distributes cash dividends and repurchases shares while pursuing active debt management. The value effect associated with share repurchases affects the capital structure, which concerns different parts of the valuation model. To the best of our knowledge, these effects have not been detected or examined in the literature. Second, in line with ME and HP, effects of the tax advantage of share repurchases on the cost of equity are disclosed by deriving appropriate adjustment formulae. Both the explicit forecast period and steady state phase are analyzed. The resulting formulae have the same structure as common adjustment formulae do. Third, we compute the valuation difference resulting from a valuation assuming cash dividends only as compared with a valuation considering cash dividends and share repurchases. Under otherwise identical assumptions, the equity market value is always lower if only cash dividends are paid. The average valuation difference amounts to 5.2% in the ME and to 9% in the HP case.

The remainder of this paper is organized as follows. In Section 2, we present the basic valuation model for the unlevered firm that distributes excess cash via cash dividends and share repurchases. In Section 3, we develop the valuation model for the levered firm and highlight the interdependent effects of cash dividends, share repurchases, and active debt management on the equity market value. In Section 4, we derive adjustment formulae for the cost of equity of the levered firm under the ME and HP settings. Finally, we present the simulation results on the valuation differences under different cash distribution strategies (Section 5). The paper concludes by summarizing the most important results.

3.2 Valuation model for the unlevered firm

In this section, we assume that the firm is all-equity financed. The firm's expected free cash flows $E[\widetilde{FCF}_t]$ in periods $t = 1, 2, \dots$ are given, and the unlevered cost of equity after personal taxes ke^u is constant over time. Cash dividends and effective capital gains are taxed differently with tax rates τ_d and τ_g . Tax rates do not vary across investors and time. Capital gains correspond to changes in market values at the end of each period (Clubb & Doran, 1992). The firm distributes its excess cash via cash dividends and share repurchases. As the latter lead to stock price appreciation, share repurchases are subject to effective capital gains tax rate τ_g (Rashid & Amoako-Adu, 1995). Regarding the magnitudes of the cash dividend tax rate and effective capital gains tax rate, we expect $\tau_d > \tau_g$. Finally, we assume that the forecasting period is divided into an explicit forecast period and a steady state phase. In other words, the valuation object reaches a steady state at the end of the explicit forecast period, in which the free cash flow and expected values of all other relevant variables (e.g., earnings before interest and taxes and capital expenditures) increase at a uniform and constant growth rate g . This nominal growth rate can include both inflation-based and real growth (Penman, 2013; Koller et al., 2015).

In more detail, in period t , the firm distributes cash dividend ratio $0 \leq r_t \leq 1$ of the available free cash flow as cash dividend and uses the residual cash flow for share repurchases. We assume cash dividend ratio r_t to be a predetermined corporate policy variable (Bierman & West, 1966; Rashid & Amoako-Adu, 1995). Thus, the shareholders' total surplus after personal taxes can be determined as follows:¹⁵

$$r_t \cdot E[\widetilde{FCF}_t] \cdot (1 - \tau_d) + (1 - r_t) \cdot E[\widetilde{FCF}_t] \cdot (1 - \tau_g) \quad \text{for } t = 1, \dots, T, \quad (35)$$

where T denotes the end of the explicit forecast period. By definition, the expected equity market value of the unlevered firm $E[\tilde{E}_{t-1}^u]$ at time $t-1$ corresponds to the total surplus after personal taxes; change in market value $(E[\tilde{E}_t^u] - E[\tilde{E}_{t-1}^u])$, which is taxed by τ_g ; and equity market value $E[\tilde{E}_t^u]$ at time t discounted by the cost of equity ke^u after personal taxes.

¹⁵ All uncertain variables are denoted by a tilde.

Hence, a recursive approach leads us to the following:

$$E[\tilde{E}_{t-l}^u] = \frac{\overbrace{r_t \cdot E[\widetilde{FCF}_t]}^{\text{cash dividends}} \cdot (1 - \tau_d) + \overbrace{(1 - r_t) \cdot E[\widetilde{FCF}_t]}^{\text{share repurchases}} \cdot (1 - \tau_g) - \tau_g \cdot \overbrace{(E[\tilde{E}_t^u] - E[\tilde{E}_{t-l}^u])}^{\text{change in market value}} + E[\tilde{E}_t^u]}{1 + ke^u} \quad \text{for } t = 1, \dots, T. \quad (36)$$

The taxation of changes in market values lead to a circularity problem, because the equity market value at time $t - l$ affects the tax base of personal taxes on capital gains in period t . This circularity problem can be easily overcome by solving equation (36) for the equity market value at time $t - l$:

$$E[\tilde{E}_{t-l}^u] = \frac{E[\widetilde{FCF}_t] \cdot (1 - r_t \cdot \tau_{d^*}) + E[\tilde{E}_t^u]}{1 + ke^{u^*}} \quad \text{for } t = 1, \dots, T, \quad (37)$$

where $\tau_{d^*} = (\tau_d - \tau_g) / (1 - \tau_g)$ indicates a modified personal tax rate, and $ke^{u^*} = ke^u / (1 - \tau_g)$ denotes the modified cost of equity of the unlevered firm. τ_{d^*} can be interpreted as a dividend tax penalty for equity investors or the personal tax disadvantage of cash dividends over capital gains (Berk & DeMarzo, 2017; Dhaliwal et al., 2005; Dempsey, 2001; Naranjo et al., 1998; Poterba & Summers, 1985). To identify the value effect associated with the tax shield of share repurchases, we rearrange the terms in equation (37) to obtain the following:

$$\begin{aligned} E[\tilde{E}_{t-l}^u] &= \frac{\overbrace{E[\widetilde{FCF}_t] \cdot (1 - \tau_{d^*}) + E[\tilde{E}_t^{u,c}]}^{\text{market value without tax shields from share repurchases}}}{1 + ke^{u^*}} + \frac{\overbrace{(1 - r_t) \cdot E[\widetilde{FCF}_t] \cdot \tau_{d^*} + E[\tilde{E}_t^{u,\Delta}]}^{\text{added market value of tax shields from share repurchases}}}{1 + ke^{u^*}} \\ &= E[\tilde{E}_{t-l}^{u,c}] + E[\tilde{E}_{t-l}^{u,\Delta}] \end{aligned} \quad \text{for } t = 1, \dots, T. \quad (38)$$

In equation (38), the first term depicts the expected market value without tax shields from share repurchases $E[\tilde{E}_{t-l}^{u,c}]$, whereas the second term denotes the added market value of tax shields from share repurchases $E[\tilde{E}_{t-l}^{u,\Delta}]$. Here, the tax advantage of share repurchases over cash dividends becomes apparent. The superscripts c resp. Δ denote the corresponding variables.¹⁶ In the steady state, all relevant values increase at the nominal growth rate g .

¹⁶ If the variable has no superscript c or Δ , it refers to the overall values.

Thus, we obtain the expected terminal value of valuation object $E[\tilde{E}_T^u]$ in period T as follows:

$$\begin{aligned} E[\tilde{E}_T^u] &= \frac{E[\widetilde{FCF}_{T+1}] \cdot (1 - \tau_d)}{ke^u - g \cdot (1 - \tau_g)} + \frac{(1 - r) \cdot E[\widetilde{FCF}_{T+1}] \cdot (\tau_d - \tau_g)}{ke^u - g \cdot (1 - \tau_g)} \\ &= E[\tilde{E}_T^{u,c}] + E[\tilde{E}_T^{u,\Delta}]. \end{aligned} \quad (39)$$

In equation (39), the taxation of effective capital gains is considered by the reduced growth rate $g \cdot (1 - \tau_g)$. Equations (38) and (39) indicate that the firm's market value decreases as cash dividend ratios (r_t and r , respectively) increase, which is due to the different taxation of cash dividends and capital gains.¹⁷ Furthermore, equations (38) and (39) show that the added market value of tax shields from share repurchases stems only from the difference in the corresponding tax rates. If $\tau_d = \tau_g$ holds, the added market value of tax shields from share repurchases becomes zero, and the two equations translate into a valuation calculus without personal taxes, which corresponds to the MM's (1961) result of dividend irrelevancy.¹⁸

Overall, the effect of the added market value of tax shields from share repurchases on the market value of an unlevered firm emerges as uncritical. However, if we consider a levered firm with predetermined capital structure targets, the value enhancing effect generates additional financing effects. The next section addresses this issue.

3.3 Valuation model for the levered firm

We now assume that the firm is financed with both equity and debt. With respect to the previous setting, we add the following assumptions: As creditors do not bear any risk, the cost of debt kd corresponds to the risk-free interest rate and is constant over time. Furthermore, the debt book value equals the debt market value. Interest on debt is fully deductible from taxable firm income (as in MM, 1963 and ME, 1980, among many others), and corporate tax rate τ is independent of the amount of this income.¹⁹ Concerning debt investors' personal taxation, we introduce tax rate τ_b for interest income. Thus, we consider three different personal tax rates for cash dividends, interest income, and capital gains.²⁰

¹⁷ This statement can be verified by computing the corresponding partial derivatives in equations (38) and (39).

¹⁸ If the cash dividend tax rate equals the effective capital gains tax rate, the cost of equity without personal taxes is obtained by dividing the cost of equity with personal taxes ke^u through one minus the uniform tax rate.

¹⁹ If interest on debt is only partially deductible, the appropriate tax rate of this tax base is used.

²⁰ In many European countries, the tax rate for cash dividends and interests is the same and thus $\tau_d = \tau_b$. Hence, the model derivations can be easily translated into different tax systems.

As for the financing strategy of the valuation object, we assume an active debt management characterized by predetermined leverage L_t in period t . Leverage is defined as follows:

$$L_t = \frac{\overbrace{L_t \cdot E[\tilde{E}_t^{\ell,c}]}^{\text{debt related to market value without tax shields from share repurchases}}}{E[\tilde{E}_t^{\ell,c}] + E[\tilde{E}_t^{\ell,A}]} + \frac{\overbrace{L_t \cdot E[\tilde{E}_t^{\ell,A}]}^{\text{additional debt related to added market value of tax shields from share repurchases}}}{E[\tilde{E}_t^{\ell,c}] + E[\tilde{E}_t^{\ell,A}]} = \frac{E[\tilde{D}_t]}{E[\tilde{E}_t^{\ell}]} \quad \text{for } t = 0, \dots, T-1, \quad (40)$$

where $\tilde{E}_t^{\ell,c}$ is the market value of equity without tax shields from share repurchases, and $\tilde{E}_t^{\ell,A}$ is the additional market value of equity related to tax shields from share repurchases. From equation (40), it is evident that in case of active debt management, additional debt $L_t \cdot \tilde{E}_t^{\ell,A}$ must be issued to adhere to the predetermined leverage. If the firm only issued debt related to the equity market value without tax shields from share repurchases, the leverage would be lower than the predetermined one. Note that issuing additional debt implies additional interest and tax shields, which, in turn, affect different parts of the flow to equity valuation calculus. In the end, the total amount of debt issued becomes $\tilde{D}_t = \tilde{D}_t^c + \tilde{D}_t^A$, while the market value of equity is $\tilde{E}_t^{\ell} = \tilde{E}_t^{\ell,c} + \tilde{E}_t^{\ell,A}$.

By considering only debt that relates to the equity market value without tax shields from share repurchases, the expected \widetilde{FtE}_t^c is computed as follows:

$$E[\widetilde{FtE}_t^c] = E[\widetilde{FCF}_t] - kd \cdot E[\tilde{D}_{t-1}^c] + \tau \cdot kd \cdot E[\tilde{D}_{t-1}^c] + E[\tilde{D}_t^c] - E[\tilde{D}_{t-1}^c] \quad \text{for } t = 1, \dots, T, \quad (41)$$

where $kd \cdot E[\tilde{D}_{t-1}^c]$ is the expected interest paid relatively to the equity market value without tax shields from share repurchases in period t . The term $\tau \cdot kd \cdot E[\tilde{D}_{t-1}^c]$ depicts the tax shield resulting from the tax deductibility of interests. The change of debt in period t is $E[\tilde{D}_t^c] - E[\tilde{D}_{t-1}^c]$. As the amount of debt depends on the equity market value at time t ($E[\tilde{D}_t^c] = L_t \cdot E[\tilde{E}_t^{\ell,c}]$), it is unknown at the time of valuation (active debt management).

Once additional debt is issued to adhere to the predetermined leverage, the expected flow to equity \widetilde{FtE}_t is obtained as follows:

$$\begin{aligned} E[\widetilde{FtE}_t] &= E[\widetilde{FtE}_t^c] + E[\widetilde{FtE}_t^A] \\ &= E[\widetilde{FCF}_t] - kd \cdot E[\tilde{D}_{t-1}^A] + \tau \cdot kd \cdot E[\tilde{D}_{t-1}^A] + E[\tilde{D}_t^A] - E[\tilde{D}_{t-1}^A] \end{aligned} \quad \text{for } t = 1, \dots, T. \quad (42)$$

It includes the flow to equity related to the market value without tax shields from share repurchases \widetilde{FtE}_t^c as well as \widetilde{FtE}_t^A , the additional flow to equity due to the additional debt $L_t \cdot \tilde{E}_t^{\ell,A} = \tilde{D}_t^A$. Equation (42) shows that \widetilde{FtE}_t^A comprises both additional interests paid and additional tax shields received. Besides, \widetilde{FtE}_t^A also considers the change in additional debt. Given the cash dividend ratio r_t , we assume that the proportion $r_t \cdot \widetilde{FtE}_t$ is used for cash dividends and $(1-r_t) \cdot \widetilde{FtE}_t$ is used for share repurchases. Accordingly, the shareholders' total surplus of the levered firm can be determined as follows:²¹

$$r_t \cdot (E[\widetilde{FtE}_t^c] + E[\widetilde{FtE}_t^A]) \cdot (1 - \tau_d) + (1 - r_t) \cdot (E[\widetilde{FtE}_t^c] + E[\widetilde{FtE}_t^A]) \cdot (1 - \tau_g) \quad \text{for } t = 1, \dots, T. \quad (43)$$

Thus, the valuation calculus for the levered firm is as follows:

$$E[\tilde{E}_{t-1}^\ell] = \frac{\overbrace{r_t \cdot (E[\widetilde{FtE}_t^c] + E[\widetilde{FtE}_t^A]) \cdot (1 - \tau_d) + (1 - r_t) \cdot (E[\widetilde{FtE}_t^c] + E[\widetilde{FtE}_t^A]) \cdot (1 - \tau_g)}^{\text{cash dividends} \quad \text{share repurchases}}}{1 + ke_t^{\ell,r}} + \frac{\overbrace{-\tau_g \cdot (E[\tilde{E}_t^\ell] - E[\tilde{E}_{t-1}^\ell])}^{\text{change in equity market value}} + E[\tilde{E}_t^\ell]}{1 + ke_t^{\ell,r}} \quad \text{for } t = 1, \dots, T. \quad (44)$$

The total surplus, change in equity market value, and equity market value in period t in equation (44) are discounted at the risk-adjusted cost of equity $ke_t^{\ell,r}$.

²¹ We assume that the cash dividend ratios r_t and r are identical for the unlevered and the levered firm.

By solving the circularity problem and rearranging the terms, we obtain the following:

$$\begin{aligned}
E[\tilde{E}_{t-1}^\ell] &= \frac{\overbrace{E[\widetilde{FtE}_t^c] \cdot (1 - \tau_{d^*}) + E[\tilde{E}_t^{\ell,c}]}^{\text{market value without tax shields from share repurchases}}}{1 + ke_t^{\ell^*,r}} \\
&+ \frac{\overbrace{(1 - r_t) \cdot E[\widetilde{FtE}_t^c] \cdot \tau_{d^*}}^{\text{added market value of tax shields from share repurchases}} + \overbrace{E[\widetilde{FtE}_t^A] \cdot (1 - r_t \cdot \tau_{d^*}) + E[\tilde{E}_t^{\ell,A}]}^{\text{market value of additional debt effects}}}{1 + ke_t^{\ell^*,r}} \\
&= E[\tilde{E}_{t-1}^{\ell,c}] + E[\tilde{E}_{t-1}^{\ell,A}]
\end{aligned}$$

for $t = 1, \dots, T$, (45)

with $ke_t^{\ell^*,r} = ke_t^{\ell,r} / (1 - \tau_g)$. In equation (45), $\tilde{E}_{t-1}^{\ell,A}$ is the sum of the added market value of tax shields from share repurchases and the market value of additional debt effects. The relevant cost of equity is the modified cost of equity.

In the steady state, all relevant values increase at growth rate g . Thus, the expected terminal value of the valuation object $E[\tilde{E}_T^\ell]$ is as follows:

$$\begin{aligned}
E[\tilde{E}_T^\ell] &= \frac{E[\widetilde{FtE}_{T+1}^c] \cdot (1 - \tau_d)}{ke^{\ell,r} - g \cdot (1 - \tau_g)} \\
&+ \frac{(1 - r) \cdot E[\widetilde{FtE}_{T+1}^c] \cdot (\tau_d - \tau_g) + E[\widetilde{FtE}_{T+1}^A] \cdot (1 - r \cdot \tau_d - (1 - r) \cdot \tau_g)}{ke^{\ell,r} - g \cdot (1 - \tau_g)} \\
&= E[\tilde{E}_T^{\ell,c}] + E[\tilde{E}_T^{\ell,A}].
\end{aligned}$$

(46)

Both the leverage and cost of equity are constant here.

Equations (45) and (46) resemble equations (38) resp. (39), but they exhibit increased complexity due to debt effects. In more detail, we face further circularity problems as \widetilde{FtE}_t^c and \widetilde{FtE}_t^A are affected by tax shields, interests, and debt changes according to equations (41) resp. (42). In the following, we solve these circularity problems successively for $E[\tilde{E}_{t-1}^{\ell,c}]$ and $E[\tilde{E}_{t-1}^{\ell,A}]$.

A. Equity Market Value Without Tax Shields from Share Repurchases

According to (45) we have the following for $E[\tilde{E}_{t-1}^{\ell,c}]$:

$$E[\tilde{E}_{t-1}^{\ell,c}] = \frac{E[\widetilde{FtE}_t] \cdot (1 - \tau_{d^*}) + E[\tilde{E}_t^{\ell,c}]}{1 + ke_t^{\ell^*,r}} \quad \text{for } t = 1, \dots, T. \quad (47)$$

Solving equation (47) for $E[\tilde{E}_{t-1}^{\ell,c}]$ in consideration of equation (41) and $E[\tilde{D}_t^c] = L_t \cdot [\tilde{E}_t^{\ell,c}]$ yields

$$E[\tilde{E}_{t-1}^{\ell,c}] = \frac{E[\widetilde{FCF}_t] \cdot (1 - \tau_{d^*}) + E[\tilde{E}_t^{\ell,c}] \cdot (1 + L_t \cdot (1 - \tau_{d^*}))}{1 + ke_t^{\ell^*,r} + (kd \cdot (1 - \tau) \cdot L_{t-1} + L_{t-1}) \cdot (1 - \tau_{d^*})}, \quad \text{for } t = 1, \dots, T. \quad (48)$$

The terminal value without tax shields from share repurchases $E[\tilde{E}_T^{\ell,c}]$ is

$$E[\tilde{E}_T^{\ell,c}] = \frac{E[\widetilde{FCF}_{T+1}] \cdot (1 - \tau_d)}{ke^{\ell,r} - g \cdot (1 - \tau_g) + (kd \cdot (1 - \tau) - g) \cdot L \cdot (1 - \tau_d)}. \quad (49)$$

The term $kd \cdot (1 - \tau) \cdot L \cdot (1 - \tau_d)$ in the denominator of equation (49) embodies interests paid and tax shields received that are adapted to a situation without share repurchases. $g \cdot L \cdot (1 - \tau_d)$ considers the expected increase in debt according to growth rate g .

B. Additional Market Value from Share Repurchases

To determine the additional market value $E[\tilde{E}_{t-1}^{\ell,A}]$, we substitute the additional debt effects on the flow to equity $\widetilde{FtE}_t^A = \tau \cdot kd \cdot \tilde{D}_{t-1}^A - kd \cdot \tilde{D}_{t-1}^A + \tilde{D}_t^A - \tilde{D}_{t-1}^A$ in equation (45):

$$E[\tilde{E}_{t-1}^{\ell,A}] = \frac{(1 - r_t) \cdot E[\widetilde{FtE}_t^c] \cdot \tau_{d^*}}{1 + ke_t^{\ell^*,r}} + \frac{\overbrace{(\tau \cdot kd \cdot E[\tilde{D}_{t-1}^A])}^{\text{additional tax shields}} - \overbrace{kd \cdot E[\tilde{D}_{t-1}^A]}^{\text{additional interests}} + \overbrace{E[\tilde{D}_t^A] - E[\tilde{D}_{t-1}^A]}^{\text{additional change in debt}} \cdot (1 - r_t \cdot \tau_{d^*}) + E[\tilde{E}_t^{\ell,A}]}{1 + ke_t^{\ell^*,r}}, \quad \text{for } t = 1, \dots, T. \quad (50)$$

Solving equation (50) for $E[\tilde{E}_{t-1}^{\ell,A}]$ with $E[\tilde{D}_t^A] = L_t \cdot E[\tilde{E}_t^{\ell,A}]$ yields

$$E[\tilde{E}_{t-1}^{\ell,A}] = \frac{(1-r_t) \cdot E[\widetilde{FtE}_t^c] \cdot \tau_{d^*} + E[\tilde{E}_t^{\ell,A}] \cdot (1+L_t \cdot (1-r_t \cdot \tau_{d^*}))}{1 + ke_t^{\ell^*,r} + (kd \cdot (1-\tau) \cdot L_{t-1} + L_{t-1}) \cdot (1-r_t \cdot \tau_{d^*})} \quad \text{for } t = 1, \dots, T. \quad (51)$$

Consequently, we obtain the following for the terminal value $E[\tilde{E}_T^{\ell,A}]$:

$$E[\tilde{E}_T^{\ell,A}] = \frac{(1-r) \cdot E[\widetilde{FtE}_{T+1}^c] \cdot (\tau_d - \tau_g)}{ke^{\ell,r} - g \cdot (1-\tau_g) + (kd \cdot (1-\tau) - g) \cdot L \cdot (1-r \cdot \tau_d - (1-r) \cdot \tau_g)}. \quad (52)$$

Note that after computing the equity market value according to equations (48) and (49), \widetilde{FtE}^c can be determined and the application of equations (51) and (52) is not affected by circularity problems. However, the valuation calculus for the levered firm cannot be applied as long as the cost of equity, $ke_t^{\ell,r}$ resp. $ke^{\ell,r}$, is not known. We will address this issue in the next section.

3.4 The cost of equity

In this section, we derive adjustment formulae for the cost of equity by following ME (1980), (1985) and HP (1985). ME and HP differ in their assumptions on the temporal adjustment of debt to the predetermined leverage: ME assume that adjustment can only occur at the beginning of a period, whereas HP allow for continuous adjustment. ME conclude that the tax shield is certain in the period of its emergence and thus discounts at the risk-free interest rate within this period. For all previous periods, however, the relevant discount rate is the cost of equity of the unlevered firm. According to HP, the unlevered cost of equity is the relevant discount rate for all periods.

To investigate the relationship between the costs of equity of the unlevered and levered firms, we rearrange the terms in equations (37) and (44). After rearranging the terms in equation (37), we obtain

$$E[\widetilde{FCF}_t] \cdot (1-r_t \cdot \tau_{d^*}) = E[\tilde{E}_{t-1}^u] \cdot (1+ke^u) - E[\tilde{E}_t^u] \quad \text{for } t = 1, \dots, T. \quad (53)$$

Furthermore, from (44), we have

$$E[\tilde{E}_{t-1}^{\ell}] = \frac{E[\widetilde{FtE}_t] \cdot (1-r_t \cdot \tau_{d^*}) + E[\tilde{E}_t^{\ell}]}{1 + ke_t^{\ell^*,r}} \quad \text{for } t = 1, \dots, T, \quad (54)$$

where $\widetilde{FtE}_t = \widetilde{FCF}_t - kd \cdot \tilde{D}_{t-1} + \tau \cdot kd \cdot \tilde{D}_{t-1} + \tilde{D}_t - \tilde{D}_{t-1}$ holds with $\tilde{D}_t = \tilde{D}_t^c + \tilde{D}_t^A$. Equation (54) cannot be used for valuation without further information on the effects that have been discussed in the last section. Yet, it is adequate to derive an adjustment formula for the cost of equity.

In addition to equations (53) and (54), we need the expected market value of tax shields in the ME setting, $E[\widetilde{VTS}_{t-1}^{ME}]$ (for more details see Appendix 1):

$$E[\widetilde{VTS}_{t-1}^{ME}] = \frac{\tau \cdot kd \cdot E[\tilde{D}_{t-1}] \cdot (1 - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g)}{1 + kd \cdot (1 - \tau_b)} - \frac{kd \cdot E[\tilde{D}_{t-1}] \cdot (\tau_b - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g)}{1 + kd \cdot (1 - \tau_b)} \\ - \left((\tau_d - \tau_g) \cdot r_t \cdot \frac{E[\tilde{D}_t]}{1 + ke^u} - (\tau_d - \tau_g) \cdot r_t \cdot \frac{E[\tilde{D}_{t-1}]}{1 + kd \cdot (1 - \tau_b)} \right) \\ + \frac{\tau_g \cdot E[\widetilde{VTS}_{t-1}^{ME}]}{1 + kd \cdot (1 - \tau_b)} + \frac{E[\widetilde{VTS}_t^{ME}] \cdot (1 - \tau_g)}{1 + ke^u} \\ \text{for } t = 1, \dots, T. \quad (55)$$

The expected market value of tax shields comprises three parts. The first part $\tau \cdot kd \cdot E[\tilde{D}_{t-1}] \cdot (1 - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g)$ stems from the deductibility of interests from firm income, adapted to the case with personal taxes and share repurchases. This part of the tax shield is also calculated from valuation models without considering personal taxes. The other two parts relate to the different taxation of equity and debt investors. The second part, $kd \cdot E[\tilde{D}_{t-1}] \cdot (\tau_b - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g)$, results from the different taxation of interests. While the tax rates of equity investors in this term are affected by the cash dividend ratio r_t , the tax rate of debt investors is not. The third part, $(\tau_d - \tau_g) \cdot r_t \cdot (E[\tilde{D}_t] - E[\tilde{D}_{t-1}])$, relates to the different taxation of changes in debt, because debt issuance and redemption are not subject to the taxation of debt investors (Dempsey, 2017). The change in debt, however, is tax-relevant in this context as debt issuance or redemption substitutes the retention resp. distribution of earnings. Note that the second and third part disappear if $\tau_d = \tau_g = \tau_b$.

Each part in equation (55) with regard to period $t-1$ is discounted at the risk-free interest rate after personal taxes $kd \cdot (1 - \tau_b)$. For all parts with regard to period t , ke^u is the appropriate risk-adjusted discount rate, because the market values of the levered and the unlevered firm differ only by a deterministic factor, which is known for each period. Hence, the same discount rate is used as that for the market value of the unlevered firm (ME, 1980, 1985). In order to derive the adjustment formula for the cost of equity of the levered firm, equations (54) and (55) are brought together with equation (53) and the following common relationship from value additivity:

$$E[\tilde{E}_t^u] = E[\tilde{E}_t^\ell] + E[\tilde{D}_t] - E[\widetilde{VTS}_t^{ME}] \quad \text{for } t = 0, \dots, T-1. \quad (56)$$

After rearranging, we obtain the adjustment formula for the cost of equity given the ME assumptions (see Appendix 2):

$$ke_t^{\ell,r,ME} = ke^u + (ke^u - kd \cdot (1 - \tau_b)) \cdot \frac{(1 + kd \cdot (1 - \tau)) \cdot (1 - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g)}{1 - \tau_g + kd \cdot (1 - \tau_b)} \cdot L_{t-1} \quad \text{for } t = 1, \dots, T. \quad (57)$$

In the steady state, the leverage and the cash dividend ratio r are constant so that we have:

$$ke^{\ell,r,ME} = ke^u + (ke^u - kd \cdot (1 - \tau_b)) \cdot \frac{(1 + kd \cdot (1 - \tau)) \cdot (1 - r \cdot \tau_d - (1 - r) \cdot \tau_g)}{1 - \tau_g + kd \cdot (1 - \tau_b)} \cdot L. \quad (58)$$

The adjustment formulae in equations (57) and (58) resemble those developed by MM and ME. Starting from the cost of equity ke^u , which depicts the operating risk of the valuation object, a risk premium is added to incorporate financial risk. The risk premium is affected by the dividend tax penalty, which reflects the tax advantage of share repurchases as compared to cash dividends. Note that the lower the cash dividend ratios r_t and r , the higher $ke_t^{\ell,r,ME}$ and $ke^{\ell,r,ME}$ because the tax rate on cash dividends is higher than the tax rate on effective capital gains.²² Thus, the tax advantage of share repurchases comes along with increasing financial risk. As equations (57) and (58) only refer to parameters that are known at the valuation date, the adjustment formulae apply without circularity problems.

Differently from ME, HP assumes that debt can be continuously adjusted to the predetermined leverage. This leads to the following equation for the expected market value of tax shields, $E[\widetilde{VTS}_{t-1}^{HP}]$:

$$E[\widetilde{VTS}_{t-1}^{HP}] = \frac{\tau \cdot kd \cdot E[\tilde{D}_{t-1}] \cdot (1 - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g)}{1 + ke^u} - \frac{kd \cdot E[\tilde{D}_{t-1}] \cdot (\tau_b - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g)}{1 + ke^u} \\ - \left((\tau_d - \tau_g) \cdot r_t \cdot \frac{E[\tilde{D}_t] - E[\tilde{D}_{t-1}]}{1 + ke^u} \right) + \frac{\tau_g \cdot E[\widetilde{VTS}_{t-1}^{HP}]}{1 + ke^u} + \frac{E[\widetilde{VTS}_t^{HP}] \cdot (1 - \tau_g)}{1 + ke^u} \quad \text{for } t = 1, \dots, T. \quad (59)$$

As compared to equation (55), the relevant discount rate for all parts of the tax shield is the cost of equity of the unlevered firm, ke^u .

²² This statement can be verified by computing the corresponding partial derivatives in equations (57) and (58).

Accordingly, the HP-type adjustment formula can be derived as follows (for more details see Appendix 3):

$$ke_t^{\ell,HP} = ke^u + (ke^u - kd \cdot (1 - \tau_b)) \cdot L_{t-1} \quad \text{for } t = 1, \dots, T. \quad (60)$$

If leverage is constant, we obtain

$$ke^{\ell,HP} = ke^u + (ke^u - kd \cdot (1 - \tau_b)) \cdot L. \quad (61)$$

As in the ME case, the adjustment formulae in (60) and (61) are not subject to circularity problems. Apparently, the tax advantage of share repurchases has no effect on the cost of equity following the assumptions by HP. This indicates a major advantage as (61) is independent of the cash dividend ratio r . Consequently, it is not necessary to specify this ratio for the levering and unlevering of beta factors.

By deriving the above adjustment formulae, we provide consistent valuation models for the case of a firm that simultaneously pays dividends and repurchases shares. The common adjustment formulae in the ME and HP case without personal taxes are obtained if $\tau_d = \tau_g = \tau_b$ is assumed.

3.5 Simulation of valuation differences

In this section, we examine how the valuation results vary depending on the distribution strategy. For this we compare the cash dividends only strategy with $r = 1$ and the cash dividends and share repurchases strategy with $r < 1$, and we determine the valuation differences via simulations. For simplicity, we assume that the valuation object has reached a steady state. For $r = 1$ the expected equity market value $E_{r=1}^{\ell,ME}$ in the ME case reduces to

$$E_{r=1}^{\ell,ME} = \frac{E[\widetilde{FCF}_1] \cdot (1 - \tau_d)}{ke_{r=1}^{\ell,ME} - g \cdot (1 - \tau_g) + (kd \cdot (1 - \tau) - g) \cdot L \cdot (1 - \tau_d)}, \quad (62)$$

with

$$ke_{r=1}^{\ell,ME} = ke^u + (ke^u - kd \cdot (1 - \tau_b)) \cdot \frac{(1 + kd \cdot (1 - \tau)) \cdot (1 - \tau_d)}{1 - \tau_g + kd \cdot (1 - \tau_b)} \cdot L. \quad (63)$$

In the HP case, the expected equity market value, $E_{r=1}^{\ell,HP}$, is

²³ Note that if $r = 1$ no additional debt must be issued and hence $\widetilde{FtE}_t^A = 0$ holds.

$$E_{r=1}^{\ell,HP} = \frac{E[\widetilde{FCF}_1] \cdot (1 - \tau_d)}{ke^{\ell,HP} - g \cdot (1 - \tau_g) + (kd \cdot (1 - \tau) - g) \cdot L \cdot (1 - \tau_d)} . \quad (64)$$

As the HP-type adjustment formula (equation (61)) is independent of the cash dividend ratio r it is also applicable if the excess cash is only partially distributed as cash dividends.

We determine the percentage valuation difference in the ME case, p^{ME} , as follows:

$$p^{ME} = \frac{E_{r=1}^{\ell,ME} - E^{\ell,ME}}{E^{\ell,ME}} . \quad (65)$$

The expected equity market value $E^{\ell,ME}$ is the sum of the market value without tax shields from share repurchases $E^{\ell,c}$ (equation (49)) and the added market value $E^{\ell,A}$ according to equation (52). The cost of equity is specified by the adjustment formula (58). To illustrate the average percentage valuation error, we simulated 1,000,000 valuation cases, which differed with regard to the cash dividend ratio r , corporate tax rate τ , cost of debt kd , growth rate g , leverage L , and cost of equity ke^u . We assumed that all valuation parameters are independent of each other and uniformly distributed over the following intervals:²⁴

$$\begin{aligned} r \in [10\%; 60\%], \quad \tau \in [25\%; 35\%], \quad kd \in [2\%; 4\%], \\ w \in [0.5\%; 1.5\%], \quad L \in [40\%; 200\%], \quad ke^u \in [5\%; 10\%] \end{aligned} . \quad (66)$$

The cash dividend tax rate and the effective capital gains tax rate are assumed to be 25% and 12.5%, respectively. The interest tax rate is also 25%.

Based on these assumptions, the conducted simulation leads to the frequency distribution of the percentage valuation error in the ME case depicted in Figure 3.

²⁴ Note that the free cash flow is independent of debt effects and hence cancels out with the percentage value difference p^{ME} in equation (65) and p^{HP} in equation (67).

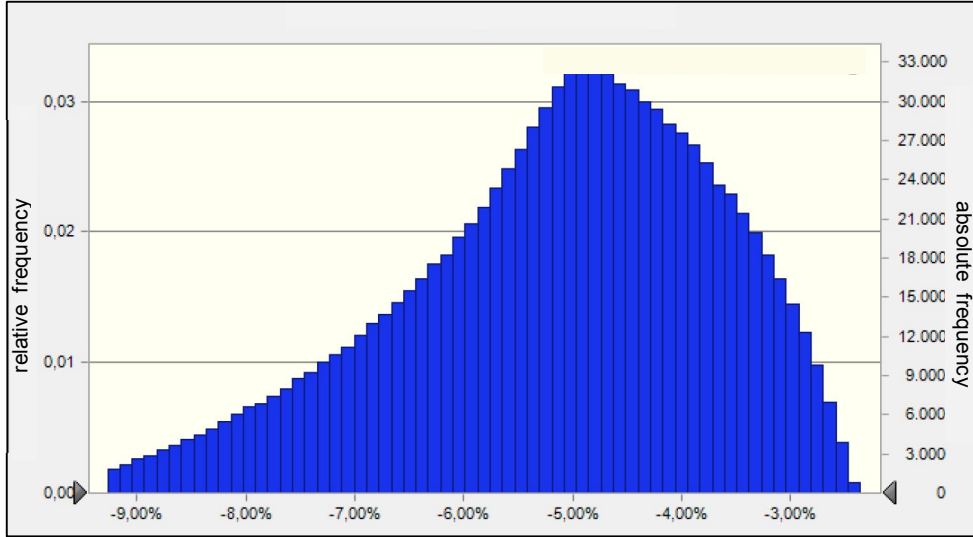


Figure 3: Frequency distribution of the valuation error in the ME setting.

Determining the equity market value using the valuation formula (62) with the cost of equity according to (63), instead of the valuation formulae (49) and (52) with the cost of equity according to (58), always produces an underestimation of the equity market value. The average valuation error is approximately -5.2% , with maximum and minimum valuation errors of -10.1% and -2.4% , respectively, and a standard deviation of 1.5% . A sensitivity analysis shows that 54% resp. 45.8% of the valuation error can be explained by the cash dividend ratio and the leverage. The lower the leverage and the cash dividend ratio, the higher the valuation error. Overall, if the firm distributes its excess cash mainly via share repurchases and has a low leverage, the percentage valuation error becomes severe.

The percentage valuation difference in the HP case, p^{HP} , yields

$$p^{HP} = \frac{E_{r=1}^{\ell,HP} - E^{\ell,HP}}{E^{\ell,HP}}. \quad (67)$$

As above, $E^{\ell,HP}$ denotes the equity market value in the HP case and is calculated as sum of the market value without tax shields from share repurchases $E^{\ell,c}$ (equation (49)) and the added market value $E^{\ell,A}$ according to (52). The cost of capital is computed using the cost of equity according to (61). For all valuation parameters, the same distributions apply as in the ME case. The conducted simulation leads to the frequency distribution depicted in Figure 4.

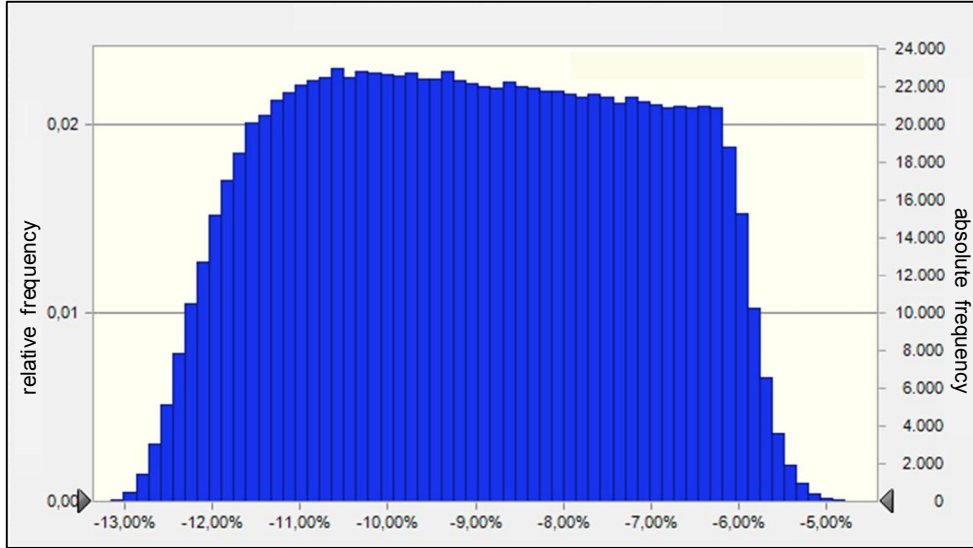


Figure 4: Frequency distribution of the valuation error in the HP setting.

As in the ME case, the application of valuation formula (64) always produces an underestimation of the equity market value. The average valuation error is approximately -9% , with maximum and minimum valuation errors of -13.2% and -4.6% , respectively, and a standard deviation of 1.9% . A sensitivity analysis shows that 96% of the valuation error is explained by the cash dividend ratio, and that the valuation error increases as the cash dividend ratio decreases. In the HP case, the level of leverage has a negligible small effect on the valuation error. This is mainly because the cost of equity in the HP case (equation (61)) is independent of the cash dividend ratio r and hence independent of the distribution strategy. The valuation error is severe for those firms distributing their excess cash mainly via share repurchases. The valuation error tends to be even higher than in the ME case as the cost of equity does not increase with share repurchases.

From the two simulations above, it becomes evident that the distribution strategy as the level of the cash dividend ratio r has a big impact on the valuation errors in the ME and HP case. To obtain the average valuation underestimations under specific distribution strategies, we run six additional simulations, in which we assume different deterministic cash dividend ratios from 10% to 60% . The other valuation parameters underlie the same distributions as in (66). The six additional simulations results are summarized in Figure 5.

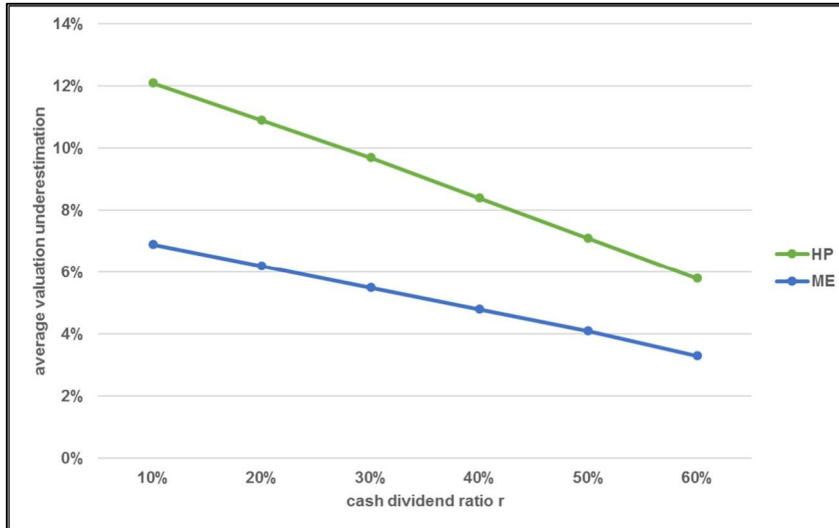


Figure 5: Average valuation underestimation in dependence of different cash dividend ratios r .

For example, if the cash dividend ratio is set to 10% the average equity market value underestimation is over 12% in the HP case and approximately 7% in the ME case if the applied valuation model does not account for share repurchases under otherwise identical assumptions. These additional simulation results emphasize the relevance of our valuation model, especially in cases of low cash dividend ratios.

3.6 Conclusions

Share repurchases have become an important alternative to distribute excess cash to shareholders, not least due to the personal tax advantage they provide in comparison to cash dividends. If both cash dividends and share repurchases are used, the equity market value increases with increasing share repurchases. Under an active debt management, this leads to the issuance of additional debt in order to adhere to the predetermined capital structure. Consequently, additional interests and tax shields arise, which in turn affect the flow to equity and thereby the equity market value.

The central result of this paper is a valuation model with three different personal tax rates for dividends, capital gains, and interests that account for the interdependencies between cash dividends, share repurchases, and active debt management. In this valuation model, the equity market value is determined as the sum of the equity market value without tax shields from share repurchases and the added market value due to tax shields from share repurchases and additional debt effects. Furthermore, we revealed the effects of share repurchases on the cost of equity by deriving the necessary adjustment formulae in the ME and HP case. Those adjustment formulae are indeed similar to the known adjustment formulae without personal taxes, but allow considering personal taxes in both cases. In the ME case, the adjustment formula is dependent on the cash dividend ratio and hence accounts for the tax advantage of share repurchases.

Evidently, the financial risk increases not only for higher leverages, but also for lower cash dividend ratios, which leads to higher costs of equity. In contrast, the cost of equity is independent of the cash dividend ratio in the HP case.

Our valuation model accounts for an explicit forecast period and a steady state phase and can be applied in valuation practice without circularity problems in the ME as well as in the HP case. This opens the possibility for a differentiated valuation approach concerning the distribution of excess cash. This seems to be even more desirable as our simulations show that the value contribution of share repurchases is far from negligible in both cases. For practitioners, the valuation model in the HP case might be more attractive because the adjustment formula is formally simple and independent of the cash dividend ratio. Especially, the independence of the cash dividend ratio can be beneficial for the unlevering and relevering of beta factors. However, practitioners should be aware of the effect that the equity market value increases severely with decreasing cash dividend ratios. Finally, further theoretical research could focus on different assumptions regarding the firm's financing strategy (e.g., passive debt management) and its dividend strategy (e.g., an earnings-based dividend strategy) in consideration of personal taxes.

4 Valuation, personal taxes, and dividend policy under passive debt management²⁵

Stefan Dierkes and Johannes Sämpelmann

Abstract

We derive consistent valuation models in accordance with the flow to equity and adjusted present value approaches, which allow accounting for the firm's dividend policy and passive debt management in light of differentiated personal taxes at the equity investor level. Specifically, we establish appropriate adjustment formulas for the relationship between the firm's unlevered and levered cost of equity, which are the basis for the unlevering and relevering of beta factors. Furthermore, using simulations, we show that dividend policy has a significantly positive effect on equity market value.

Keywords: valuation, personal taxes, passive debt management, dividend policy, cost of equity

JEL Classification: G32, H20, M41

²⁵

Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3314012.

4.1 Introduction

Since debt financing provides a corporate tax advantage, the choice of a firm's financing policy between passive or active debt management, affects the value of tax shields and, thus, firm value (Miles & Ezzell, 1980, 1985; Modigliani & Miller, 1958, 1963).²⁶ Thereby, passive debt management is characterized by predetermined debt levels, whereas active debt management presumes predetermined capital structure targets in future periods. In this study, we assume passive debt management, as in Modigliani and Miller (1963). Besides financing policy, dividend policy, as the choice for distributing or retaining cash flows, also affects equity market value. This is because distributed cash flows are taxed at the cash dividend tax rate, which differs from the effective capital gains tax rate at which retained cash flows are taxed. In the past, the tax rate on realized capital gains used to be indeed lower than that on cash dividends. Nowadays, in the USA and numerous other countries, such as Germany, tax systems that equally tax cash dividends and realized capital gains exist. However, because investments in shares are usually long term, the corresponding capital gains are normally not realized immediately. Hence, capital gains taxes can be deferred, resulting in a tax advantage compared to the cash dividend taxes (Berk & DeMarzo, 2017; Brealey et al., 2017).²⁷ Overall, the relevance of the dividend policy considering differentiated personal tax rates at the equity investor level and the assumption of passive debt management in this paper lead to a valuation model that has not yet been developed in the literature.

A starting point for integrating personal taxes in valuation models are the studies of Farrar and Selwyn (1967) and Myers (1967). The literature most closely related to dividend policy in consideration of differentiated personal tax rates at the equity investor level starts with the study of Amoako-Adu (1983). The author assumes – as we do – that the cash flow available for distribution is distributed to equity investors by a predetermined payout ratio, while the remaining cash flow is retained by the firm. He derives a valuation model according to the adjusted present value (APV) approach, assuming passive debt management and a steady state, wherein new investments equivalent to the depreciations are undertaken. Subsequently, Rashid and Amoako-Adu (1987) only extend the existing APV approach of Amoako-Adu (1983) by an inflation-based growth of all relevant values, accordingly not recognizing additional real growth. Moreover, Rashid and Amoako-Adu (1995) derive an adjustment formula for the cost of equity, which is consistent with the derived market value of tax shields in their 1987 study. Consequently, it is also possible to apply the flow to equity (FtE) approach. However, we show that the valuation models of Rashid and Amoako-Adu (1987, 1995) contain inconsistencies regarding the effective capital gains tax rate, resulting from the assumption of a steady state with an

²⁶ Modigliani and Miller (1958, 1963) and Miles and Ezzell (1980, 1985) abstract from personal taxes.

²⁷ The optimal dividend policy would imply that a firm pays no cash dividends at all. However, cash dividends are created because of signaling effects and other reasons (Arditti, Levy & Sarnat, 1976; Black, 1976).

inflation-based growth of all relevant values. Note that an explicit forecast period is neither accounted for by Amoako-Adu (1983) nor Rashid and Amoako-Adu (1987, 1995).

More recent studies with respect to the integration of personal taxes in valuation models deal with, for example, the tax loss treatment in case of debt default (Cooper & Nyborg, 2008; Molnár & Nyborg, 2013). A recent study published by Dempsey (2017) develops different discounting techniques for the various DCF models, while integrating personal taxes. Specifically, he derives weighted average cost of capital and cost of equity under both passive and active debt management according to the debt adjustment assumptions of Harris and Pringle (1985). Moreover, he shows that the different DCF models yield the same equity market value, given an explicit forecast period. Concerning the personal taxation of equity investors, each of the above-mentioned recent studies assumes a blended personal tax rate on cash dividends and capital gains (Sick, 1990; Taggart, 1991). In particular, Dempsey (2017, pp. 3-4) writes: “For simplicity of exposition, q_E is defined here as a single value for a particular firm that encapsulates the mix of how the firm chooses between retentions to equity, dividends and stock repurchases.” Hence, the assumption of a blended personal tax rate serves as a simplification as it keeps the valuation models tractable. However, commonly, it remains an open question how such a blended personal tax rate is determined and, consequently, this indeterminacy results in difficulties when applying the valuation models.

The contribution of this study to the literature is threefold. First, we develop the valuation model of a firm under passive debt management, which distributes part of its cash flow as cash dividends and retains the other part. The retained cash flow is assumed to be used for share repurchases (Rashid & Amoako-Adu, 1987, 1995). The consideration of two different equity investor tax rates on cash dividends and effective capital gains leads to the derivation of a blended personal tax rate, which is dependent on the dividend policy of the firm. In the literature, it generally remains unclear how the dividend policy affects this tax rate (e.g., Dempsey, 2017). Second, the effects of the dividend policy on the cost of equity are disclosed by deriving appropriate adjustment formulas. Both the explicit forecast period and steady state phase are analyzed. Specifically, our derived adjustment formula for the steady state differs from that of Rashid and Amoako-Adu (1995), who do not account for the effective capital gains tax rate consistently. Conceptually, the FtE and APV approaches developed by Dempsey (2017) can be converted and specified into the FtE and APV approaches derived in this study under the assumptions of passive debt management and uniform blended personal tax rates. In this regard, the derivation of the blended personal tax rate has implications for the underlying cost of equity. To the best of our knowledge, the interdependent effects between the blended personal tax rate in this paper and the underlying cost of equity have not been detected in the existing literature. Finally, the relevance of our derived valuation model is demonstrated for each case by using numerical examples and simulations compared to a valuation model, which assumes the full distribution

of the FtE to equity investors. Specifically, the simulation results show that the average valuation underestimation is 7.6% if the FtE is fully distributed to equity investors under otherwise identical assumptions. Overall, the main results of this paper are consistent valuation models that allow accounting for a firm's dividend policy and passive debt management in light of differentiated personal taxes at the equity investor level.

The remainder of this paper is structured as follows. In Section 2, the valuation model of the unlevered firm is presented. Then, the valuation model of the levered firm is developed according to the FtE approach under passive debt management in Section 3. Subsequently, we derive the market value of tax shields and adjustment formulas for the cost of equity of the levered firm in Section 4. In Section 5, we present numerical examples and simulation results for the valuation differences under different dividend policies. Finally, Section 6 concludes the paper.

4.2 Valuation model for the unlevered firm

In the following, we divide the forecast horizon into an explicit forecast period and a subsequent steady state. In the steady state, all relevant variables increase at a nominal growth rate g , which considers an inflation-based growth and/or real growth (Friedl & Schwetzler, 2011; Penman, 2013). We expect that the firm is all-equity financed. The expected free cash flow, $E[\widetilde{FCF}_t]$, in period $t = 1, 2, \dots$ is given. Generally, the firm will not distribute the full free cash flow as cash dividends to equity investors, but only a certain percentage of it. This might be due to several reasons, such as exploiting the tax advantage of retained over distributed cash flows. Therefore, firm's management sets a deterministic payout ratio, $r_t \leq 1$, in period t , which is related to the free cash flow. Consequently, the expected cash dividend, $E[\widetilde{Div}_t^u]$, of the unlevered firm is calculated as:²⁸

$$E[\widetilde{Div}_t^u] = r_t \cdot E[\widetilde{FCF}_t], \quad \text{for } t = 1, \dots, T, \quad (68)$$

where T depicts the end of the explicit forecast period. In the presence of personal taxes, distributed and retained cash flows have different tax implications. The proportion of the free cash flow, r_t , which is distributed to equity investors, is taxed at the cash dividend tax rate, τ_d . The residual $(1 - r_t)$ of the free cash flow is retained by the firm. We follow Rashid and Amoako-Adu (1987, 1995) in assuming that the retained free cash flows are used for share repurchases to maintain the independence of investment and financing decisions. Hence, the retained free cash flows lead to stock price appreciation and are thus taxed at the effective capital gains tax rate, τ_g . The cash dividend and effective capital gains tax rates are not assumed to vary across

²⁸ All random variables are denoted by a tilde.

equity investors and time. Regarding their magnitude, we expect $\tau_d > \tau_g$ due to the possible deferral of capital gains taxes. Under the common assumption that capital gains correspond to changes in market value (e.g., Clubb & Doran, 1992; Cooper & Nyborg, 2008), the expected market value of the unlevered firm, $E[\tilde{V}_{t-1}^u]$, in period $t-1$ is determined under a recursive approach, as follows:

$$E[\tilde{V}_{t-1}^u] = \frac{\overbrace{r_t \cdot E[\widetilde{FCF}_t]}^{\text{cash dividends}} \cdot (1 - \tau_d) + \overbrace{(1 - r_t) \cdot E[\widetilde{FCF}_t]}^{\substack{\text{retained free cash flows} \\ \text{used for share repurchases}}} \cdot (1 - \tau_g) - \tau_g \cdot \overbrace{(E[\tilde{V}_t^u] - E[\tilde{V}_{t-1}^u])}^{\text{change in market value}} + E[\tilde{V}_t^u]}{1 + ke^u}, \quad \text{for } t = 1, \dots, T. \quad (69)$$

The cost of equity for the unlevered firm after personal taxes equals ke^u and is assumed to be given and constant over time. Note that equation (69) is consistent with prior research (Samuelson, 1964), that is, under a uniform personal tax rate, the cost of equity without personal taxes is obtained by dividing the cost of equity with personal taxes ke^u to one minus the uniform personal tax rate.

Apparently, the taxation of changes in market value in (69) leads to a circularity problem because the market value in period $t-1$ is included in the tax base for the taxation of capital gains. However, this problem is overcome by solving equation (69) for the expected market value in period $t-1$. Additionally, dividing the numerator and denominator by $(1 - \tau_g)$ leads to:

$$E[\tilde{V}_{t-1}^u] = \frac{E[\widetilde{FCF}_t] \cdot (1 - \tau_{E,t}^r) + E[\tilde{V}_t^u]}{1 + ke^{u*}}, \quad \text{for } t = 1, \dots, T, \quad (70)$$

where $\tau_{E,t}^r = r_t \cdot (\tau_d - \tau_g) / (1 - \tau_g)$ represents the blended personal tax rate and $ke^{u*} = ke^u / (1 - \tau_g)$ the modified cost of equity of the unlevered firm. Specifically, the blended personal tax rate $\tau_{E,t}^r$ considers all effects resulting from retentions and cash dividends due to the differentiated personal taxation of cash dividends and capital gains. To obtain the blended personal tax rate, $\tau_{E,t}^r$, we need to modify the unlevered cost of equity, ke^u and, consequently, use ke^{u*} when applying equation (70).²⁹ Under different tax rates for cash dividends and effective capital gains, equation (70) indicates that the higher the payout ratio, r_t , is, the higher the

²⁹ In this context, it remains an open question how the blended personal tax rate is determined by Dempsey (2017). Thus, the modification of the cost of equity is not calculated. Consequently, it is not possible to use the blended personal tax rate without modifying the cost of equity.

blended personal tax rate, $\tau_{E,t}^r$, is and, consequently, the lower the firm market value. Note that the increase in firm market value only stems from the differences in personal tax rates regarding cash dividends and effective capital gains (Rashid & Amoako-Adu, 1987). Therefore, if $\tau_d = \tau_g$, equation (70) corresponds to Miller and Modigliani's (1961) dividend policy irrelevance result and transforms into a valuation model without personal taxes.

Given a steady state, all expected values (e.g., EBIT and capital expenditures) increase at a constant and uniform growth rate, g . Accordingly, the expected market value of the unlevered firm also increases at this growth rate in (70) and, hence, $E[\tilde{V}_t^u] = E[\tilde{V}_{t-1}^u] \cdot (1 + g)$. Consequently, we obtain the market value of the unlevered firm in the steady state as:

$$E[\tilde{V}_T^u] = \frac{E[\widetilde{FCF}_{T+1}] \cdot (1 - \tau_E^r)}{ke^{u^*} - g}, \quad (71)$$

where payout ratio r is constant and, consequently, $\tau_E^r = r \cdot (\tau_d - \tau_g) / (1 - \tau_g)$ holds. Given equations (70) and (71), the market value of the unlevered firm can be determined over an explicit forecast period and a subsequent steady state, accounting for the firm's dividend policy in light of the differentiated personal taxes at the equity investor level.

4.3 Valuation model for the levered firm

Henceforth, we assume passive debt management, which is characterized by predetermined debt levels, D_{t-1} , in period $t = 1, 2, \dots$. In the steady state, all relevant values increase at a constant and uniform growth rate, g , so that this growth also holds for debt levels and, consequently $D_{T+1} = D_T \cdot (1 + g)$. The debt market value equals debt book value. Because creditors do not have to bear any risk, the cost of debt, kd , corresponds to the risk-free interest rate, which is constant over time. Furthermore, we assume a constant corporate tax rate, τ , which is independent of the amount of taxable income. Interest on debt is fully deductible from taxable income (e.g., Miles & Ezzell, 1980; Modigliani & Miller, 1963). In the following, we focus on determining equity market value according to the FtE approach because of the need to derive appropriate adjustment formulas to actually apply this approach. The derivation of these adjustment formulas in the explicit forecast period and steady state is especially important, as they form the basis for the unlevering and relevering of beta factors in valuation practice. However, besides the FtE approach, it is also possible to determine equity market value according to the APV approach, as the market value of tax shields is the key component in deriving the adjustment formulas.

Following the argumentation in the preceding section, the expected cash dividend of the levered firm, $E[\widetilde{Div}_t^\ell]$, is calculated as:³⁰

$$E[\widetilde{Div}_t^\ell] = r_t \cdot E[\widetilde{FtE}_t], \quad \text{for } t = 1, \dots, T, \quad (72)$$

where the expected FtE, $E[\widetilde{FtE}_t]$, is defined as $E[\widetilde{FtE}_t] = E[\widetilde{FCF}_t] - kd \cdot (1 - \tau) \cdot D_{t-1} + \Delta D_t$, with $\Delta D_t = D_t - D_{t-1}$ as the change in debt market value over period t . As the debt market value is deterministic over each period, as per the assumption of passive debt management, FtE can be determined without circularity problems. Then, the expected equity market value, $E[\widetilde{E}_{t-1}^\ell]$, is:

$$E[\widetilde{E}_{t-1}^\ell] = \frac{\overbrace{r_t \cdot E[\widetilde{FtE}_t]}^{\text{cash dividends}} \cdot (1 - \tau_d) + \overbrace{(1 - r_t) \cdot E[\widetilde{FtE}_t]}^{\text{retained flow to equity used for share repurchases}} \cdot (1 - \tau_g) - \tau_g \cdot \overbrace{(E[\widetilde{E}_t^\ell] - E[\widetilde{E}_{t-1}^\ell])}^{\text{change in market value}} + E[\widetilde{E}_t^\ell]}{1 + ke_t^\ell}, \quad \text{for } t = 1, \dots, T, \quad (73)$$

where ke_t^ℓ depicts the cost of equity for the levered firm. Note that equation (73) is similar to (69), but refers to the expected FtE. Solving the circularity problem and dividing the numerator and denominator by $(1 - \tau_g)$, we obtain:

$$E[\widetilde{E}_{t-1}^\ell] = \frac{E[\widetilde{FtE}_t] \cdot (1 - \tau_{E,t}^r) + E[\widetilde{E}_t^\ell]}{1 + ke_t^{\ell*}}, \quad \text{for } t = 1, \dots, T, \quad (74)$$

where $ke_t^{\ell*} = ke_t^\ell / (1 - \tau_g)$ depicts the modified cost of equity of the levered firm. Equation (74) is identical with equation (8) in Dempsey (2017) for $q_E = 1 - \tau_{E,t}^r$ and $K_{E,i} = ke_t^{\ell*}$.³¹ Thus, equation (8) in Dempsey (2017) and equation (74) in this paper differ with regard to the specification of the blended personal tax rate and levered cost of equity. Specifically, the blended value of q_E in Dempsey (2017) is not further defined and thus how it is determined remains an

³⁰ We expect that payout ratios r_t and r are identical for the levered and unlevered firms.

³¹ Note that index i in $K_{E,i}$ denotes the corresponding period. When comparing equation (74) with equation (8) in Dempsey (2017), we note that the expected FtE in (74) can also be determined as:

$$E[\widetilde{FtE}_t] = \overbrace{E[\widetilde{EBIT}_t]}^{E[\widetilde{FCF}_t]} \cdot (1 - \tau) + E[\widetilde{Q}_t] - E[\widetilde{I}_t] - kd \cdot (1 - \tau) \cdot D_{t-1} + \Delta D_t, \quad \text{with } E[\widetilde{Q}_t] \text{ as the expected non-cash adjustments and } E[\widetilde{I}_t] \text{ as expected investments.}$$

open question.³² Conversely, the blended personal tax rate, $\tau_{E,t}^r$, allows accounting for the dividend policy of the firm resulting from the different personal tax rates at the equity investor level. Similar to the calculation of the modified cost of equity of the unlevered firm in the preceding section, the modified levered cost of equity, $ke_t^{\ell*}$, in equation (74) results from the derivation of the blended personal tax rate, $\tau_{E,t}^r$. As Dempsey (2017) does not specify blended value q_E the modification of the levered cost of equity, $K_{E,i}$, is consequently not calculated. In this respect, the relation between $K_{E,i}$ and the blended value of q_E is not revealed by equation (8) in Dempsey (2017).

Given a steady state, we obtain:

$$E[\tilde{E}_T^\ell] = \frac{E[\widetilde{FtE}_{T+1}] \cdot (1 - \tau_E^r)}{ke^{\ell*} - g}, \quad (75)$$

where $ke^{\ell*} = ke^\ell / (1 - \tau_g)$.³³ Admittedly, equations (74) and (75) cannot be used, because the costs of equity of the levered firm, ke_t^ℓ and ke^ℓ , are yet to be determined in the explicit forecast period and steady state. The key component for the derivation of adjustment formulas is the market value of tax shields, which is determined in the next section.

4.4 Market value of tax shields and cost of equity

To derive tax shields, we sum the FtE and flow to debt and respectively subtract the free cash flow after personal taxes. As, under passive debt management, the debt market value, D_{t-I} , is deterministic and assumed not to contain any default risk and the payout ratio, r_t , is also deterministic, the appropriate discount rate for the tax shields is the risk-free interest rate after personal taxes, $kd \cdot (1 - \tau_b)$, for all periods.

³² In Dempsey (2017), the job of converting cash flows to market values is allocated to blended value q_E , which is rather unusual when dealing with DCF models. Accordingly, Dempsey defines his cost of equity, $K_{E,i}$, as market expected growth rate. However, do note that this does not alter the comparison.

³³ Multiplying the numerator and denominator in (75) by $(1 - \tau_g)$ shows that, for $g = \pi$, with π as the inflation rate, the growth rate in equation (6) in Rashid and Amoako-Adu (1995) is not multiplied by one minus the effective capital gains tax rate. In this respect, Rashid and Amoako-Adu (1995) refer also to a blended personal tax rate, $\tau_E^{RA,r}$, defined as $\tau_E^{RA,r} = r \cdot \tau_d + (1 - r) \cdot \tau_g$ (similar to Cooper & Nyborg, 2004). The difference from our derived personal tax rate results because the relation between the levered cost of equity and the blended personal tax rate is neither disclosed by Rashid and Amoako-Adu (1995) nor by Cooper and Nyborg (2004).

Accordingly, we obtain the market value of tax shields, VTS_{t-1} , in the explicit forecast period (see Appendix 4 for details):

$$VTS_{t-1} = \frac{(\tau \cdot kd \cdot D_{t-1} - kd \cdot D_{t-1} + \Delta D_t) \cdot (1 - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g)}{1 + kd \cdot (1 - \tau_b)} + \frac{kd \cdot D_{t-1} \cdot (1 - \tau_b) - \Delta D_t \cdot (1 - \tau_g) - \tau_g \cdot (VTS_t - VTS_{t-1}) + VTS_t}{1 + kd \cdot (1 - \tau_b)},$$

for $t = 1, \dots, T$, (76)

where τ_b is the constant personal tax rate of debt investors on interest, which is assumed not to vary across them. Overall, we presume three different personal tax rates on cash dividends, interest, and effective capital gains.³⁴ Solving (76) for VTS_{t-1} , rearranging terms, and dividing the numerator and denominator by $(1 - \tau_g)$ yields:

$$VTS_{t-1} = \frac{\overbrace{\tau \cdot kd \cdot D_{t-1} \cdot (1 - \tau_{E,t}^r)}^{\text{corporate tax shield}}}{1 + kd \cdot (1 - \tau_b^*)} - \frac{\overbrace{kd \cdot D_{t-1} \cdot (\tau_b^* - \tau_{E,t}^r)}^{\text{debt interest tax shield}}}{1 + kd \cdot (1 - \tau_b^*)} - \frac{\overbrace{\Delta D_t \cdot \tau_{E,t}^r}^{\text{change in debt tax shield}}}{1 + kd \cdot (1 - \tau_b^*)} + \frac{VTS_t}{1 + kd \cdot (1 - \tau_b^*)},$$

for $t = 1, \dots, T$, (77)

where $\tau_b^* = (\tau_b - \tau_g) / (1 - \tau_g)$ is the modified personal tax rate at the debt investor level. Equation (77) shows that the market value of tax shields can be split into three parts. The corporate tax shield results from the tax deductibility of interest in corporate tax base accounting for the dividend policy of the firm and personal taxes. This tax shield is known from the valuation calculation without personal taxes. The debt interest tax shield and the change in the debt tax shield relate to the different personal taxations of equity and debt investors. Regarding the debt interest tax shield, equity investor tax rates are affected by the payout ratio, while the debt investor tax rate is not. The change in the debt tax shield relates to the different personal taxation of the changes in debt market value, thus connecting the debt issue and redemption to higher or lower distributed or retained cash flows. It is worth noting that the debt issue and redemption are not subject to the personal taxation of debt investors. However, the change in debt market value is tax-relevant for equity investors (e.g., Dempsey, 2017). In case of growth of the firm, generally, $\Delta D_t > kd \cdot (1 - \tau) \cdot D_{t-1}$ holds and, consequently, equation (77) indicates that the

³⁴ In several European countries, the tax rates on cash dividends and interests are identical and, thus, $\tau_b = \tau_d$.

higher the payout ratio, r_t , is, the smaller are the modified tax shields in period t (see Appendix 5 for further details).³⁵

In the steady state, we obtain (see Appendix 6):

$$VTS_T = D_T \cdot \left(1 - \frac{(kd \cdot (1 - \tau) - g) \cdot (1 - \tau_E^r)}{kd \cdot (1 - \tau_{b^*}) - g} \right). \quad (78)$$

Equation (78) indicates that, in general, the higher the payout ratio, r , is, the higher are the modified tax shields (see, again, Appendix 5). Hence, similar to higher debt levels, higher distributions increase the modified tax shields in (78). Compared to the value effect of the payout ratio, r_t , on the modified tax shields in case of growth of the firm in (77), the increase of the modified tax shields in the steady state due to higher payout ratio r in (78) is rather counterintuitive because the cash dividend tax rate is actually higher than the effective capital gains tax rate.

According to the APV approach, we can now determine firm market value by first determining the market value of the unlevered firm (equations (70) and (71)), and then the market value of tax shields (equations (77) and (78)) in the explicit forecast period and subsequent steady state. To determine equity market value, we subtract debt market value from firm market value.

Linking equation (70) with equations (74) and (77), we can derive the levered cost of equity, ke_t^ℓ , in period t in the explicit forecast period (see Appendix 7 for details):

$$ke_t^\ell = ke^u + (ke^u - kd \cdot (1 - \tau_b)) \cdot \frac{D_{t-1} - VTS_{t-1}}{E[\tilde{E}_{t-1}^\ell]}, \quad \text{for } t = 1, \dots, T. \quad (79)$$

Provided that the firm is in a steady state and thus substituting equation (78) in (79), we obtain:

$$ke^\ell = ke^u + (ke^u - kd \cdot (1 - \tau_b)) \cdot \frac{(kd \cdot (1 - \tau) - g) \cdot (1 - \tau_E^r)}{kd \cdot (1 - \tau_{b^*}) - g} \cdot L(r), \quad (80)$$

where $L(r) = D_T / E[\tilde{E}_T^\ell]$. When multiplying the numerator and denominator in (80) by $(1 - \tau_g)$, it becomes obvious that the adjustment formula in Rashid and Amoako-Adu's (1995)

³⁵ Note that equation (77) is identical to equation (21) in Dempsey (2017) for $q_E = 1 - \tau_{E,t}^r$, $q_D = 1 - \tau_{b^*}$, $r_D = kd$, and $K_{CTB} = kd \cdot (1 - \tau_{b^*})$. In Dempsey's (2017) study, K_{CTB} serves as the risk-adjusted discount rate for tax shields in equation (21). Consequently, when assuming passive debt management and risk-free debt, K_{CTB} equals the risk-free interest rate after modifying personal taxes, $kd \cdot (1 - \tau_{b^*})$. Similar to the previous section, the modified personal tax rate of debt investors, τ_{b^*} , results when deriving the blended personal tax rate, $\tau_{E,t}^r$.

equation (7) does not account for the effective capital gains tax rate consistently as, for $g = \pi$, with π as the inflation rate, the growth rate is not multiplied by one minus the effective capital gains tax rate.

As the unlevering of beta factors is usually conducted assuming solely a steady state, the derivation of asset betas according to the reformulation of equation (80) requires information about the payout ratios of reference companies. In this regard, note that leverage $L(r)$ in equation (80) is dependent on payout ratio r , as the cash dividend tax rate exceeds the effective capital gains tax rate. Concerning the effect of the dividend policy on the levered cost of equity, an interesting result is that the level of the levered cost of equity, ke^ℓ , in the steady state is independent of the level of payout ratio r according to equation (80). This is because with, for example, a higher payout ratio, r , τ_E^r increases and $(kd \cdot (1 - \tau) - g) \cdot (1 - \tau_E)$ accordingly decreases; however, $L(r)$ increases because $E[\tilde{E}_T^\ell]$ decreases. Remarkably, the two opposite value effects cancel each other out.³⁶ This is even more surprising as, intuitively, with a higher payout ratio, r , the more the levered cost of equity should increase due to the higher tax payments equity investors are obligated to from the difference in the cash dividend and effective capital gains tax rates (Rashid & Amoako-Adu, 1987). Specifically, the adjustment formula in (80) is identical for $g = 0$, $q_E = 1 - \tau_E^r$, $q_D = 1 - \tau_{b^*}$, $K_U = ke^u$, $K_E = ke^\ell$, and $K_D = r_D \cdot q_D = kd \cdot (1 - \tau_{b^*})$ with equation (25) in Dempsey (2017).³⁷ Eventually, the derived adjustment formulas in (79) and (80) resemble those developed by Modigliani and Miller (1958, 1963) and Miles and Ezzell (1980, 1985). Starting from the cost of equity, ke^u , which depicts operating risk, a risk premium is added to incorporate financial risk.

Given adjustment formulas (79) and (80), the FtE approach is also applicable. However, as the adjustment formulas require the equity market value as input parameter, the application of (74) and (75) indicates circularity problems. These circularity problems easily can be solved using a common spreadsheet software. However, in this respect, the APV approach has the advantage that the valuation can be conducted without circularity problems.

³⁶ This is because the blended personal tax rate, τ_E^r , cancels out of the adjustment formula in (80). However, note that this simplification results in an adjustment formula with unobservable input parameters, which causes difficulties when it comes to the unlevering of beta factors in valuation practice. For details, see Appendix 8.

³⁷ The substitution of equation (13) in (24) from Dempsey (2017) and solving for K_E leads to:

$$K_E = K_U + (K_U - r_D \cdot q_D) \cdot (1 - \alpha) \cdot \frac{\Theta}{1 - \Theta}, \text{ with } \alpha = 1 - \frac{(1 - \tau) \cdot q_E}{q_D} \text{ and } \Theta = D_T / E[\tilde{V}_T^\ell], \text{ which is identical to equation (25) in Dempsey (2017) for } K_D = r_D \cdot q_D.$$

4.5 Illustration of the implications of dividend policy on equity market value

Here, we examine how the valuation results vary depending on the level of payout ratio r . For this, we compare a firm that fully distributes the FtE to its equity investors ($r = 1$) with a firm that retains part of its FtE ($r < 1$). We first show a simple numerical example assuming a steady state, in which all relevant values increase at a nominal growth rate, g . Firm 1 sets a payout ratio of 100% and firm 2 of 50%. The other assumptions, which hold for both firms are:

$$\begin{aligned} g &= 1\%; \tau = 30\%; \tau_d = \tau_b = 25\%; \tau_g = 12.5\%; kd = 5\%; \\ ke^u &= 10\%; D_0 = 2,000; E[\widetilde{FCF}_1] = 500 \end{aligned} \quad (81)$$

We avoid the circularity problem associated with the FtE approach by first valuing the firm according to the APV approach. Subsequently, leverage is known and we can value the firm according to the FtE approach. The conducted valuations according to the APV approach for firms 1 and 2 lead to the results in Table 1.

APV approach	Firm 1 ($r = 100\%$)	Firm 2 ($r = 50\%$)
Free cash flows after blended personal taxes	429	464
Market value of the unlevered firm	4,110	4,452
Market value of tax shields	696	587
Equity market value	2,805	3,039
Leverage	71%	66%

Table 1: Application of the APV approach.

The market value of the unlevered firm is calculated according to equation (71). Obviously, the unlevered firm's market value increases with decreasing payout ratio r due to the higher cash dividend tax rate compared to the effective capital gains tax rate. The market value of tax shields is computed according to equation (78). Interestingly, the higher the payout ratio, r , is, the more the market value of tax shields increases. Hence, the market value of tax shields has a weakening effect on the personal tax advantage of retained cash flows compared to cash dividends. Eventually, the equity market value is calculated as the sum of the market values of the unlevered firm and of tax shields minus debt market value. Overall, Table 1 illustrates that equity market value is higher, the lower payout ratio r is. Consequently, the higher the payout ratio, r , is, the higher is the leverage.

From equation (75), the equity market value can be directly determined according to the FtE approach for firms 1 and 2. For the calculation of the levered cost of equity (equation (80)), we use the leverage in Table 1. The results of the application of the FtE approach are summarized in Table 2.

FtE approach	Firm 1 ($r = 100\%$)	Firm 2 ($r = 50\%$)
Flow to equity after blended personal taxes	386	418
Levered cost of equity	14.75%	14.75%
Equity market value	2,805	3,039

Table 2: Application of the FtE approach.

We note that, independently of the level of the payout ratio r , we calculate the same levered cost of equity. Eventually, we obtain the same equity market values as under the APV approach.

To illustrate the implications of dividend policy on the equity market value for a more general setting, we use simulations. For this, we assume two firms in a steady state. Firm 1 sets again a deterministic payout ratio of 100%. Consequently, the calculation of the equity market value, $E_0^{\ell, r=1}$, for firm 1 according to the FtE approach can be simplified to:

$$E_0^{\ell, r=1} = \frac{E[\widetilde{FtE}_1] \cdot (1 - \tau_E^{r=1})}{ke^{\ell*} - g}, \quad (82)$$

where $\tau_E^{r=1} = (\tau_d - \tau_g) / (1 - \tau_g)$.³⁸ As we calculate the same levered cost of equity independently of the level of the payout ratio, r , we can also use equation (80) for determining the modified levered cost of equity, $ke^{\ell*}$, in (82).

For firm 2, we assume payout ratio r to be drawn from a uniform distribution, $r \in [5\%; 95\%]$. To obtain an indication of the average expected valuation difference between firms 1 and 2, 1,000,000 valuation cases were simulated. We determine the percentage valuation difference in terms of equity market value if equation (82) is used instead of equation (75), with $r \in [5\%; 95\%]$. In this case, the percentage valuation difference p is calculated as:

$$p = \frac{E_0^{\ell, r=1} - E_0^{\ell}}{E_0^{\ell}} = \frac{(1 - r) \cdot (\tau_d - \tau_g)}{r \cdot (\tau_d - \tau_g) + \tau_g - 1} < 0. \quad (83)$$

³⁸ Note that $1 - \tau_E^{r=1}$ equals $(1 - \tau_d) / (1 - \tau_g)$ in footnote 1 in Dempsey (2017).

The equity investor tax rates are assumed to have the same values as those in the above numerical example (see (81)). Based on these assumptions, the conducted simulation leads to the frequency distribution of the percentage valuation difference in Figure. 6.

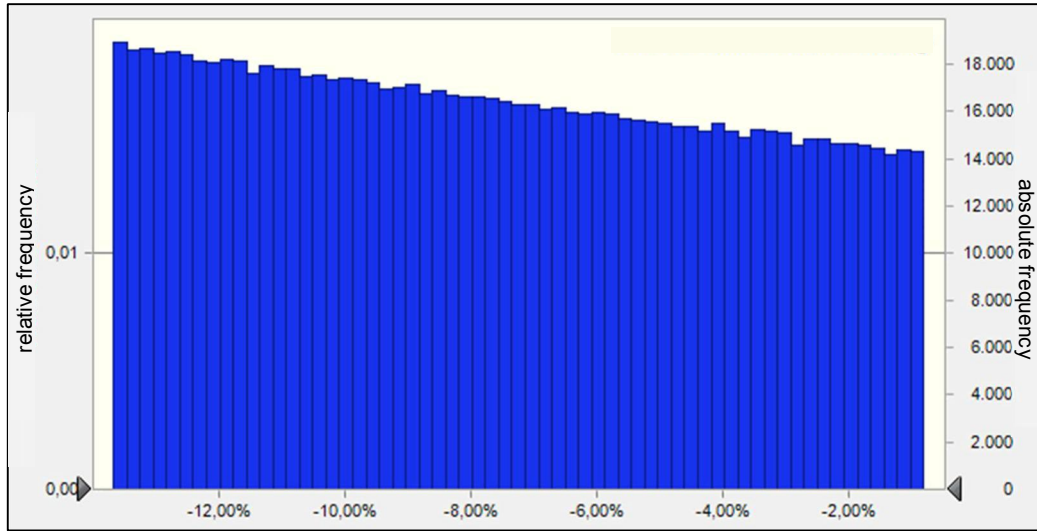


Figure 6: Frequency distribution of percentage valuation difference.

If (82) applies instead of (75), with $r \in [5\%; 95\%]$, the equity market value is always underestimated under our assumptions. The average valuation underestimation is approximately 7.6%, while the minimum and maximum valuation underestimations are 0.8% and 13.7%. From equation (83), the valuation underestimation increases with a decreasing payout ratio r and with the increasing difference between the cash dividend and effective capital gains tax rates. Eventually, the simulation results show that the assumption of a full distribution of the FtE to equity investors severely underestimates equity market value and emphasizes the relevance of our valuation model, especially for low payout ratios.

4.6 Conclusions

When incorporating personal taxes in DCF models, the dividend policy affects equity market value, as the cash dividend tax rate exceeds the effective capital gains tax rate. Consequently, the equity market value increases the more the firm engages in retaining cash flows. Thus, the main results of this paper are the proposed valuation models, which allow considering the firm's dividend policy over an explicit forecast period and a subsequent steady state under passive debt management. Specifically, we derive a blended personal tax rate, encapsulating all the effects resulting from retentions and cash dividends. By specifying the blended personal tax rate, we can actually apply the proposed valuation models. Furthermore, we reveal the impact of the dividend policy on the cost of equity by deriving appropriate adjustment formulas for the relationship between firm's unlevered and levered costs of equity, while assuming both an explicit forecast period and a steady state. These adjustment formulas have the same structure as

the one in valuation literature, which do not consider personal taxes. Practitioners should note that the unlevering of beta factors assuming a steady state requires information about the payout ratios of the reference companies.

Conceptually, the FtE and APV approaches derived by Dempsey (2017) can be converted and specified to the FtE and APV approaches in this study under the assumptions of passive debt management and uniform blended personal tax rates. Specifically, the use of the blended personal tax rate results in modified cost of equities. In this respect, our approaches open the possibility for a more differentiated valuation approach, especially concerning the effects of dividend policy on cash flows, tax shields, and cost of equity. This seems even more desirable, as our simulation results show that the value contribution of the chosen dividend policy of a firm on its equity market value is far from negligible: the average equity market value underestimation is approximately 7.6% if the valuation model assumes the full distribution of the FtE to the equity investors. Finally, further theoretical research could focus on different assumptions regarding a firm's financing policy (e.g., active debt management) and dividend policy (e.g., effects of share repurchases) in consideration of personal taxes. Furthermore, the explicit consideration of the default risk of debt might also be a promising future research field.

5 Unlevering und Relevering mit „falschen“ Anpassungsformeln – Wie schlimm ist das?

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In der Praxis der Unternehmensbewertung wird beim Unlevern und Relevern von Betafaktoren und Kapitalkostensätzen regelmäßig auch dann eine auf Modigliani und Miller zurückgehende Anpassungsformel angewendet, wenn die hierfür erforderlichen Voraussetzungen nicht erfüllt sind. In diesem Beitrag werden zunächst die aus theoretischer Sicht korrekten Anpassungsformeln in Abhängigkeit von der Berücksichtigung persönlicher Steuern, der Finanzierungspolitik, dem Risiko des Fremdkapitals und dem Verlauf des freien Cashflows dargestellt. Mit Hilfe von Simulationen wird dann analysiert, welche Bewertungsfehler entstehen, wenn nicht die korrekten Anpassungsformeln zum Einsatz kommen. Im Ergebnis zeigt sich, dass von einer undifferenzierten Vorgehensweise beim Unlevern und Relevern Abstand zu nehmen ist.

Schlagwörter: Unternehmensbewertung, Betafaktoren, Unlevering, Relevering, Finanzierungspolitik

5.1 Einleitung

Bei der Bewertung von Unternehmen mittels Discounted Cashflow (DCF) Verfahren werden die Kapitalisierungszinssätze kapitalmarktorientiert mit dem Capital Asset Pricing Model (CAPM) bestimmt. Das zentrale Risikomaß zur Ermittlung des Eigenkapitalkostensatzes gemäß dem CAPM stellt das Equity Beta dar. Dieser Betafaktor gibt im Allgemeinen an, wie hoch das relative und nicht über Portefeuillebildung diversifizierbare Risiko des Bewertungsobjekts im Vergleich zum Gesamtkapitalmarkt ist. Das Equity Beta berücksichtigt zwei Risikokomponenten. Dies ist zum einen das operative Risiko, das durch das Asset Beta erklärt wird und zum anderen das Finanzierungsrisiko, das aus der Verschuldung resultiert. Zur Ermittlung des Equity Betas wird zumeist auf Referenzunternehmen zurückgegriffen, deren operatives Risiko mit dem des Bewertungsobjekts als vergleichbar angenommen wird. Da sich das Finanzierungsrisiko zwischen Bewertungsobjekt und Referenzunternehmen üblicherweise unterscheidet, ist das Equity Beta der Referenzunternehmen beim Unlevern um deren Finanzierungsrisiko zu bereinigen und – sofern das zur Anwendung kommende DCF-Verfahren dies erfordert – beim Relevern um das Finanzierungsrisiko des Bewertungsobjekts anzureichern.³⁹

Für das Unlevern und Relevern existieren verschiedene Anpassungsformeln, die sich bspw. durch Annahmen hinsichtlich der Cashflow-Entwicklung oder der Finanzierungspolitik unterscheiden. Ebenso resultieren Unterschiede aus der Berücksichtigung oder Nicht-Berücksichtigung von persönlichen Steuern auf der Ebene der Kapitalgeber in Nach- bzw. Vorsteuerkalkülen sowie des Risikos des Fremdkapitals. Obwohl die Anwendung der Anpassungsformeln an spezifische Voraussetzungen geknüpft ist, verwendet die Bewertungspraxis in der Regel zwei vom IDW empfohlene, vergleichsweise einfache Anpassungsformeln.⁴⁰ Besonderer Beliebtheit erfreut sich die auf Modigliani und Miller (M/M) zurückgehende Anpassungsformel, bei der von einem Vorsteuerkalkül, dem Rentenfall ohne Wachstum, risikolosem Fremdkapital und autonomer Finanzierung ausgegangen wird.⁴¹ Entspricht die Bewertungssituation nicht diesen Annahmen – was nahezu stets der Fall ist – so wird der Unternehmenswert mit der M/M-Anpassungsformel ungenau und damit letztlich falsch ermittelt.⁴²

Sofern man die Definition der Kapitalkosten wie Kruschwitz/Löffler/Lorenz (2011) wegen deren empirischen Bestimmbarkeit und ökonomischen Interpretierbarkeit daran knüpft, dass es sich hierbei um bedingte erwartete, aber deterministische Renditen handelt, ist mit einer autonomen Finanzierung eine diesbezügliche Inkonsistenz verbunden.⁴³ Fraglich ist jedoch, ob man

³⁹ Vgl. Diedrich/Dierkes, Unternehmensbewertung, Stuttgart 2015, S. 126 f. sowie Ballwieser/Hachmeister, Unternehmensbewertung, 5. Aufl., Stuttgart 2016, S. 111.

⁴⁰ Vgl. IDW, WP Handbuch, Band 2, 2014, Rn. A 371 und A 372.

⁴¹ Vgl. Kruschwitz/Löffler/Lorenz, WPg 2011, S. 672; IDW a.a.O. (Fn. 38), Rn. A 371.

⁴² Auch in der Literatur finden sich Beispiele eines undifferenzierten Rückgriffs auf die M/M Anpassungsformel. Vgl. z. B. Ernst/Amann/Großmann/Lump, Internationale Unternehmensbewertung, München 2012, S. 83-86.

⁴³ Vgl. Kruschwitz/Löffler/Lorenz, a.a.O. (Fn. 39); Kruschwitz/Löffler/Lorenz, WPg 2012, S. 1048-1052.

hieraus den Schluss ziehen sollte, dass bei der Anpassung von Kapitalkosten auch dann die Anpassungsformeln bei wertabhängiger Finanzierung verwendet werden sollten, wenn das Unternehmen eine autonome Finanzierung verfolgt. In diesem Fall läge zwar keine Inkonsistenz mit der Definition von Kapitalkosten als bedingte erwartete, aber deterministische Rendite vor, jedoch würde dieses Vorgehen zu einem falschen Bewertungsergebnis führen, weil der Risikogehalt der künftigen Tax Shields nicht korrekt berücksichtigt wird. Wir gehen daher in diesem Beitrag wie in der Praxis üblich davon aus, dass im Fall einer autonomen Finanzierung Anpassungsformeln verwendet werden, die zu dieser Finanzierungspolitik passen und mithin auf den Überlegungen von Modigliani/Miller basieren. Hierbei sollte man sich jedoch darüber im Klaren sein, dass die Ableitung von Kapitalkosten aus empirisch beobachtbaren Renditen dann problematisch ist.⁴⁴ Darüber hinaus ist bei autonomer Finanzierung zu berücksichtigen, dass die künftigen Fremdkapitalquoten grundsätzlich unsicher sind und sich jeweils aus dem Quotient des deterministisch festgelegten Fremdkapitalbestands und des erwarteten Marktwerts des verschuldeten Unternehmens ergeben.⁴⁵ Meitner/Streitferdt (2012) zeigen anhand eines Beispiels, dass auf Basis ihrer Kapitalkostensatzdefinition auch bei dieser Konsequenz mittels der M/M-Anpassungsformel korrekte Unternehmenswerte ermittelt werden können.⁴⁶

Vor dem Hintergrund des Einflusses der Wahl der Anpassungsformel auf das Bewertungsergebnis ist es erstaunlich, dass die Anpassungsformel in der Bewertungspraxis vielfach nicht mit der konkreten Bewertungssituation abgestimmt wird. So wird die M/M-Anpassungsformel bspw. in Nachsteuerekalkülen angewendet, obwohl aus der Berücksichtigung persönlicher Steuern eigentlich die Notwendigkeit der Verwendung von spezifischen Nachsteuer-Anpassungsformeln erwächst. Eine standardisierte Anwendung etablierter Anpassungsformeln, die unabhängig von den tatsächlichen Gegebenheiten erfolgt, könnte man im Prinzip nur dadurch rechtfertigen, dass der hieraus resultierende Bewertungsfehler vernachlässigbar gering ist. Bislang mangelt es jedoch an einer systematischen Analyse der Bewertungsfehler, die mit der Anwendung nicht zur Bewertungssituation passender und damit falscher Anpassungsformeln verbunden sind, sodass hierüber letztlich keine Aussage getroffen werden kann. Der vorliegende Beitrag zielt daher auf die Analyse dieser Bewertungsfehler ab, wobei wir uns der Methodik der Simulation bedienen. Im Ergebnis zeigt sich, dass zum Teil erhebliche Bewertungsfehler auftreten können. Hieraus leitet sich für die Praxis die Empfehlung ab, dass die Auswahl von Anpassungsformeln bei der Unternehmensbewertung differenzierter vorzunehmen ist.

Der Beitrag ist wie folgt aufgebaut. Im nachfolgenden Kapitel 2 werden die aus theoretischer Sicht korrekten Anpassungsformeln für Betafaktoren in Abhängigkeit von der Finanzierungs-

⁴⁴ Vgl. Kruschwitz/Löffler/Lorenz, a.a.O. (Fn. 41), S. 1051.

⁴⁵ Vgl. hierzu Meitner/Streitferdt, WPg 2012, S. 1039; Diedrich/Dierkes a.a.O. (Fn. 37), S. 85-91.

⁴⁶ Vgl. Meitner/Streitferdt, a.a.O. (Fn. 43), S. 1039-1041.

politik, des Verlaufs des freien Cashflows und des Risikos des Fremdkapitals dargestellt. Darüber hinaus erfolgt eine Differenzierung in Vor- und Nachsteuerkalkülen, womit ein systematischer Überblick über die in Abhängigkeit von der Bewertungssituation anzuwendende Anpassungsformel gegeben wird, wie man ihn in der Literatur bislang nicht findet. Im Kapitel 3 wird mittels Simulationen analysiert, welche Bewertungsfehler entstehen können, wenn anstelle der korrekten eine unpassende Anpassungsformel verwendet wird. Im abschließenden Kapitel 4 wird auf die sich hieraus ergebenden Schlussfolgerungen für die Praxis der Unternehmensbewertung eingegangen.

5.2 Anpassungsformeln aus theoretischer Sicht

Für die Wahl der richtigen Anpassungsformel für das Un- und Relevanz von Betafaktoren sind die nachfolgenden Fragen entscheidend:

- a) Liegt in Bezug auf die Besteuerung der Kapitalgeber ein Vorsteuer- oder ein Nachsteuerkalkül vor?
- b) Welche Finanzierungspolitik wird angenommen?
- c) Ist das Fremdkapital ausfallgefährdet?
- d) Welchen Verlauf haben die freien Cashflows?

Im Weiteren wird zunächst von einem Vorsteuerkalkül ausgegangen, bei dem nur Steuern berücksichtigt werden, die auf der Unternehmensebene anfallen. Die persönliche Besteuerung auf Ebene der Kapitalgeber wird hierbei vernachlässigt und erst später bei den Anpassungsformeln für Nachsteuerkalküle berücksichtigt.

In Bezug auf die **Finanzierungspolitik** wird bei der Unternehmensbewertung zwischen einer autonomen und einer wertabhängigen Finanzierung unterschieden. Kennzeichen der den Beiträgen von M/M zugrunde liegenden autonomen Finanzierung ist, dass die Fremdkapitalbestände zum Bewertungszeitpunkt deterministisch festgelegt werden. Bei wertabhängiger Finanzierung werden hingegen die Fremdkapitalquoten oder die Verschuldungsgrade zum Bewertungszeitpunkt deterministisch bestimmt. Während man bei einer wertabhängigen Finanzierung gemäß Miles und Ezzell (M/E) davon ausgeht, dass die Fremdkapitalbestände nur zu Beginn einer Periode an die Fremdkapitalquote angepasst werden können, wird bei der wertabhängigen Finanzierung gemäß Harris und Pringle (H/P) unterstellt, dass die Anpassung der Fremdkapitalbestände kontinuierlich vorgenommen werden kann.⁴⁷

⁴⁷ Vgl. Drukarczyk/Schüler, Unternehmensbewertung, 7. Aufl., München 2016, S.162-170 oder Ballwieser/Hachmeister, a.a.O. (Fn. 37), S. 156 f.

Das **Ausfallrisiko** des Fremdkapitals wird im Credit Spread (cs_t) abgebildet, der die Differenz zwischen dem Fremdkapitalzinssatz und dem risikolosen Zinssatz angibt. Solange das Ausfallrisiko von Unternehmen nicht zu hoch ist, kann der Fremdkapitalzinssatz als hinreichend gute Annäherung für den Fremdkapitalkostensatz angesehen und dementsprechend in DCF Verfahren verwendet werden.⁴⁸ Wenn der Fremdkapitalkostensatz (kd_t) größer als der risikolose Zinssatz des Kapitalmarktes (r_t) ist, impliziert dies gemäß dem CAPM ein Debt Beta (β^D) größer null.⁴⁹ Bezeichnet MRP die Marktrisikoprämie, gilt für den Fremdkapitalkostensatz gemäß dem CAPM Formel (1), wobei periodenspezifische Größen mit dem Index t gekennzeichnet sind.

$$kd_t = r_t + MRP \cdot \beta_t^D, \quad (1)$$

Sofern der Fremdkapitalkostensatz kd_t bekannt ist, kann mittels Umstellung das Debt Beta ermittelt werden.⁵⁰ Es folgt Formel (2).

$$\beta_t^D = \frac{kd_t - r_t}{MRP} = \frac{cs_t}{MRP} \quad (2)$$

In Bezug auf den **Verlauf der freien Cashflows** ist zu beachten, ob eine Detailprognose- oder Rentenphase vorliegt und in der Rentenphase von einem inflations- und/oder realen Wachstum ausgegangen wird. In der Detailprognosephase mit schwankenden freien Cashflows sind die Betafaktoren bei autonomer Finanzierung auch bei konstantem Debt Beta grundsätzlich periodenspezifisch anzupassen, weil sich das Finanzierungsrisiko bei deterministisch festgelegten Fremdkapitalbeständen verändert. Bei wertabhängiger Finanzierung ist eine periodenspezifische Anpassung von Betafaktoren bei konstantem Debt Beta hingegen nur dann erforderlich, wenn die Fremdkapitalquote nicht für alle Perioden einheitlich festgelegt wird. Sofern das Debt Beta jedoch periodenspezifisch ist, muss die Anpassung sowohl bei autonomer als auch bei wertabhängiger Finanzierung periodenspezifisch vorgenommen werden. In der Rentenphase sind die Betafaktoren hingegen bei beiden Finanzierungspolitiken periodenkonstant. Während der Betafaktor aber bei wertabhängiger Finanzierung unabhängig von der Wachstumsrate ist, wird dieser bei autonomer Finanzierung von ihr beeinflusst.

In der folgenden Übersicht 1 sind die Anpassungsformeln für Betafaktoren bei einem Vorsteuerkalkül für autonome und wertabhängige Finanzierung zusammenfassend dargestellt.

⁴⁸ Vgl. Ballwieser/Hachmeister, a.a.O. (Fn. 37), S. 56.

⁴⁹ Zum Unterschied zwischen Fremdkapitalzinssatz, Fremdkapitalkostensatz sowie risikolosen Zinssatz siehe bspw. Koller/Goedhart/Wessels, Valuation, 6. Aufl., Hoboken 2015, S. 304-307.

⁵⁰ Vgl. Kruschwitz/Löffler/Lorenz, a.a.O. (Fn. 39), S. 678; IDW, a.a.O. (Fn. 38), S. 129, Rn. A 372; Kuhner/Maltry, Unternehmensbewertung, 2. Aufl., Berlin 2017, S. 298-301.

Autonome Finanzierung		
Modigliani/Miller		Formel
Nicht-Rentenfall	$\beta_t^\ell = \beta^u + (\beta^u - \beta_t^D) \cdot \frac{D_{t-1} - VTS_{t-1}}{E[\tilde{E}_{t-1}^\ell]}$	(3)
Rente mit Wachstum	$\beta^\ell = \beta^u + (\beta^u - \beta^D) \cdot \frac{kd \cdot (1 - \tau) - w}{kd - w} \cdot L$	(4)
Rente ohne Wachstum	$\beta^\ell = \beta^u + (\beta^u - \beta^D) \cdot (1 - \tau) \cdot L$	(5)
Wertabhängige Finanzierung		
Miles/Ezzell		
Nicht-Rentenfall	$\beta_t^\ell = \beta^u + (\beta^u - \beta_t^D) \cdot \frac{1 + kd_t \cdot (1 - \tau)}{1 + kd_t} \cdot L_{t-1}$	(6)
Rente mit/ ohne Wachstum	$\beta^\ell = \beta^u + (\beta^u - \beta^D) \cdot \frac{1 + kd \cdot (1 - \tau)}{1 + kd} \cdot L$	(7)
Harris/Pringle		
Nicht-Rentenfall	$\beta_t^\ell = \beta^u + (\beta^u - \beta_t^D) \cdot L_{t-1}$	(8)
Rente mit/ ohne Wachstum	$\beta^\ell = \beta^u + (\beta^u - \beta^D) \cdot L$	(9)
Symbolverzeichnis		
β^u = Asset Beta D = Marktwert des Fremdkapitals β^ℓ = Equity Beta E = Marktwert des Eigenkapitals β^D = Debt Beta L = Verschuldungsgrad kd = Fremdkapitalkostensatz VTS = Marktwert der Tax Shield w = Wachstumsfaktor τ = Teilsteuersatz bezogen auf die Fremdkapitalzinsen E[·] = Erwartungswertoperator		

Übersicht 1: Anpassungsformeln bei einem Vorsteuerkalkül.

Bei der Bestimmung des Equity Betas sind unter anderem das Asset Beta und das Debt Beta zu berücksichtigen. Das **Asset Beta** trägt dem systematischen operativen Risiko des Unternehmens Rechnung, wobei den Anpassungsformeln die gängige Annahme zugrunde liegt, dass das Asset Beta im Zeitablauf konstant ist. In dem **Debt Beta** kommt das von den Fremdkapitalgebern zu tragende Risiko zum Ausdruck,⁵¹ wobei alle Anpassungsformeln darin übereinstimmen, dass das Debt Beta mindernd auf die Höhe des Equity Betas und damit des Eigenkapitalkostensatzes wirkt. Nur bei nicht-ausfallgefährdetem Fremdkapital entspricht der Fremdkapitalkostensatz der sicheren Verzinsung und das Debt Beta ist null.⁵²

⁵¹ Vgl. Copeland/Weston/Shastri, Financial Theory and Corporate Policy, 4. Aufl., Essex 2014, S. 545-554.

⁵² Vgl. Brealey/Myers/Allen, Principles of Corporate Finance, 12. Aufl., New York 2017, S. 604-606.

Die Unterschiede bei den Anpassungsformeln resultieren insbesondere aus der **Finanzierungs-politik** und dem damit zusammenhängenden Risikogehalt der **Tax Shields**. Bei Annahme einer autonomen Finanzierung sind die Fremdkapitalbestände künftiger Perioden deterministisch geplant. Unsicherheit bezüglich der künftigen Tax Shields besteht nur in dem Maße, in dem das Fremdkapital ausfallgefährdet ist. Aus diesem Grund werden die Tax Shields wie die Zahlungen an die Fremdkapitalgeber mit dem Fremdkapitalkostensatz diskontiert, der dem Ausfallrisiko Rechnung trägt. Dagegen begründet sich die Unsicherheit der Tax Shields bei wertabhängiger Finanzierung vor allem in der Abhängigkeit des Marktwerts des Fremdkapitals vom Marktwert des verschuldeten Unternehmens. Die bei wertabhängiger Finanzierung relevanten Bewertungsansätze von H/P und M/E weichen wegen der unterschiedlichen Annahmen in Bezug auf die Anpassung der Fremdkapitalbestände ab. Die Annahmen von M/E führen dazu, dass der Tax Shield in der Periode seiner Entstehung mit dem Fremdkapitalkostensatz und in allen vorhergehenden Perioden mit dem Eigenkapitalkostensatz des unverschuldeten Unternehmens zu diskontieren ist.⁵³ Bei H/P mit einer kontinuierlichen Anpassung der Fremdkapitalbestände an den Verschuldungsgrad weisen die Tax Shields hingegen in allen Perioden das gleiche Risiko wie das operative Geschäft auf, weshalb sie stets mit dem Eigenkapitalkostensatz des unverschuldeten Unternehmens zu diskontieren sind.⁵⁴ Daraus folgt, dass die Höhe des Equity Betas bei wertabhängiger Finanzierung gemäß M/E unter sonst gleichen Bedingungen niedriger als bei H/P ist. Zudem ist das Equity Beta bei autonomer Finanzierung durch den geringeren Risikogehalt der Tax Shields unter sonst gleichen Bedingungen immer kleiner als bei wertabhängiger Finanzierung.⁵⁵

Wird die Bewertung nicht mit einem Vorsteuerkalkül, sondern mit einem Nachsteuerkalkül durchgeführt, sind eigenständige Anpassungsformeln anzuwenden, die grundsätzlich nicht mit den Anpassungsformeln für Vorsteuerkalküle übereinstimmen. Übersicht 2 fasst die Anpassungsformeln für ein Nachsteuerkalkül zusammen.⁵⁶

⁵³ Vgl. Miles/Ezzell, The Journal of Financial and Quantitative Analysis 1980, S. 722-726.

⁵⁴ Vgl. Harris/Pringle, The Journal of Financial Research, 1985, S. 240 f.

⁵⁵ Vgl. Harris/Pringle, a.a.O (Fn. 52), S. 240.

⁵⁶ Für die bei einem Nachsteuerkalkül zu verwendenden Anpassungsformeln bei autonomer und wertabhängiger Finanzierung siehe Diedrich/Dierkes, a.a.O. (Fn. 1), S. 126 f.

Autonome Finanzierung		
Modigliani/Miller		Formel
Nicht-Rentenfall	$\beta_t^{\ell,s} = \beta^{u,s} + (\beta^{u,s} - \beta_t^{D,s}) \cdot \frac{D_{t-1} - VTS_{t-1}}{E[\tilde{E}_{t-1}^{\ell}]}$	(10)
Rente mit Wachstum	$\beta_t^{\ell,s} = \beta^{u,s} + (\beta^{u,s} - \beta_t^{D,s}) \cdot \frac{kd^s \cdot (1-\tau) - w \cdot (1-s_d)}{kd^s - w \cdot (1-s_g)} \cdot L$	(11)
Rente ohne Wachstum	$\beta^{\ell} = \beta^{u,s} + (\beta^{u,s} - \beta^{D,s}) \cdot (1-\tau) \cdot L$	(12)
Wertabhängige Finanzierung		
Miles/Ezzell		
Nicht-Rentenfall	$\beta_t^{\ell,s} = \beta^{u,s} + (\beta^{u,s} - \beta_t^{D,s}) \cdot \frac{1-s_d + kd_t^s \cdot (1-\tau)}{1-s_g + kd_t^s} \cdot L_{t-1}$	(13)
Rente mit/ ohne Wachstum	$\beta_t^{\ell,s} = \beta^{u,s} + (\beta^{u,s} - \beta_t^{D,s}) \cdot \frac{1-s_d + kd^s \cdot (1-\tau)}{1-s_g + kd^s} \cdot L$	(14)
Harris/Pringle		
Nicht-Rentenfall	$\beta_t^{\ell,s} = \beta^{u,s} + (\beta^{u,s} - \beta_t^{D,s}) \cdot L_{t-1}$	(15)
Rente mit/ ohne Wachstum	$\beta_t^{\ell,s} = \beta^{u,s} + (\beta^{u,s} - \beta_t^{D,s}) \cdot L$	(16)
Symbolverzeichnis		
s_d = persönlicher Steuersatz auf Dividenden und Zinsen s_g = persönlicher Steuersatz auf Kursgewinne bzw. Marktwertzuwächse		

Übersicht 2: Anpassungsformeln bei einem Nachsteuerkalkül.

Der Index s gibt an, dass es sich um Größen nach persönlichen Steuern handelt. Zur Berücksichtigung des Steuerstundungseffektes bei der Kursgewinnsteuer wird der persönliche Steuersatz auf Dividenden und Zinsen s_d üblicherweise niedriger als der persönliche Steuersatz auf Kursgewinne bzw. Marktwertzuwächse s_g angesetzt.⁵⁷ Da Fremdkapitalzinsen der Besteuerung durch s_d unterliegen, muss auch ein Debt Beta nach persönlichen Steuern verwendet werden. Für das Debt Beta in einem Nachsteuerkalkül gilt Formel (17):

$$\beta_t^{D,s} = \frac{kd_t \cdot (1-s_d) - r_t \cdot (1-s_d)}{MRP^s} = \frac{kd_t^s - r_t^s}{MRP^s} \quad (17)$$

Bei der Bestimmung des Marktwertes des Tax Shield in einer Nachsteuerrechnung ist zu berücksichtigen, dass in diesen zwei Komponenten eingehen: Der unternehmensteuerbedingte Tax Shield ergibt sich wie in Vorsteuerkalkülen aus der steuerlichen Abzugsfähigkeit der Fremdkapitalzinsen von der Bemessungsgrundlage der Unternehmensteuern, wobei in einem Nachsteuerkalkül die persönliche Besteuerung der Kapitalgeber ergänzend zu berücksichtigen

⁵⁷ Vgl. zum Steuerstundungseffekt Wiese, WPg 2007, S. 368-375.

ist. In Nachsteuerkalkülen ist mit dem einkommensteuerbedingten Tax Shield eine zweite Komponente einzubeziehen, die darauf zurückzuführen ist, dass die Aufnahme von Fremdkapital einen Ausschüttungsverzicht substituiert, der für die Eigenkapitalgeber steuerlich relevant ist, während hiermit bei den Fremdkapitalgebern keine steuerlichen Konsequenzen verbunden sind.⁵⁸

Bezüglich der Auswirkungen der Finanzierungspolitik, des Risikogehalts des Fremdkapitals und des Verlaufs des freien Cashflows auf die Höhe des Equity Betas kann auf die entsprechenden Ausführungen bei den Anpassungsformeln für Vorsteuerkalküle verwiesen werden. Ein Vergleich der Anpassungsformeln bei Vor- und Nachsteuerkalkülen zeigt zwar, dass diese strukturell eine große Ähnlichkeit aufweisen, jedoch werden die Anpassungsformeln im Nachsteuerkalkül durch die persönliche Besteuerung beeinflusst. Selbst wenn man, wie in der Bewertungspraxis üblich, vereinfachend davon ausgeht, dass das Asset Beta im Nachsteuerkalkül mit dem im Vorsteuerkalkül übereinstimmt, so wird das Equity Beta im Nachsteuerkalkül durch das von der persönlichen Besteuerung abhängige Debt Beta beeinflusst. Nur wenn man darüber hinaus annimmt, dass das Fremdkapital risikolos ist, stimmen die Anpassungsformeln bei autonomer Finanzierung im Rentenfall ohne Wachstum und bei wertabhängiger Finanzierung gemäß H/P im Vor- und Nachsteuerkalkül überein. Die Anwendung der H/P Anpassungsformel ist hierbei zusätzlich noch mit dem Vorteil verbunden, dass sie unabhängig vom Teilsteuersatz der Fremdkapitalzinsen ist, was insbesondere bei Unternehmen mit mehreren Geschäftsbereichen zu einer Vereinfachung der Bewertung führt.⁵⁹

5.3 Analyse der Bewertungsfehler durch die Verwendung „falscher“ Anpassungsformeln

Die vergleichsweise geringe Komplexität und gute Verständlichkeit der M/M Anpassungsformel für den Rentenfall ohne Wachstum (Formel 5) und der H/P Anpassungsformel (Formel 8 bzw. 9) eines Vorsteuerkalküls sowie deren Anwendungsempfehlung im WP Handbuch tragen wesentlich dazu bei, dass diese in der Bewertungspraxis zumeist angewendet werden. Wie die Ausführungen im vorangegangenen Kapitel jedoch deutlich gemacht haben, ist die Anwendung von Anpassungsformeln an spezifische Voraussetzungen geknüpft. Wenn diese in Bewertungssituationen nicht erfüllt sind, so führt die Anwendung unpassender und damit falscher Anpassungsformeln zu Bewertungsfehlern. Als Ursachen für die Verwendung einer falschen Anpassungsformel kommt den nachfolgenden Punkten eine besondere Bedeutung zu:

⁵⁸ Zur Bestimmung des Marktwertes des Tax Shields in einer Nachsteuerrechnung siehe insb. Diedrich/Dierkes, a.a.O. (Fn. 39), S. 112 f.

⁵⁹ Der Gesamtkapitalkostensatz beim TCF Verfahren ist bei H/P in einem Vorsteuerkalkül finanzierungsunabhängig.

Erstens vernachlässigt die Bewertungspraxis bei der Anpassung von Betafaktoren oftmals das Debt Beta, was nur bei risikolosem Fremdkapital gerechtfertigt ist. **Zweitens** ist davon auszugehen, dass der Rentenfall ohne Wachstum sowohl in der Detailprognosephase als auch in der Rentenphase nicht der Realität entspricht. Insofern ist die Verwendung der M/M Anpassungsformel für den Rentenfall ohne Wachstum, auf die im Handbuch der Wirtschaftsprüfer in besonderer Weise Bezug genommen wird, auch bei autonomer Finanzierung letztlich in allen Perioden mit Fehlern verbunden. **Drittens** führt die M/M Anpassungsformel zu einem Bewertungsfehler, wenn das zu bewertende Unternehmen eine wertabhängige Finanzierung verfolgt, wovon in der Bewertungspraxis regelmäßig ausgegangen wird. **Viertens** ist eine Differenzierung zwischen einem Vor- und einem Nachsteuerkalkül notwendig, da bei einem Nachsteuerkalkül grundsätzlich eigenständige Anpassungsformeln zu verwenden sind.

Im Weiteren wird analysiert, wie groß die Bewertungsfehler sind, wenn von den tatsächlichen Bewertungssituationen abweichende und demnach „falsche“ Anpassungsformeln zur Anwendung kommen. Um die Auswirkungen der Verwendung einer „falschen“ Anpassungsformel auf den Marktwert des Eigenkapitals aufzuzeigen, werden 1.000.000 Bewertungsfälle simuliert. Hierbei wird folgende Bewertungssituation unterstellt:

- Rentenfall mit Wachstum
- gegebener freier Cashflow
- Anwendung des FtE-Verfahrens

Die Ausprägungen der für die Bewertung relevanten Größen werden als voneinander unabhängig und in den folgenden Intervallen gleichverteilt angenommen:⁶⁰

$$\tau \in [20\%;40\%], w \in [0,5\%;1,5\%], \text{MRP} \in [5,5\%;7\%], \text{cs} \in [1\%;4\%]$$

$$\beta^u = \beta^{u,s} \in [0,8;1,5], \Theta \in [30\%;70\%], \text{MRP}^s \in [5\%;6\%]$$

Θ symbolisiert die Fremdkapitalquote, wobei sich der Verschuldungsgrad L aus $\Theta/(1-\Theta)$ ergibt. Bei der Analyse des Nachsteuerkalküls werden ein konstanter Steuersatz auf Dividenden und Zinsen in Höhe von 26,375% und ein Steuersatz auf Kursgewinne bzw. Marktwertzuwächse in Höhe von 13,188% angesetzt. Vereinfachend wird davon ausgegangen, dass das Asset Beta nach persönlichen Steuern mit dem Asset Beta vor persönlichen Steuern übereinstimmt.

In der Übersicht 3 sind die in der Simulation ermittelten durchschnittlichen Bewertungsfehler sowie ergänzend in den eckigen Klammern jeweils die Bandbreiten der möglichen Fehler angegeben. Insgesamt werden mit einem Vor- und einem Nachsteuerkalkül bei autonomer und

⁶⁰ Die Marktrisikoprämien vor und nach persönlichen Steuern orientieren sich an den vom Fachausschuss der Unternehmensbewertung (FAUB) empfohlenen Bandbreiten. Vgl. IDW (Hrsg.), IDW Fachnachrichten 2012, S. 568-569.

wertabhängiger Finanzierung vier Bewertungssituationen betrachtet, wobei von einer wertabhängigen Finanzierung gemäß M/E ausgegangen wird. Bei dem Vorsteuerkalkül bei autonomer Finanzierung (Fall A) liefert z. B. die Anwendung der M/M Anpassungsformel mit Wachstum und Debt Beta das richtige Bewertungsergebnis, was in der Tabelle durch einen dunkelgrauen Hintergrund dieses Feldes gekennzeichnet ist. Als mögliche alternative Anpassungsformeln werden in dieser Situation die M/M Anpassungsformel mit Wachstum bei Vernachlässigung des Debt Betas, die M/M Anpassungsformeln ohne Wachstum sowie die H/P Anpassungsformeln untersucht. Demnach ist bspw. die M/M Anpassungsformel mit Wachstum bei Vernachlässigung des Debt Betas mit einem mittleren Bewertungsfehler von $-11,2\%$ verbunden, wobei die Bandbreite der Bewertungsfehler zwischen $-34,3\%$ und $9,7\%$ liegt. Da die Anwendung der M/E Anpassungsformeln sowie auch die Anwendung der Anpassungsformeln eines Nachsteuerkalküls in dieser Bewertungssituation nicht realistisch sind, werden die Auswirkungen dieser Anpassungen nicht analysiert, was in der Tabelle an dem hellgrauen Hintergrund dieser Tabellenfelder zu erkennen ist.

		Vorsteuerkalkül		Nachsteuerkalkül	
		Fall A: autonom	Fall B: wertabhängig	Fall C: autonom	Fall D: wertabhängig
Vorsteueranpassungen					
M/M Anpassung mit Wachstum					
(4)	mit Debt Beta	0% [0%;0%]		2,2% [-27,0%;23,9%]	
	ohne Debt Beta	-11,2% [-34,3%;9,7%]		-7,7% [-30,0%;17,8%]	
M/M Anpassung ohne Wachstum					
(5)	mit Debt Beta	-5,4% [-68,8%;-0,1%]	11,1% [0,7%;36,5%]		
	ohne Debt Beta	-17,4% [-71,0%;-4,3%]	-2,9% [-35,7%;27,1%]	-14,5% [-80,1%;-2,9%]	-5,5% [-31,7%;16,0%]
M/E Anpassung					
(7)	mit Debt Beta		0% [0%;0%]		-5,4% [-10,2%;-1,2%]
	ohne Debt Beta		-15,5% [-46,7%;-2,8%]		-18,0% [-44,3%;-6,4%]
H/P Anpassung					
(9)	mit Debt Beta	-14,8% [-76,9%;-1,0%]	-0,4% [-1,0%;0,0%]		
	ohne Debt Beta	-28,2% [-78,9%;-10,0%]	-15,9% [-47,2%;-3,0%]	-26,0% [-85,6%;-8,6%]	-18,4% [-44,9%;-6,5%]
Nachsteueranpassungen					
M/M Anpassung mit Wachstum					
(11)	mit Debt Beta			0% [0%;0%]	
	ohne Debt Beta			-10,1% [-32,0%;12,5%]	
M/M Anpassung ohne Wachstum					
(12)	mit Debt Beta			-3,9% [-79,0%;-0,1%]	6,1% [0,5%;23%]
	ohne Debt Beta			-14,5% [-80,1%;-2,9%]	-5,5% [-31,7%;16,0%]
M/E Anpassung					
(14)	mit Debt Beta				0% [0%;0%]
	ohne Debt Beta				-12,2% [-39,1%;-2,2%]
H/P Anpassung					
(16)	mit Debt Beta			-14,5% [-84,6%;-1,9%]	-5,8% [-10,8%;-1,3%]
	ohne Debt Beta			-26,0% [-85,6%;-8,6%]	-18,4% [-44,9%;-6,5%]

Übersicht 3: Simulationsergebnisse – Durchschnitte und Bandbreiten der Bewertungsfehler im Rentenfall mit Wachstum.

Insgesamt zeigen die Ergebnisse der Simulation, dass die Anwendung einer unpassenden Anpassungsformel mit erheblichen Bewertungsfehlern verbunden sein kann. Der maximale mittlere Bewertungsfehler in Höhe von $-26,0\%$ tritt auf, wenn in einem Nachsteuerkalkül bei autonomer Finanzierung (Fall C) die H/P Anpassungsformel ohne Debt Beta des Vorsteuerkalküls angewendet wird. Aber auch aus einem geringen mittleren Bewertungsfehler kann nicht ohne weiteres die Schlussfolgerung gezogen werden, dass eine unpassende Anpassungsformel in einer Bewertungssituation angewendet werden kann. Ergänzend ist auch die Bandbreite der möglichen Bewertungsfehler zu berücksichtigen. So ist die Anwendung der M/M Anpassungsformel mit Wachstum und Debt Beta im Fall C nur mit einem mittleren Bewertungsfehler von $2,2\%$ verbunden, jedoch liegen die maximale Unter- und Überbewertung bei $-27,0\%$ bzw. $23,9\%$. Insofern kann man unter Berücksichtigung des Durchschnitts und der Bandbreite der möglichen Bewertungsfehler im Prinzip nur in einem Vorsteuerkalkül die Anwendung der H/P Anpassungsformel mit Debt Beta rechtfertigen, obwohl von der wertabhängigen Finanzierung gemäß M/E (Fall B) ausgegangen wird. In einem Nachsteuerkalkül (Fall D) wäre eine dementsprechende Vereinfachung mit einem mittleren Bewertungsfehler von $-5,8\%$ hingegen als problematisch einzustufen. Im Folgenden soll auf drei für die Praxis besonders relevante Problembereiche näher eingegangen werden:

Der **erste** Problembereich betrifft die in der Praxis vielfach angewandte M/M Anpassungsformel für den Rentenfall ohne Wachstum und Debt Beta (Formel 5). Ein Blick auf die Durchschnitte und Bandbreiten der Bewertungsfehler in allen Bewertungssituationen zeigt, dass diese nie zu einer akzeptablen Bewertung führt. In dem Vorsteuerkalkül bei wertabhängiger Finanzierung (Fall B) ist zwar der mittlere Bewertungsfehler mit $-2,9\%$ noch gering, jedoch ist die Bandbreite der Bewertungsfehler von $-35,7\%$ bis $27,1\%$ groß. Bemerkenswert ist zudem, dass die M/M Anpassungsformel ohne Wachstum mit Debt Beta selbst in dem Vorsteuerkalkül bei autonomer Finanzierung (Fall A) nur zu unbefriedigenden Lösungen führt, wodurch die Bedeutsamkeit der Berücksichtigung der Wachstumsrate in den Anpassungsformeln bei autonomer Finanzierung im Rentenfall deutlich wird.

Zweitens ist regelmäßig ein erheblicher Fehler mit einer Vernachlässigung des Debt Betas verbunden, wenn der Fremdkapitalkostensatz den risikolosen Zinssatz übersteigt. Wird bspw. bei autonomer Finanzierung die Anpassungsformel (4) mit einem Debt Beta von null verwendet, führt dies zu einer durchschnittlichen Unterschätzung des Unternehmenswerts von $-11,2\%$ bei einem Vorsteuerkalkül (Fall A) und von $-7,7\%$ bei einem Nachsteuerkalkül (Fall C). Würde man bei der Anpassung darüber hinaus die Wachstumsrate nicht berücksichtigen und Formel (5) ohne Debt Beta anwenden, würde dies die durchschnittlichen Bewertungsfehler auf $-17,4\%$ bzw. $-14,5\%$ erhöhen. Ergänzend ist zu beachten, dass in der Simulation angenommen wurde, dass der Verschuldungsgrad und der Credit Spread unabhängig voneinander sind. Würde man

in der Simulation einen positiven funktionalen Zusammenhang zwischen diesen Größen unterstellen, wovon in der Realität auszugehen ist,⁶¹ so würde dies die ermittelten durchschnittlichen Bewertungsfehler erhöhen.

Der **dritte** Problembereich resultiert daraus, dass in Nachsteuerekalkülen spezifische Nachsteuer-Anpassungsformeln anzuwenden sind, was in der Praxis im Allgemeinen nicht geschieht.⁶² In der Regel werden die aus Vorsteuerekalkülen bekannten Anpassungsformeln verwendet, womit erhebliche Bewertungsfehler verbunden sein können. Wird in einem Nachsteuerekalkül bei wertabhängiger Finanzierung (Fall D) bspw. die Vorsteuer-M/E Anpassungsformel mit Debt Beta angewendet, so ist dies mit einem durchschnittlichen Bewertungsfehler von -5,4% verbunden.

5.4 Fazit

In der Bewertungspraxis werden bei der Anpassung von Betafaktoren häufig vergleichsweise einfache Anpassungsformeln angewendet, obwohl die hierfür notwendigen Anwendungsvoraussetzungen nicht erfüllt sind. In diesem Beitrag wurde mittels einer Simulation gezeigt, dass hiermit erhebliche Bewertungsfehler verbunden sein können. Die Auswahl der Anpassungsformel sollte daher stets in Abhängigkeit von der Berücksichtigung persönlicher Steuern, der Finanzierungspolitik, des Risikos des Fremdkapitals und damit eines Debt Betas sowie des Verlaufs des freien Cashflows erfolgen. Die Anwendung einer einfachen Anpassungsformel lässt sich u. E. nicht mit Praktikabilitätsgründen rechtfertigen, weil die Bewertung in der Praxis ohnehin mit Tabellenkalkulationsprogrammen vorgenommen wird, womit alle Anpassungsformeln letztlich in gleichem Maße praktikabel sind. Nur in dem Sonderfall, in dem die Referenzunternehmen und das zu bewertende Unternehmen bzgl. aller Anwendungsvoraussetzungen identisch sind, ist die Wahl der Anpassungsformel beim Un- und Relevanz irrelevant, weil das am Kapitalmarkt beobachtbare Raw Beta dann mit dem Equity Beta übereinstimmt. Da dieses jedoch in der Regel nicht gegeben ist, sollte man der Wahl der geeigneten Anpassungsformel beim Un- und Relevanz besondere Beachtung schenken. Für die Bewertungspraxis sind hierbei die nachfolgenden Punkte von besonderer Relevanz:

- Die Anwendung der M/M Anpassungsformel für den Rentenfall ohne Wachstum ist in allen Bewertungssituationen mit erheblichen Bewertungsfehlern verbunden. Dieses gilt sogar bei autonomer Finanzierung für die Rentenphase, wenn dort von einem Wachstum der freien Cashflows auszugehen ist.

⁶¹ Vgl. Copeland/Weston/Shastri, a.a.O. (Fn. 49), S. 553 f.

⁶² Vgl. Diedrich/Dierkes, WPg 2017, S. 208f.

- Die Wahl einer Anpassungsformel für autonome Finanzierung bei wertabhängiger Finanzierung und umgekehrt hat gravierende Auswirkungen auf das Bewertungsergebnis und sollte vermieden werden.
- In einem Vorsteuernkalkül kann die H/P Anpassungsformel vereinfachend auch bei wertabhängiger Finanzierung gemäß M/E angewendet werden. Die H/P Anpassungsformel weist zudem den Vorteil auf, dass diese unabhängig von den Teilsteuersätzen der Fremdkapitalzinsen ist. In einem Nachsteuernkalkül ergibt sich ein weiterer Vorteil daraus, dass die Vorsteuer-Anpassungsformel auch in einem Nachsteuernkalkül angewendet werden kann, wenn das Fremdkapital risikolos ist und man von der Übereinstimmung des Asset Betas vor und nach persönlichen Steuern ausgeht.
- Sofern das Fremdkapital risikobehaftet und damit der Fremdkapitalkostensatz größer als der risikolose Zinssatz ist, ist das Debt Beta bei der Anpassung von Betafaktoren zu berücksichtigen.
- Im Allgemeinen führt die Anwendung von Vorsteuer-Anpassungsformeln in Nachsteuernkalkülen zu erheblichen Bewertungsfehlern. Demzufolge sollten in Nachsteuernkalkülen auch die spezifischen Nachsteuer-Anpassungsformeln eingesetzt werden.

6 Conclusions

6.1 Summary and implications

Firm valuations are conducted regularly using DCF models. In this context, the corporate tax deductibility of interest induces tax shields, which in turn enhance the equity market value. The appropriate discount rate for these tax shields is closely related to the firm's financing policy. In this respect, most valuation literature refers to passive or active debt management; the market value of tax shields is generally higher under passive debt management than under an active one. Hence, a firm's chosen financing policy affects the level of equity market value. In addition to the financing policy, the dividend policy also affects the equity market value, as the cash dividend tax rate exceeds the effective capital gains tax rate. Thus, the equity market value increases with an increase in a firm's participation in retaining cash flows or repurchasing shares. Consequently, both financing and dividend policies affect the equity market value in light of personal taxes. Accordingly, the aim of this thesis was to develop consistent and theoretically sound valuation models that consider the firm's financing and dividend policy simultaneously. In this respect, theoretical research in the area of corporate valuation is particularly concerned with deriving appropriate adjustment formulas for the relationship between the firm's unlevered and levered costs of equity. Consequently, besides the financing policy, dividend policy, and personal taxes, the forecast horizon and default risk of debt also need to be considered further.

The first study, *Terminal value calculation with constant payout ratio and active debt management*, shows that, under active debt management, the tax-driven value effects of the dividend policy lead to an additional debt financing to adhere to the predetermined capital structure target. This induces additional interests, tax shields, and changes in the debt market value, which, in turn, affect the flow to equity. Eventually, the additional debt effects result in a complex valuation model of the levered firm, which differs from the standard terminal value model applied in the valuation practice. Conceptually, it becomes evident that the assumed financing and dividend policy is not implemented consistently in the standard terminal value model. From a practical perspective, it is shown that overestimation of the equity market value in the steady state occurs by not accounting for the additional debt financing effects, under otherwise identical assumptions. The overestimation of the value contribution of an earnings-based dividend policy is above 50% in extreme cases, depending on the parameters.

The second study, *Valuation with share repurchases and personal taxes*, considers that share repurchases have become an important alternative for distributing cash flows to equity investors, which is not least due to the tax advantage they provide when compared with cash dividends. In the derived valuation model, the equity market value is calculated as the equity market value without tax shields from retained cash flows and an added equity market value from tax shields from retained cash flows. Here, the tax shields from retained cash flows represent the

tax advantage of the retained over the distributed cash flows. This approach might be advantageous for practitioners, as it clearly accounts for the dividend policy's relevance and value effects in light of personal taxes in a straightforward manner. Additionally, the effects of share repurchases on the cost of equity are disclosed by deriving appropriate adjustment formulas under active debt management assuming an explicit forecast period and a subsequent steady state. The derived adjustment formulas in the cases of Miles and Ezzell and Harris and Pringle are similar to the known adjustment formulas under active debt management without personal taxes, but they consider personal taxes in both the cases. It is worth noting that the adjustment formula in the case of Miles and Ezzell is dependent on the cash dividend ratio and hence accounts for the tax advantage of share repurchases. As a result, besides leverage, the financial risk of a firm increases with an increase in the firm's participation in share repurchases. Conversely, the adjustment formula in the case of Harris and Pringle is independent of the cash dividend ratio. This might be especially beneficial for practitioners, as this ratio does not need to be specified for the unlevering and relevering of beta factors. Eventually, the developed valuation models can be applied without circularity problems in corporate valuation practice and allow accounting for an explicit forecast period and a subsequent steady state. This opens the possibility of a differentiated valuation approach for the distribution of cash flows. This seems even more desirable as the simulation results point out that share repurchases have a significant positive effect on the equity market value in the cases of both Miles and Ezzell and Harris and Pringle.

The third study, *Valuation, personal taxes, and dividend policy under passive debt management*, focuses on the development of valuation models that account for the firm's dividend policy and passive debt management in an explicit forecast period and a steady state. Specifically, a blended personal tax rate at the equity investor level is derived by encapsulating all the effects resulting from retentions and cash dividends. Concerning this matter, it remains an open question in existing literature how the blended personal tax rate is determined and, consequently, how the dividend policy affects this tax rate. By specifying the blended personal tax rate in the third study, we can actually apply the proposed valuation models. Furthermore, the impact of the dividend policy on the cost of equity is disclosed by deriving appropriate adjustment formulas, which are similar to the known adjustment formulas under passive debt management, but they consider personal taxes. Practitioners should note that the unlevering of beta factors assuming a steady state requires information about the cash dividend ratios of the reference companies. Conceptually, it becomes evident that the valuation models developed by Dempsey (2017) can be converted and specified to the derived valuation models in the third study under the assumptions of passive debt management and uniform blended personal tax rates, which result in modified cost of equities. However, the derived valuation models in the third study open the possibility of a more differentiated valuation approach, especially concerning the effects of dividend policy on cash flows, tax shields and cost of equities. This seems

even more desirable as the simulation results show that the value contribution of a firm's chosen dividend policy is far from negligible under passive debt management.

Finally, the fourth study, *Unlevering and relevering with "wrong" adjustment formulas – How bad is that?*, points out the need for choosing adjustment formulas that fit the assumed financing policy, consideration of personal taxes, forecast horizon, and default risk of debt. By using simulations, it is shown that severe valuation errors can occur if the "wrong" adjustment formula is used, which highlights the importance of using adjustment formulas that match the actual valuation case. This might be especially helpful for valuation practitioners as they usually apply an adjustment formula that is suitable only if the firm pursues passive debt management and is in a steady state, wherein new investments equivalent to the depreciations are undertaken. Thus, valuation practitioners should be more conscious about which adjustment formula to use.

6.2 Limitations and outlook

This thesis is subject to limitations, which affect all the studies presented in this thesis and first concern the assumed financing policies. In this regard, each study considers one or both of the idealized financing policies: passive debt management and active debt management. These two financing policies are the two most referenced in valuation literature and practice. However, empirical studies show that the assumption of passive or active debt management can be seen as rather unrealistic, and managers often pursue other strategies when determining debt levels (e.g., Graham & Harvey, 2002; Grinblatt & Liu, 2008). Accordingly, further valuation approaches try to bridge this gap by focusing on alternative financing policies (e.g., Ruback, 2002; Kruschwitz & Löffler, 2006; Dierkes & Schäfer, 2016).

Second, this thesis oversimplifies the modeling of the effective capital gains tax rate. This oversimplification is attributed to the fact that the thesis only makes statements about the magnitude of the effective capital gains tax rate when compared with the cash dividend tax rate. Therefore, in principle, how the effective capital gains tax rate is actually determined remains open. In this respect, the level of the effective capital gains tax rate depends on many influencing variables such as the holding period, share price growth rate, and transaction costs (Elton & Gruber, 1970; Zhang et al., 2008). A pragmatic approach, which is used in corporate valuation practice and in this thesis, is to set the effective capital gains tax rate as equal to half of the cash dividend tax rate.

Third, although an earnings-based dividend policy is prevalent in practice, its integration into DCF models is not straightforward. This results mainly because firm managers often determine a cash dividend ratio based on earnings and not cash flows, which is generally because managers give greater weight to earnings-based rather than cash flow-based objectives (Graham et al., 2005). Accordingly, the cash dividend ratio related to cash flows is generally stochastic and not

deterministic, which results in mathematical concerns when determining a firm's dividends. Consequently, this thesis assumes a deterministic cash dividend ratio related to the cash flows to keep the valuation models tractable. Finally, a few more general limitations cause concern, such as the assumption of risk-free debt. It is expected that explicitly accounting for the default risk of debt will result in even more complex valuation models.

From a theoretical perspective, further research could focus on extending the preceding analysis using an alternative financing policy. A starting point for such an alternative financing policy could be a focus on partially active debt management, as in Dierkes and Schäfer (2016). Furthermore, financial managers are intent on maintaining a constant dividend ratio, which holds more significance for them than capital structure choices (Baker et al., 2002). Hence, development of a valuation model that sets its debt levels and, accordingly, its tax shields depending on this constant dividend ratio might be a promising future research field. Moreover, different dividend policies such as yield-oriented and value-based dividend policies might be considered further. From an empirical perspective, an examination can be conducted on whether retained cash flows and share repurchases affect the financial risk of a firm.

Appendix

Appendix 1: Derivation of the market value of tax shields under active debt management

To derive the market value of tax shields, we start with the expected tax shield $E[\widetilde{TS}_t]$ as the sum of the flow to equity and the flow to debt minus the free cash flow:

$$\begin{aligned}
 E[\widetilde{TS}_t] = & \overbrace{(E[\widetilde{FCF}_t] + \tau \cdot kd \cdot E[\tilde{D}_{t-1}] - kd \cdot E[\tilde{D}_{t-1}] + E[\tilde{D}_t] - E[\tilde{D}_{t-1}]) \cdot (I - r_t \cdot \tau_d - (I - r_t) \cdot \tau_g))}^{\text{flow to equity}} \\
 & - \tau_g \cdot (E[\tilde{E}_t^\ell] - E[\tilde{E}_{t-1}^\ell]) \\
 & + \overbrace{(kd \cdot E[\tilde{D}_{t-1}]) \cdot (I - \tau_b) - (E[\tilde{D}_t] - E[\tilde{D}_{t-1}])}^{\text{flow to debt}} \\
 & - \overbrace{(E[\widetilde{FCF}_t] \cdot (I - r_t \cdot \tau_d - (I - r_t) \cdot \tau_g) - \tau_g \cdot (E[\tilde{E}_t^u] - E[\tilde{E}_{t-1}^u]))}^{\text{free cash flow}} .
 \end{aligned} \tag{84}$$

Since $E[\tilde{E}_t^\ell] = E[\tilde{V}_t^\ell] - E[\tilde{D}_t]$, we get:

$$\begin{aligned}
 E[\widetilde{TS}_t] = & \tau \cdot kd \cdot E[\tilde{D}_{t-1}] \cdot (I - r_t \cdot \tau_d - (I - r_t) \cdot \tau_g) - kd \cdot E[\tilde{D}_{t-1}] \cdot (\tau_b - r_t \cdot \tau_d - (I - r_t) \cdot \tau_g) \\
 & - (E[\tilde{D}_t] - E[\tilde{D}_{t-1}]) \cdot r_t \cdot (\tau_d - \tau_g) - \tau_g \cdot (E[\widetilde{VTS}_t] - E[\widetilde{VTS}_{t-1}]) .
 \end{aligned} \tag{85}$$

Following the ME valuation approach, we obtain:

$$\begin{aligned}
 E[\widetilde{VTS}_{t-1}^{ME}] = & \frac{\tau \cdot kd \cdot E[\tilde{D}_{t-1}] \cdot (I - r_t \cdot \tau_d - (I - r_t) \cdot \tau_g) - kd \cdot E[\tilde{D}_{t-1}] \cdot (\tau_b - r_t \cdot \tau_d - (I - r_t) \cdot \tau_g)}{I + kd \cdot (I - \tau_b)} \\
 & - \left((\tau_d - \tau_g) \cdot r_t \cdot \frac{E[\tilde{D}_t]}{I + ke^u} - (\tau_d - \tau_g) \cdot r_t \cdot \frac{E[\tilde{D}_{t-1}]}{I + kd \cdot (I - \tau_b)} \right) \\
 & + \frac{\tau_g \cdot E[\widetilde{VTS}_{t-1}^{ME}]}{I + kd \cdot (I - \tau_b)} + \frac{E[\widetilde{VTS}_t^{ME}] \cdot (I - \tau_g)}{I + ke^u} .
 \end{aligned} \tag{86}$$

Solving equation (86) for $E[\widetilde{VTS}_{t-1}^{ME}]$ and dividing by $(I - \tau_g)$ yields:

$$\begin{aligned}
 E[\widetilde{VTS}_{t-1}^{ME}] = & \frac{\tau \cdot kd \cdot E[\tilde{D}_{t-1}] \cdot (I - r_t \cdot \tau_{d^*}) - kd \cdot E[\tilde{D}_{t-1}] \cdot (\tau_{b^*} - r_t \cdot \tau_{d^*})}{I + kd \cdot (I - \tau_{b^*})} \\
 & - \left(\tau_{d^*} \cdot r_t \cdot \frac{E[\tilde{D}_t]}{I + ke^{u^*}} - \tau_{d^*} \cdot r_t \cdot \frac{E[\tilde{D}_{t-1}]}{I + kd \cdot (I - \tau_{b^*})} \right) + \frac{E[\widetilde{VTS}_t^{ME}]}{I + ke^{u^*}} ,
 \end{aligned} \tag{87}$$

where $\tau_{b^*} = (\tau_b - \tau_g) / (1 - \tau_g)$. Note that τ_{b^*} depicts a modified personal tax rate, resulting from the difference in personal tax rates on interests and capital gains.

The following relationship between ke^u and ke^{u^*} holds:

$$1 + ke^{u^*} = (1 + ke^u) \cdot \left(1 - \frac{\tau_g}{1 + kd \cdot (1 - \tau_b)} \right) \cdot \frac{1}{1 - \tau_g}. \quad (88)$$

(88) holds because, due to value additivity, equation (36) can also be expressed as

$$E[\tilde{E}_{t-1}^u] = \frac{E[\widetilde{FCF}_t] \cdot (1 - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g)}{1 + ke^u} + \frac{E[\tilde{E}_t^u] \cdot (1 - \tau_g)}{1 + ke^u} + \frac{E[\tilde{E}_{t-1}^u] \cdot \tau_g}{1 + kd \cdot (1 - \tau_b)}, \quad (89)$$

where $E[\tilde{E}_{t-1}^u]$ is discounted at the risk-free interest rate after personal taxes, because the market value of the unlevered firm is known in period $t-1$. Solving equation (89) for $E[\tilde{E}_{t-1}^u]$ yields:

$$E[\tilde{E}_{t-1}^u] = \frac{E[\widetilde{FCF}_t] \cdot (1 - r_t \cdot \tau_{d^*}) + E[\tilde{E}_t^u]}{(1 + ke^u) \cdot \left(1 - \frac{\tau_g}{1 + kd \cdot (1 - \tau_b)} \right) \cdot \frac{1}{1 - \tau_g}}. \quad (90)$$

Note that the left-hand side of equation (53) and the numerator of equation (90) are identical, and thus equation (88) holds.

Finally, equation (87) depicts the market value of tax shields in the ME case. As for the HP case, the relevant discount rate in equation (87) is the modified cost of equity of the unlevered firm (ke^{u^*}). Hence, in this case the expected market value of the tax shields, $E[\widetilde{VTS}_{t-1}^{HP}]$, is

$$E[\widetilde{VTS}_{t-1}^{HP}] = \frac{\tau \cdot kd \cdot E[\tilde{D}_{t-1}] \cdot (1 - r_t \cdot \tau_{d^*}) - kd \cdot E[\tilde{D}_{t-1}] \cdot (\tau_{b^*} - r_t \cdot \tau_{d^*})}{1 + ke^{u^*}} - \left(\tau_{d^*} \cdot r_t \cdot \frac{E[\tilde{D}_t] - E[\tilde{D}_{t-1}]}{1 + ke^{u^*}} \right) + \frac{E[\widetilde{VTS}_t^{HP}]}{1 + ke^{u^*}}. \quad (91)$$

Appendix 2: Derivation of the adjustment formula in the ME case

Plugging equation (53) in equation (54) and solving for $ke_t^{\ell^*,r,ME}$ yields:

$$ke_t^{\ell^*,r,ME} = \frac{E[\tilde{V}_{t-1}^u] \cdot (I + ke^{u^*}) - E[\tilde{V}_t^u]}{E[\tilde{E}_{t-1}^\ell]} + \frac{(\tau \cdot kd \cdot E[\tilde{D}_{t-1}] - kd \cdot E[\tilde{D}_{t-1}] + E[\tilde{D}_t] - E[\tilde{D}_{t-1}]) \cdot (I - r_t \cdot \tau_{d^*}) + E[\tilde{E}_t^\ell] - E[\tilde{E}_{t-1}^\ell]}{E[\tilde{E}_{t-1}^\ell]} . \quad (92)$$

Furthermore, by plugging equation (56) in equation (92) and collecting terms, we obtain

$$ke_t^{\ell^*,r,ME} = \frac{(E[\tilde{E}_{t-1}^\ell] + E[\tilde{D}_{t-1}] - E[\widetilde{VTS}_{t-1}^{ME}]) \cdot (I + ke^{u^*}) - E[\tilde{D}_t] \cdot r_t \cdot \tau_{d^*}}{E[\tilde{E}_{t-1}^\ell]} + \frac{(\tau \cdot kd \cdot E[\tilde{D}_{t-1}] - kd \cdot E[\tilde{D}_{t-1}] - E[\tilde{D}_{t-1}]) \cdot (I - r_t \cdot \tau_{d^*}) + E[\widetilde{VTS}_t^{ME}] - E[\tilde{E}_{t-1}^\ell]}{E[\tilde{E}_{t-1}^\ell]} . \quad (93)$$

Rearranging terms in equation (93) yields

$$ke_t^{\ell^*,r,ME} = ke^{u^*} + \frac{E[\tilde{D}_{t-1}] \cdot (I + ke^{u^*}) - E[\widetilde{VTS}_{t-1}^{ME}] \cdot (I + ke^{u^*}) - E[\tilde{D}_t] \cdot r_t \cdot \tau_{d^*}}{E[\tilde{E}_{t-1}^\ell]} + \frac{(\tau \cdot kd \cdot E[\tilde{D}_{t-1}] - kd \cdot E[\tilde{D}_{t-1}] - E[\tilde{D}_{t-1}]) \cdot (I - r_t \cdot \tau_{d^*}) + E[\widetilde{VTS}_t^{ME}]}{E[\tilde{E}_{t-1}^\ell]} . \quad (94)$$

Inserting equation (87) in equation (94) and aggregating terms yields

$$ke_t^{\ell^*,r,ME} = ke^{u^*} + \frac{(I + ke^{u^*} - kd \cdot (I - \tau) \cdot (I - r_t \cdot \tau_{d^*}) - I + r_t \cdot \tau_{d^*}) \cdot (I + kd \cdot (I - \tau_{b^*}))}{I + kd \cdot (I - \tau_{b^*})} \cdot \frac{E[\tilde{D}_{t-1}]}{E[\tilde{E}_{t-1}^\ell]} + \frac{-(\tau \cdot kd \cdot (I - r_t \cdot \tau_{d^*}) - kd \cdot (\tau_{b^*} - r_t \cdot \tau_{d^*}) + \tau_{d^*} \cdot r_t) \cdot (I + ke^{u^*})}{I + kd \cdot (I - \tau_{b^*})} \cdot \frac{E[\tilde{D}_{t-1}]}{E[\tilde{E}_{t-1}^\ell]} . \quad (95)$$

Finally, by collecting terms in equation (95) we obtain the cost of equity of the levered firm:

$$ke_t^{\ell^*,r,ME} = ke^{u^*} + (ke^{u^*} - kd \cdot (I - \tau_{b^*})) \cdot \frac{(I + kd \cdot (I - \tau)) \cdot (I - r_t \cdot \tau_{d^*})}{I + kd \cdot (I - \tau_{b^*})} \cdot L . \quad (96)$$

Further simplifications yield equation (57).

Appendix 3: Derivation of the adjustment formula in the HP case

Until the insertion of the market value of tax shields, the derivation in the HP case is the same as in the ME case. Inserting equation (91) into equation (94) and collecting terms yield the corresponding adjustment formula for the cost of equity.

Appendix 4: Derivation of the market value of tax shields over the explicit forecast period under passive debt management

To derive the market value of tax shields, we start with the expected tax shield, $E[\widetilde{TS}_t]$, as the sum of the flow to equity and flow to debt minus the respective free cash flow after personal taxes:

$$\begin{aligned}
 E[\widetilde{TS}_t] = & \overbrace{(E[\widetilde{FCF}_t] - kd \cdot D_{t-1} \cdot (1 - \tau) + \Delta D_t) \cdot (1 - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g) - \tau_g \cdot (E[\tilde{E}_t^\ell] - E[\tilde{E}_{t-1}^\ell])}^{\text{flow to equity after personal taxes}} \\
 & + \overbrace{kd \cdot D_{t-1} \cdot (1 - \tau_b) - \Delta D_t}^{\text{flow to debt after personal taxes}} \\
 & - \overbrace{(E[\widetilde{FCF}_t] \cdot (1 - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g) - \tau_g \cdot (E[\tilde{E}_t^u] - E[\tilde{E}_{t-1}^u]))}^{\text{free cash flow after personal taxes}}
 \end{aligned} \tag{97}$$

Since $E[\tilde{E}_{t-1}^\ell] = E[\tilde{V}_{t-1}^\ell] - D_{t-1}$, we get:

$$\begin{aligned}
 TS_t = & (-kd \cdot D_{t-1} \cdot (1 - \tau) + \Delta D_t) \cdot (1 - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g) \\
 & + kd \cdot D_{t-1} \cdot (1 - \tau_b) - \Delta D_t \cdot (1 - \tau_g) - \tau_g \cdot (VTS_t - VTS_{t-1})
 \end{aligned} \tag{98}$$

Discounting each component in (98) with $1 + kd \cdot (1 - \tau_b)$ yields:

$$\begin{aligned}
 VTS_{t-1} = & \frac{(-kd \cdot D_{t-1} \cdot (1 - \tau) + \Delta D_t) \cdot (1 - r_t \cdot \tau_d - (1 - r_t) \cdot \tau_g)}{1 + kd \cdot (1 - \tau_b)} \\
 & + \frac{kd \cdot D_{t-1} \cdot (1 - \tau_b) - \Delta D_t \cdot (1 - \tau_g) - \tau_g \cdot (VTS_t - VTS_{t-1}) + VTS_t}{1 + kd \cdot (1 - \tau_b)}
 \end{aligned} \tag{99}$$

Rearranging the terms, we obtain equation (76).

Appendix 5: Partial Derivation of the modified tax shields in period t for the payout ratio under passive debt management

Given equation (77), the modified tax shields TS_t^* in period t in the explicit forecast period are determined as:

$$TS_t^* = \tau \cdot kd \cdot D_{t-1} \cdot (1 - \tau_{E,t}^r) - kd \cdot D_{t-1} \cdot (\tau_b^* - \tau_{E,t}^r) - \Delta D_t \cdot \tau_{E,t}^r. \quad (100)$$

The partial derivation of equation (100) for payout ratio r_t yields:

$$\frac{\partial TS_t^*}{\partial r_t} = (kd \cdot (1 - \tau) \cdot D_{t-1} - \Delta D_t) \cdot \frac{\tau_d - \tau_g}{1 - \tau_g}. \quad (101)$$

Under assumption $\tau_d > \tau_g$, the direction of the partial derivation in (101) depends on the magnitude of the change in debt market value ΔD_t over period t . For $\Delta D_t < 0$ (redemption of debt) (101) is above zero and, consequently, indicates that the higher the payout ratio, r_t , is, the higher are the modified tax shields. Conversely, for positive changes in debt market value, which fulfill $\Delta D_t > kd \cdot (1 - \tau) \cdot D_{t-1}$, (101) is smaller than zero and, consequently, indicates that the higher the payout ratio, r_t , is, the lower are the modified tax shields.

As $\Delta D_{T+1} = g \cdot D_T$ holds in a steady state, we can rearrange (101) to obtain:

$$\frac{\partial TS_{T+1}^*}{\partial r} = D_T \cdot (kd \cdot (1 - \tau) - g) \cdot \frac{\tau_d - \tau_g}{1 - \tau_g} > 0. \quad (102)$$

Typically, $(kd \cdot (1 - \tau) - g) > 0$ holds, so that in a steady state, the higher the payout ratio, r , is, the higher are the modified tax shields.

Appendix 6: Derivation of the market value of tax shields in the steady state under passive debt management

In a steady state, equation (99) can be expressed as:

$$\begin{aligned}
 VTS_T = & \frac{(-kd \cdot D_T \cdot (1-\tau) + g \cdot D_T) \cdot (1-r \cdot \tau_d - (1-r) \cdot \tau_g)}{I + kd \cdot (1-\tau_b)} \\
 & + \frac{kd \cdot D_T \cdot (1-\tau_b) - g \cdot D_T \cdot (1-\tau_g) - \tau_g \cdot g \cdot VTS_T + VTS_T \cdot (1+g)}{I + kd \cdot (1-\tau_b)} .
 \end{aligned} \tag{103}$$

Solving the circularity problems, rearranging terms, and dividing the numerator and denominator by $(1-\tau_g)$ yields equation (78).

Appendix 7: Derivation of the cost of equity over the explicit forecast period under passive debt management

Solving equation (70) for the free cash flow after blended personal taxes yields:

$$E[\widetilde{FCF}_t] \cdot (1 - \tau_{E,t}) = E[\tilde{V}_{t-1}^u] \cdot (1 + ke^{u*}) - E[\tilde{V}_t^u]. \quad (104)$$

Furthermore, solving (74) for $1 + ke_t^{\ell*}$ and inserting (104) yields:

$$1 + ke_t^{\ell*} = \frac{E[\tilde{V}_{t-1}^u] \cdot (1 + ke^{u*}) - E[\tilde{V}_t^u] + (\tau \cdot kd \cdot D_{t-1} - kd \cdot D_{t-1} + D_t - D_{t-1}) \cdot (1 - \tau_{E,t}) + E[\tilde{E}_t^{\ell}]}{E[\tilde{E}_{t-1}^{\ell}]} \quad (105)$$

Value additivity leads to:

$$E[\tilde{V}_t^u] = E[\tilde{E}_t^{\ell}] + D_t - VTS_t. \quad (106)$$

Inserting (106) in (105) and rearranging the terms yields:

$$ke_t^{\ell*} = ke^{u*} + \frac{(D_{t-1} - VTS_{t-1}) \cdot (1 + ke^{u*}) - D_t \cdot \tau_{E,t}}{E[\tilde{E}_{t-1}^{\ell}]} + \frac{(\tau \cdot kd \cdot D_{t-1} - kd \cdot D_{t-1} - D_{t-1}) \cdot (1 - \tau_{E,t}) + VTS_t}{E[\tilde{E}_{t-1}^{\ell}]} \quad (107)$$

Solving (77) for VTS_t and inserting it in (107), rearranging the terms, and multiplying with $(1 - \tau_g)$ finally yields (80).

Appendix 8: Further simplification of the adjustment formula in the steady state according to (80)

The further simplification of equation (80) yields:

$$ke^{\ell} = ke^u + (ke^u - kd \cdot (1 - \tau_b)) \cdot \frac{kd \cdot (1 - \tau) - g}{kd \cdot (1 - \tau_{b^*}) - g} \cdot \frac{D_T}{E[\widetilde{FtE}_{T+1}] / (ke^{\ell^*} - g)}. \quad (108)$$

Note that equation (108) is independent of payout ratio r . However, (108) no longer refers to leverage $L(r)$, which causes difficulties when it comes to the unlevering of beta factors in val-

uation practice, as $\frac{D_T}{E[\widetilde{FtE}_{T+1}] / (ke^{\ell^*} - g)}$ is not observable.

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