The CAPM with German Income Tax

Martin Jonas,[*] Andreas Löffler[†] and Jörg Wiese[‡]

published in Die Wirtschaftsprüfung, 57:17 (2004), 898–906

1 Introduction

Including personal tax in the practice of business appraisals is contentious. Although, there is consent that in general these taxes influence the appraisal in some way,[1] which is the inversion of the argument of the irrelevancy conditions. Meanwhile, there are different opinions on how to integrate taxes appropriately into the calculation of business appraisals in a world characterized by uncertain expectations. More recently, the literature has focused on the after-tax CAPM model developed by *Brennan*[2].[3] This model accounts for a variety of tax rates on income from capital market investments. This gives reason to believe in its suitability for the German tax system, which applies the method of half income taxation. In this paper we will not display all the details of the German tax system in a model. Particularly, progression effects will be ignored for reasons of simplicity.

Brennan showed that under certain conditions, equilibria exist in capital markets with individual personal taxes and with it, the existence of the market risk premium. The *Brennan* CAPM offers the gross yield, which is a requirement

∗ Warth & Klein, Düsseldorf.
† Chair of Banks and Finance, University Hannover.
‡ Seminar for Accounting and Auditing, Ludwig–Maximilians–University Munich.

1 See for example *Moxter* (1983), pp. 177-178;*Ballwieser* (1995), p. 36; *Richter* (2002), pp. 326-330; *IDW*(2000),p. 830, Tz. 51.

2 See *Brennan*(1970); a. *Litzenberger/Ramaswamy* (1979).

3 See for example *Drukarczyk/Richter* (1995), p. 562; *Richter* (2004), pp. 20-21; *Schmidbauer* (2002), p. 1256; *Schultze* (2003), p. 275; *Schwetzler/Piehler*(2004), p. 14-15.

for investors who are subject to different tax rates on capital gains, interest, and dividends. The *Brennan* CAPM model reveals shortcomings in regard to net return. Although Brennan adds that personal taxes influence price and return, he also claims that the net return cannot be derived from the observable gross yield without applying additional conditions. This is because there is no information on market participants' marginal utility, marginal tax and initial endowments.

Hence, the *Brennan* CAPM has limited applicability in terms of business appraisals. This problem is usually ignored at the international level for reasons of simplicity.[4] Therefore, most appraisals neglect the influence of personal taxes. Following the IDW S1 valuation standard, personal taxes are considered only in the shape of a deduction of a general amount, an approach that ultimately leads to bias and rejections.[5]

The paper is divided into four parts and structured as follows. Section 2 covers the assumptions of the model including the conditions for capital market equilibria allowing for taxes. In section 3 we derive the capital market line with taxes, considering tax rates that are the same for all investors. A summary of hypotheses concludes the paper.

2 The Model

Environment The CAPM is a model with two specific points in time. The present $t = 0$ is certain, the future $t = 1$ is uncertain. No other assumptions about the number and structure of possible future states are made.[6] Instead, we turn to the capital market.

Capital Market: Underlying Assets Risky underlying assets S that offer future returns can be traded. These future returns (future stock price) are uncertain. Beside the future stock price $\widetilde{Y^s}$ $(s = 1, \ldots, S)$, the holder of asset s

4 Exceptions are i.e., Australia and New Zealand, where against the background of a transfer tax system, a CAPM-based valuation model allowing for income tax was developed in the early 1990s, see for example *Lally* (1992) and *Cliffe/Marsden* (1992).

5 These criticize i.e., *Maul* (2003), pp. 273 f., *Jonas* (2001), pp. 411 ff.,.

6 Our model could imply that in the future, only finite states occur. Also, we could postulate an infinite number of states in the future. In the latter case, these may be discrete (countable like natural numbers) or uncountable (like real numbers).

receives a safe dividend D^s.

Furthermore, there is a risk free asset whose future stock price is $Y^0 = 1$ and whose interest rate is r_f.

In the following, we will not assume complete capital markets. The information the investors have about the assets does not necessarily include the entire return as a random variable. The investors only know the expected values of all the risky assets, which are described as

$$\mathrm{E}[\tilde{Y}^s], \qquad s = 1, \dots, S.$$

Also, the investors are aware of all covariances of the stock prices of risky underlying assets which, for simplicity, are displayed in a matrix:

$$\begin{pmatrix} \mathrm{Cov}[\tilde{Y}^1, \tilde{Y}^1] & \mathrm{Cov}[\tilde{Y}^1, \tilde{Y}^2] & \cdots & \mathrm{Cov}[\tilde{Y}^1, \tilde{Y}^S] \\ \mathrm{Cov}[\tilde{Y}^2, \tilde{Y}^1] & \mathrm{Cov}[\tilde{Y}^2, \tilde{Y}^2] & \cdots & \mathrm{Cov}[\tilde{Y}^2, \tilde{Y}^S] \\ \vdots & \vdots & & \vdots \\ \mathrm{Cov}[\tilde{Y}^S, \tilde{Y}^1] & \mathrm{Cov}[\tilde{Y}^S, \tilde{Y}^2] & \cdots & \mathrm{Cov}[\tilde{Y}^S, \tilde{Y}^S] \end{pmatrix}$$

We assume that this matrix has a determinant different from zero. This is equivalent to the proposition that no asset is redundant in the market. In other words, no asset can be recreated with the remaining assets.

Every underlying asset will be traded today. The price of asset s is referred to as $p(\tilde{Y}^s)$. The price of the risk free asset today is $p(Y^0) = 1$.

Capital Market: Portfolios Investors build portfolios with risky underlying assets. A portfolio is the arrangement of the S risky assets and will be denoted by X. The risky asset portfolio vector can be interpreted as follows:

$$X = \begin{pmatrix} X_1 \\ X_2 \\ \vdots \\ X_S \end{pmatrix} \begin{array}{ll} \longleftarrow & \text{Quantity of risky asset \#1} \\ \longleftarrow & \text{Quantity of risky asset \#2} \\ & \quad\vdots \\ \longleftarrow & \text{Quantity of risky asset \#}S \end{array}$$

The portfolios are arranged today. Their structure will not change until the future (tomorrow). The expected return on a risky portfolio X and its variance result from the sums

$$\mathrm{E}[X] = \sum_{s=1}^{S} X_s \cdot (E[\tilde{Y}_s] + D_s), \qquad \mathrm{Var}[X] = \sum_{s=1}^{S} \sum_{r=1}^{S} X_s \cdot \mathrm{Cov}[\tilde{Y}_s, \tilde{Y}_r] \cdot X_r.$$

The price of a portfolio is $p(Z)$. The market is arbitrage free, hence value additivity holds

$$p(X) = \sum_{s=1}^{S} p(\widetilde{Y}^s) X_s.$$

Investors There are i investors who act as price takers within the market. At time $t = 0$, each investor i holds an initial endowment $\bar{X}_s^i$ of a risky asset s. The investors do not hold any risk free assets today. The quantity of assets s held in an optimal portfolio is referred to as X_s^i. Referring to vector notation, the investor's initial endowment of risky assets is $\bar{X}^i$, while the optimal risky portfolio is X^i. Ignoring the risk free asset and focusing only on the aggregate supply of risky assets, the market portfolio is described as the sum

$$M = \bar{X} = \sum_{i=1}^{I} \bar{X}^i.$$

Now, let us consider one investor with a μ-σ utility function V^i who wishes to maximize their utility from today's wealth $p(\bar{X}^i)$. In the classic CAPM, the investor maximizes her utility function, which involves the expected return as well as the variance of the returns. The higher the expected return, the higher the investor's utility. However, the higher the variance, the lower the investor's benefit. At this point, we will expand the model to include income tax. The income tax base shall be the assets' dividends in the portfolio, as well as the realized stock price gains.

We imply a linear income tax rate. The tax rates are investor specific and labeled with an index i. The tax rate on dividends is τ_D^i. Realized stock price gains are taxed at the rate τ_K^i. The interest on the risk free asset is also assessed for taxation at the rate τ_0^i. The expected return of the portfolio X of investor i is made up of the following components:

$$\underbrace{(1 + r_f)X_0 - \tau_0^i r_f X_0}_{\text{taxed risk free}} + \sum_{s=1}^{S} \underbrace{\left(X_s \cdot \Big(\overbrace{E[Y^s]}^{\text{Stock price}} + \overbrace{D^s}^{\text{Dividend}} \Big) - \left(\tau_K^i \overbrace{(E[Y^s] - p(Y^s))}^{\text{Stock price gain}} + \tau_D^i D^s \right) \right)}_{\text{taxed risky}}.$$

We know that the dividend, the price of a risky asset, and the return on the risk free asset do not influence the optimal portfolio's variance directly. Therefore, investor i solves the problem by considering income tax:

$$\max_{X,X_0} \quad V^i \left((1 + r_f(1 - \tau_0^i))X_0 + \sum_{s=1}^{S} X_s \cdot \Big((1 - \tau_K^i)\,\mathrm{E}[\widetilde{Y}_s] + \tau_K^i p(\widetilde{Y}_s) + (1 - \tau_D^i)D_s \Big), \right.$$
$$\left. (1 - \tau_K^i)^2 \sum_{s=1}^{S} \sum_{r=1}^{S} X_s \cdot \mathrm{Cov}[\widetilde{Y}_s, \widetilde{Y}_r] \cdot X_r \right), \qquad \text{s.t.} \sum_{s=1}^{S} p(X_s) + X_0 = p(\bar{X}^i). \quad (1)$$

There is no non-negativity constraint $X \geq 0$ as X does not describe quantities of goods but a portfolio containing different underlying assets. A non-negativity constraint ($X \geq 0$) would result in an exclusion of short sales. In our model, bear raids are allowed. The investor will use up her budget completely. Otherwise, she would be able to use the remaining amount to buy risk free assets and consequently increase her utility.

Definition of CAPM–Equilibrium Equilibria describe a situation in which two conditions need to be met. Firstly, an investor arranges her portfolio in such a way that their utility function is maximized. Secondly, demand needs to match supply. Formally, a CAPM equilibrium is fully explained by the prices $p(Y^s)$ of all core assets Y^s and the investors $i = 1, \ldots, I$'s optimal demand X^i provided the following two conditions are met:

1. X^i is the solution to the μ–σ utility maximization problem(1) of investor i.

2. The market clears, which means total demand matches total supply.

$$M = \sum_{i=1}^{I} X^i$$

The clearing of the market obviously refers solely to the risky assets. At first sight, it may not be apparent why the market for the risk free asset clears as well. This is a conclusion of the Walras' rule: if all markets are cleared and investors consume their entire budget, the last market clears as well. Thus, the risk free asset is not our concern.

Pretax vs. after-tax prices An equilibrium is characterized by the prices of the corresponding underlying assets. Let us assume that in our model the underlying tax rates change. A priori, it is not safe to further assume that the initially defined prices of the underlying assets continue to result in an equilibrium. The investors' wealth remains unchanged, but their after-tax income changes which may influence optimal demand. Thus, we could ask the following question: When $p(Y^s)$ are equilibrated prices in a model with taxation, what prices lead to an equilibrium in a model that neglects taxation? In short, what is the relationship between pre- and after-tax prices?

While this question is interesting and important, we will ignore it completely in our consideration. As long as we do not neglect taxation and keep the tax rates unaltered, this question is immaterial. This influences the returns used in the model: The term

$$r_X := \frac{(1+r_f)X_0 + \sum_{s=1}^{S} X_s \cdot (\mathrm{E}[\widetilde{Y}_s] + D_s))}{p(X) + p(X_0)} - 1$$

describes an expected return from which the income tax has not been deducted yet. Thereby, equilibrium prices with taxation are implied here. This return is not unobservable since it can be calculated using the daily stock market reports. When such a return is labeled as a pretax return yield, we need to state that this model is not the CAPM without taxation but rather the CAPM with taxation. The returns simply have not been taxed yet.

We may only state that there is a relationship between this return and the return after deducting income tax by breaking down r_X into its elements (stock market return and dividend yield). The expected capital gain of underlying asset s before tax deduction is

$$k_s := \frac{\mathrm{E}[Y^s]}{p(Y^s)} - 1.$$

The dividend yield before income tax deduction is then referred to as

$$d_s := \frac{D^s}{p(Y^s)}.$$

The sum of the two terms is the expected total yield of underlying asset s. Similarly, the expected capital gain of portfolio X will be denoted by k_X and dividend yield by d_X. The yield of the underlying asset after tax deduction can then be described as

$$r_s^{i,\tau} := (1 - \tau_K^i) k_s + (1 - \tau_D^i) d_s,$$

which obviously needs to be investor specific. This definition is intuitive.

Existence and uniqueness of equilibria We will not address the question whether equilibria exist with a random initial endowment and an arbitrary investors' utility function. Also, we ignore the important question concerning the uniqueness of equilibria. We focus solely on the characteristics of equilibria and what implications they have for prices.

3 Capital market line with tax

We initially turn towards investor i's maximization problem. Accordingly, we construct the Lagrange function in the variables X and X_0 and obtain

$$\mathcal{L} = V^i \Bigg((1 + r_f(1 - \tau_0^i)) X_0 + \sum_{s=1}^{S} X_s \cdot ((1 - \tau_K^i) \operatorname{E}[Y^s] + \tau_K^i p(Y^s) + (1 - \tau_D^i) D_s), \\ \sum_{s=1}^{S} \sum_{r=1}^{S} X_s \cdot \operatorname{Cov}[Y^s, Y^r] \cdot X_r \Bigg) - \lambda \left(\sum_{s=1}^{S} X_s p(Y^s) + X_0 - p(\bar{X}^i) \right).$$

The risk free asset increases the expected value but has no influence on variance. The optimal (not yet taxed) portfolio will from now on be referred to as X^{*i} instead of simply X.

Firstly, we differentiate the Lagrange function with respect to X_0^{*i}, the quantity demanded of risk free assets, and receive[7]

$$0 = \frac{\partial \mathcal{L}}{\partial X_0^{*i}} = V_\mu(\operatorname{E}[X^{*i}], \operatorname{Var}[X^{*i}]) \cdot (1 + r_f(1 - \tau_0^i)) - \lambda$$

7 Here, we make use of the basic rule of the total derivative, according to which the following always applies for any function $f(x, y)$:

$$\frac{df(x,y)}{dz} = f_x \frac{dx}{dz} + f_y \frac{dy}{dz}.$$

We describe the derivative of V^i with respect to the first variable as V_μ and the derivative with respect to the second variable as V_{σ^2}.

and rearrange it to

$$\lambda = V_\mu(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}]) \cdot (1 + r_f(1 - \tau_0^i)). \tag{2}$$

The derivatives with respect to variable s result in[8]

$$\begin{aligned}
0 = \frac{\partial \mathcal{L}}{\partial X_s^{*i}} &= \frac{\partial V(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}])}{\partial X_s^{*i}} - \lambda p(Y^s) \\
&= V_\mu(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}]) \left((1-\tau_K^i)\,\mathrm{E}[Y^s] + \tau_K^i p(Y^s) + (1-\tau_D^i)D^s\right) + \\
&\quad + (1-\tau_K^i)^2 V_{\sigma^2}(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}]) \cdot 2 \sum_{r=1}^{S} X_r^{*i}\,\mathrm{Cov}[Y^s, Y^r] - \lambda p(Y^s).
\end{aligned}$$

We insert equation (2) and obtain

$$\begin{aligned}
0 &= V_\mu(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}]) \left((1-\tau_K^i)\,\mathrm{E}[Y^s] + \tau_K^i p(Y^s) + (1-\tau_D^i)D^s\right) + \\
&\quad + (1-\tau_K^i)^2 V_{\sigma^2}(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}]) \cdot 2 \sum_{r=1}^{S} X_r^{*i}\,\mathrm{Cov}[Y^s, Y^r] - \\
&\quad - V_\mu(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}]) \cdot (1 + r_f(1-\tau_0^i))p(Y^s) \\
&= (1-\tau_K^i)\,\mathrm{E}[Y^s] + \tau_K^i p(Y^s) + (1-\tau_D^i)D^s + \\
&\quad + (1-\tau_K^i)^2 \frac{V_{\sigma^2}(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}])}{V_\mu(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}])} \cdot 2 \sum_{r=1}^{S} X_r^{*i}\,\mathrm{Cov}[Y^s, Y^r] - (1 + r_f(1-\tau_0^i))p(Y^s).
\end{aligned}$$

We divide both sides by the price $p(Y^s)$ of underlying asset s and insert the return function of k_s, d_s and $r_s = k_s + d_s$ and obtain

$$\begin{aligned}
0 &= (1-\tau_K^i)(k_s + 1) + \tau_K^i + (1-\tau_D^i)d_s + \\
&+ (1-\tau_K^i)^2 \frac{V_{\sigma^2}(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}])}{V_\mu(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}])} \cdot 2 \sum_{r=1}^{S} X_r^{*i}\,\mathrm{Cov}[r_s, Y^r] - (1 + r_f(1-\tau_0^i))
\end{aligned}$$

and rearrange it to

$$\begin{aligned}
0 &= (1-\tau_K^i)k_s + (1-\tau_D^i)d_s - r_f(1-\tau_0^i) + \\
&\qquad + (1-\tau_K^i)^2 \frac{V_{\sigma^2}(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}])}{V_\mu(\mathrm{E}[X^{*i}], \mathrm{Var}[X^{*i}])} \cdot 2 \sum_{r=1}^{S} X_r^{*i}\,\mathrm{Cov}[r_s, Y^r].
\end{aligned}$$

8 The following step includes a derivative with respect to a double sum. Using $S = 3$ as an example, it is clear that the derivative corresponds to the term used here.

Our calculations finally result in the following on account of $X^{*i} = \sum_{r=1}^{S} X_r^{*i} Y^r$

$$(1-\tau_K^i)^2 \operatorname{Cov}[r_s, X^{*i}] = -\frac{1}{2}\left((1-\tau_K^i)k_s + (1-\tau_D^i)d_s - r_f(1-\tau_0^i)\right)\underbrace{\frac{V_\mu(\mathrm{E}[X^{*i}], \operatorname{Var}[X^{*i}])}{V_{\sigma^2}(\mathrm{E}[X^{*i}], \operatorname{Var}[X^{*i}])}}_{=:H_i}$$

or rearranged

$$-\frac{1}{2}\operatorname{Cov}[r_s, X^{*i}] = \left(\frac{1}{1-\tau_K^i}k_s + \frac{1-\tau_D^i}{(1-\tau_K^i)^2}d_s - \frac{1-\tau_0^i}{(1-\tau_K^i)^2}r_f\right)H_i.$$

In the next step we summate across all investors. This results in

$$-\frac{1}{2}\operatorname{Cov}[r_s, M] = \sum_{i=1}^{I}\frac{H_i}{1-\tau_K^i}k_s + \left(\sum_{i=1}^{I}\frac{1-\tau_D^i}{(1-\tau_K^i)^2}H_i\right)d_s - \left(\sum_{i=1}^{I}\frac{1-\tau_0^i}{(1-\tau_K^i)^2}H_i\right)r_f.$$

Now, we divide the equation by the sum of the individual degree of risk $\sum_{i=1}^{I} H_i = H$ and obtain

$$-\frac{1}{2}\frac{\operatorname{Cov}[r_s, M]}{H} = \underbrace{\left(\sum_{i=1}^{I}\frac{H_i}{(1-\tau_K^i)H}\right)}_{=:\Phi_K}k_s + \underbrace{\left(\sum_{i=1}^{I}\frac{1-\tau_D^i}{(1-\tau_K^i)^2}\frac{H_i}{H}\right)}_{=:\Phi_D}d_s - \underbrace{\left(\sum_{i=1}^{I}\frac{1-\tau_0^i}{(1-\tau_K^i)^2}\frac{H_i}{H}\right)}_{=:\Phi_0}r_f. \quad (3)$$

The terms in brackets on the right, which correspond to individual taxation and individual risk attitude, respectively, are weighted proportions of tax rates and thus arcane to a direct observation of the market. However, in the case of non-individual (typecast) tax rates the term simplifies to $\Phi_K = \frac{1}{1-\tau_K}$, $\Phi_D = \frac{1-\tau_D}{(1-\tau_K)^2}$ as well as $\Phi_0 = \frac{1-\tau_0}{(1-\tau_K)^2}$.[9]

The last equation is now multiplied by the proportion in terms of value of the assets s which are included in the market portfolio. This part is addressed

9 A simplification may also be performed when the individual attitude to risk is identical or at least known.

with ω_s, hence we obtain

$$
\begin{aligned}
-\frac{1}{2}\frac{\mathrm{Cov}[r_s, M]}{H} &= \Phi_K k_s + \Phi_D d_s - \Phi_0 r_f \\
-\frac{1}{2}\frac{\omega_s\,\mathrm{Cov}[r_s, M]}{H} &= \omega_s \Phi_K k_s + \omega_s \Phi_D d_s - \omega_s \Phi_0 r_f \\
-\frac{1}{2}\frac{\mathrm{Cov}[\sum_{s=1}^{S}\omega_s r_s, M]}{H} &= \Phi_K \underbrace{\sum_{s=1}^{S}\omega_s k_s}_{=k_M} + \Phi_D \underbrace{\sum_{s=1}^{S}\omega_s d_s}_{=d_M} - \underbrace{\sum_{s=1}^{S}\omega_s}_{=1} \Phi_0 r_f \\
-\frac{1}{2}\frac{\mathrm{Cov}[r_M, M]}{H} &= \Phi_K k_M + \Phi_D d_M - \Phi_0 r_f.
\end{aligned}
$$

Rearranging this for H and plugging it into equation (3), we obtain

$$
\frac{\mathrm{Cov}[r_s, M]}{\mathrm{Cov}[r_M, M]}\left(\Phi_K k_M + \Phi_D d_M - \Phi_0 r_f\right) = \Phi_K k_s + \Phi_D d_s - \Phi_0 r_f.
$$

or expand by $\frac{1}{p(M)}$ and rearrange it to

$$
\Phi_K k_s + \Phi_D d_s = \Phi_0 r_f + \left(\Phi_K k_M + \Phi_D d_M - r_f \Phi_0\right) \underbrace{\frac{\mathrm{Cov}[r_M, r_s]}{\mathrm{Cov}[r_M, r_M]}}_{=\beta_s}.
$$

If the tax rates are all identical, this equation simplifies to the after-tax CAPM

$$
(1-\tau_K)k_s + (1-\tau_D)d_s = (1-\tau_0)r_f + \left((1-\tau_K)k_M + (1-\tau_D)d_M - (1-\tau_0)r_f\right)\beta_s.
$$

If a minority shareholder uses the last equation in practice, it is often further simplified. The tax rate of capital gain can be expected to be zero because of the minimum holding period of one year (§ 23 Einkommensteuergesetz – German Income Act) and an insignificant share (less than 1%, § 17 Einkommensteuergesetz). The net return is then

$$
k_s + (1-\tau_D)d_s = (1-\tau_0)r_f + \left(k_M + (1-\tau_D)d_M - (1-\tau_0)r_f\right)\beta_s.
$$

Net return, which comprises stock return yield and after tax dividend yield, corresponds to the taxed yield of the risk free asset plus the taxed risk premium. In terms of business appraisals, it is relevant whether the market risk premium is situated above or below the known untaxed market risk premium. To this end, we further imply that (so called "half income procedure" or Halbeinkünfteverfahren)

$$
\tau_D = \frac{\tau_0}{2}
$$

and for the risk premium including the income tax obtain the following term:

$$k_M + (1 - \frac{\tau_0}{2})d_M - (1 - \tau_0)r_f > k_M + d_M - r_f \qquad \Longleftrightarrow \qquad r_f > \frac{1}{2}d_M \, .$$

Therefore, if the dividend yield of the market portfolio is below the doubled risk free interest rate, the taxed risk premium is greater than the untaxed risk premium.

4 Conclusion

In reality, observed yields are typically pretax returns. These are based on prices, which in turn are influenced by the income tax system. The question arises which approach is more error-prone when using observable returns for business appraisals, the implication of which for calculating prices is: Should observable pretax returns be used (although the aim is to obtain a value influenced by tax)? Or should calculated after tax returns be used (although assumptions need to be made which, ceteris paribus, may lead to an irrelevance of income tax)?

The analysis of the impact of changes in tax rates on the capital market equilibrium requires information that is not obtainable empirically. However, regarding the typecast business appraisal from a minority shareholder's point of view we demonstrated that a workable CAPM including taxation can be deduced. We are able to derive our results without assuming more than the *Brennan* CAPM and the IDW S1 standard.

5 Literature

Ballwieser, Wolfgang (1995): Unternehmensbewertung und Steuern, in: *Elschen, Rainer / Siegel, Theodor / Wagner, Franz* (eds.): Unternehmenstheorie und Besteuerung, FS Dieter Schneider, Wiesbaden 1995, pp. 15-37.

Brennan, Michael J. (1970): Taxes, Market Valuation and Corporate Financial Policy, in: NTJ, Vol. 23 (1970), pp. 417-427.

Cliffe, Cheryl / Marsden, Alastair (1992): The Effect of Dividend Imputation on Company Financing Decisions and Cost of Capital in New Zealand, in: Pacific Accounting Review, Vol. 4 (1992), No. 1, pp. 1 - 30.

Drukarczyk, Jochen / Richter, Frank (1995): Unternehmensgesamtwert, anteilseignerorientierte Finanzentscheidungen und APV-Ansatz, in: DBW, Vol. 55. (1995), pp. 559-580.
IDW (2000): IDW Standard: Grundsätze zur Durchführung von Unternehmensbewertungen (IDW S 1), in: WPg, Vol. 53. (2000), pp. 825-842.
Jonas, Martin (2001): Steuern in der Unternehmensbewertung unter besonderer Berücksichtigung der Unternehmenssteuerreform, in: Steuerberater-Jahrbuch 2000/2001, Köln 2001, pp. 409 - 423.
Lally, Martin (1992): The CAPM under Dividend Imputation, in: Pacific Accounting Review, Vol. 4 (1992), No. 1, pp. 31 - 45.
Litzenberger, Robert H. / Ramaswamy, Krishna (1979): The Effect of Personal Taxes and Dividends on Capital Asset Prices, in: JFE, Vol. 7 (1979), pp. 163-195.
Moxter, Adolf (1983): Grundsätze ordnungsmäßiger Unternehmensbewertung, 2nd fully revised edition, Wiesbaden 1983.
Richter, Frank (2002): Kapitalmarktorientierte Unternehmensbewertung, Frankfurt am Main u.a. 2002.
Richter, Frank (2003): Relativer Unternehmenswert und Einkommensteuer oder: Was ist paradox am Steuerparadoxon?, in: *Richter, Frank/Schüler, Andreas/Schwetzler, Bernhard* (eds.): Kapitalgeberansprüche, Marktwertorientierung und Unternehmenswert, FS Jochen Drukarczyk, München 2003, pp. 307-329.
Richter, Frank (2004): Valuation With or Without Personal Income Taxes?, in: sbr, Vol. 56 (2004), pp. 20-45.
Schmidbauer, Rainer (2002): Der Kapitalisierungszinssatz in der Unternehmensbewertung nach dem StSenkG – Diskussion auf Irrwegen?, in: BB, Vol. 57. (2002), pp. 1251-1257.
Schultze, Wolfgang (2003): Methoden der Unternehmensbewertung, 2. revised and extended edition, Düsseldorf 2003.
Schwetzler, Bernhard / Piehler, Maik (2004): Unternehmensbewertung bei Wachstum, Risiko und Besteuerung – die Anwendungsbedingungen der IDW S 1 Wachstumsformel, working paper, Leipzig 2002, Version 1/2004.
Wiese, Jörg (2004): Unternehmensbewertung mit dem Nachsteuer-CAPM?, working paper, Münchener Betriebswirtschaftliche Beiträge, Ludwig-Maximilians-Universität München 2003.