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Analysts' dividend forecasts, portfolio selection, and market risk premia

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by Wolfgang Breuer[*], Franziska Feilke[**], Marc Gürtler[***]

Abstract. The most relevant practical impediment to an application of the Markowitz portfolio selection approach is the problem of estimating return moments, in particular return expectations. We analyze the consequences of using return estimates implied by analysts' dividend forecasts under the explicit notion of taxes and non-flat term structures of interest rates and achieve quite good performance results. As a by-product, these results cast some doubt upon the adequacy of estimating market risk premia with implied returns, because estimation techniques with good performance results are hardly suited to describe market expectations.

Keywords: analysts' forecasts, CAPM, implied returns, market risk premium, portfolio optimization, return estimation.

JEL classification: G11, G12, G14

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1 Introduction

Today, there is no doubt that modern portfolio selection theory was initiated by the famous contributions of Markowitz (1952, 1959). However, even more than fifty years later the practical relevance of Markowitz' work for actual portfolio management decisions lies far behind the theoretical impact of his idea of mean-variance oriented portfolio optimization. Certainly, practical applications of the Markowitz approach are mostly impeded by the necessity of the adequate estimation of expectation values, variances, and covariances of security returns. While estimations for variances and covariances that are based on historical return realizations work quite satisfactorily (see, for example, Chopra and Ziemba, 1993), it is well-known that average historical return realizations are only a rather poor proxy for actual expected future returns (see, for example, Jorion, 1986; Kempf and Memmel, 2002). Because of this problem, there have been numerous attempts for decades to develop alternative approaches of expected return estimation. The easiest way to circumvent the problem is to apply portfolio selection techniques that do not rely on the estimation of expected stock returns. For example, on the basis of the equilibrium analysis by Sharpe (1964), Lintner (1965), and Mossin (1966), one should simply realize a fraction of the market portfolio that is defined as the total supply of risky assets on the capital market under consideration. A similar, but simplified portfolio selection strategy would be just to realize a portfolio with equal shares of all risky assets at hand. Such a strategy would result as optimal for an individual who has no information about equity returns at all and who therefore just acts according to the Laplace principle (also known as the principle of indifference). An application of the Laplace principle for situations in which an investor is aware of all return variances and covariances but has no idea at all regarding expected stock returns leads to the realization of the variance minimal stock portfolio.

In addition to such simple portfolio selection strategies as just described, one could also try to apply alternatives to the estimation of expected stock returns as average historical return realizations. Factor models are based on historical return realizations as well, but only postulate the stability of certain relationships between the return of a stock and several independent variables. The three-factor model propagated by Fama and French (1993, 1995) seems to be one of the most prominent examples for these kinds of approaches. Other authors aim at refining estimation techniques based on historical return realizations by using Bayesian expectation formation approaches (see, for example, Jorion, 1986; Kempf et al., 2002). Finally, there are authors who introduce additional ad hoc restrictions on admissible portfolio weights in order to achieve better portfolio performance (see, for example, Frost and Savarino, 1988; Eichhorn et al., 1998; Grauer and Shen, 2000).

In this paper, however, as a first goal we want to examine in more detail opportunities to utilize analysts' dividend forecasts as the basis for the estimation of expected returns. The main idea is to assume that current security prices are in line with analysts' forecasts of expected dividends. Against this background and by the use of a variant of the Gordon (1962) dividend discount model, internal rates of return for given current security prices and analysts' dividend forecasts can be computed. These internal rates of return are used as proxies of expectation values and often serve as the basis for calculating equity risk premia in literature (see, for example, Claus and Thomas, 2001; Fama and French, 2002; Daske et al., 2006). However, such an approach implicitly assumes that all investors share the analysts' (average) return expectations. Certainly, this premise will not hold exactly in reality. Moreover, in order not to lead to contradictions, portfolio selection based on analysts' dividend forecasts should result in the optimality of holding the market portfolio. As a further consequence, one might expect that the performance of portfolio selection procedures based on analysts' dividend forecasts should be the same as that of holding directly the market portfolio. Up to now, Stotz (2004, 2005) seems to be the only one to examine the efficiency of portfolio management decisions based on analysts' dividend forecasts. Based on an analysis of the stocks in the DJ Stoxx 50 index from December 1989 to November 2000, he compares resulting Sharpe

(1966) ratios for portfolios relying on analysts' dividend forecasts and those that utilize simple historical return realizations. While for the first strategy, a Sharpe ratio with respect to monthly excess returns of 0.384 is obtained, the second strategy only leads to a Sharpe ratio of 0.268. Moreover, the Sharpe ratio of simply holding the market portfolio also amounts to only 0.243. In fact, this last result may also be interpreted as an indirect evidence against the utilization of analysts' dividend forecasts for the assessment of market risk premia. Based on such considerations, it seems to pay to take a closer look at possibilities of portfolio selection based on analysts' dividend forecasts. Thereby, we want to extend the analysis of Stotz (2004, 2005) in several ways. First of all, Stotz himself gives no theoretical justification of his approach. In contrast, we make use of a variant of the multi-period Capital Asset Pricing Model (CAPM), as developed by Fama (1977) and adjusted to German tax laws by Mai (2006), Rapp and Schwetzler (2007) or Wiese (2007). This allows us to identify theoretically conditions under which analysts' dividend forecasts are suited for the derivation of expected one-period (excess) returns of securities even if non-flat term structures of interest rates and personal income taxes are taken into account, thereby explicitly assuming German tax rules. Secondly, we present an empirical examination of whether the explicit recognition of non-flat term structures of interest rates and of the German personal income taxation leads to significantly better portfolio optimization outcomes than the "basic" dividend discount approach. To these ends, we compute achievable Sharpe ratios for four different approaches that rely on analysts' dividend forecasts: (1) the base case with flat term structure of interest rates and without explicit recognition of (personal) German income taxation, (2) non-flat term structure without explicit recognition of (personal) German income taxation, (3) flat term structure, but (personal) German income taxation, (4) non-flat term structure of interest rates and (personal) German income taxation. Moreover, we contrast the results of these four dividend oriented approaches not only just with the performance of historical estimators based on simple historical return realizations, but with several additional portfolio selection strategies as well. In addition, we extend the empirical investigation by taking into account several other performance measures (Jensen's, 1968, alpha, the Treynor, 1965, ratio, the Treynor-Black, 1973, appraisal ration, the four-factor approach of Carhart, 1997). To be more precise, we compute performance measures for simply holding a portfolio with equal shares of all stocks, for holding the market portfolio and for holding the variance minimal portfolio. Furthermore, we consider the performance of portfolios that rely on historical (pre- or post-tax) return realizations as the basis for calculating expectation values, i.e. the simple historical average return and the expected security return according to the three-factor approach by Fama and French (1993, 1995). To complete our analysis, we finally take the Bayesian approach of Kempf et al. (2002) into account. We find that the ranking of all these approaches varies for situations with rising and situations with falling stock prices. However, the overall performance of the dividend discount approach with non-flat term structure of interest rates and (personal) German income taxation seems to be the best.

Thirdly, we show empirically that general expectation biases in analysts' forecasts do not strongly affect portfolio performance. We try to present a graphical rationale for our findings that may explain the quite positive results that can be accomplished by this approach despite the overwhelming empirical evidence of analysts' dividend forecasts being biased (see, e.g. Easterwood and Nutt 1999; Chan et al. 2003; Hong and Kubik 2003).

For given database and estimation techniques with respect to expected security returns, it is straightforward to derive estimators for market risk premia as well, as is done in the articles cited previously. We therefore contribute to the existing literature in a fourth way by estimating risk market premia for our dataset with the help of the different portfolio selection strategies described in the last paragraphs. Thereby, we seem to be the first to make use of a multi-period post-tax CAPM with non-flat term structure of interest rates. We are therefore able to assess the consequences of such additional considerations in comparison to a pre-tax standard approach with flat term structure of interest rates. The "post-tax" approach with non-flat term structure leads to negative estimators for market risk premia in bullish and in bearish markets and our finding can be interpreted as a caveat with respect to estimating market risk premia on the basis of analysts' dividend forecasts. Maybe it is more adequate to apply these forecasts as a starting point for individual portfolio selection than for estimating market risk premia.

The rest of our paper is organized in the following way. Section 2 introduces our underlying theoretical concept. In Section 3, we present our empirical setting. Section 4 contains our empirical analysis regarding the efficiency of portfolio selection strategies based on analysts' dividend forecasts. Besides the relevance of non-flat term structures of interest rates and tax considerations, we examine the (performance) consequences of general expectation biases in analysts' forecasts. Section 5 is devoted to the problem of market risk premia estimation. Section 6 concludes.

2 Theoretical background

Consider a firm j with uncertain dividends $\tilde{d}_{j,t}$ (after corporate taxes) from t = 1 to t = T. Let $r_{f,t}$ stand for the interest rate for riskless lending/borrowing from t−1 to t which is already known at time 0. Deterministic values $r_{f,t}$ immediately imply that future one-period spot rates are identical to corresponding forward rates. In the same manner as $r_{f,t}$, expectation values, variances and covariances of all security returns $\tilde{r}_{j,t}$ and market portfolio returns $\tilde{r}_{m,t}$ for any time period t−1 to t are known at time 0 and do not change over time.

Moreover, all individuals only look at expectation values and variances of their personal payoffs at any point in time and act on perfect capital markets. Under these conditions, the well-known multi-period CAPM developed by Fama (1977) is in effect. To be more precise, the market value $V_{j,0}$ of a firm's j equity at time 0 can be computed as:

$$V_{j,0} = \sum_{t=1}^{T} \frac{E(\tilde{d}_{j,t})}{\prod_{\kappa=1}^{t} \left(1 + r_{f,\kappa} + \frac{E(\tilde{r}_{m,\kappa}) - r_{f,\kappa}}{Var(\tilde{r}_{m,\kappa})} \cdot Cov(\tilde{r}_{j,\kappa}, \tilde{r}_{m,\kappa})\right)}. \qquad (1)$$

Expected dividends are thus discounted by one-period costs of capital from t = 0 to t = T which each discount factor being determined on the basis of the relevant riskless interest rate $r_{f,t}$ and a premium for the systematic risk connected with the uncertain dividends.

In the last years, even accountants have discovered the usefulness of this approach for firm valuation when they were engaged in merger transactions (see, for example, Breuer et al., 2007). However, it seems necessary to take personal taxes into account because of their high practical relevance for valuation purposes. To this end, we introduce $\tau^{(equ)}$ as the (homogeneous) personal tax rate of individuals for dividends and capital gains, as both kinds of (equity) income are taxed in the same manner in Germany as long as shares are not held for more than a year. Moreover, we need $\tau^{(debt)}$ to denote the personal tax rate for fixed income (debt) financial instruments. In Germany, for the time being, we have $\tau^{(equ)} = 0.5 \cdot \tau^{(debt)}$. In contrast, before 2002 we had $\tau^{(equ)} = \tau^{(debt)}$ in Germany. As has been shown by Mai (2006), Rapp and Schwetzler (2007) or Wiese (2007) this implies

$$\begin{aligned} V_{j,0} &= \sum_{t=1}^{T} \frac{E(\tilde{d}_{j,t}) \cdot (1 - \tau^{(equ)}) - \left(E(V_{j,t}) - E(V_{j,t-1})\right) \cdot \tau^{(equ)}}{\prod_{\kappa=1}^{t} \left(1 + r_{f,\kappa} \cdot (1 - \tau^{(debt)}) + \underbrace{\frac{E(\tilde{r}_{m,\kappa}) \cdot (1 - \tau^{(equ)}) - r_{f,\kappa} \cdot (1 - \tau^{(debt)})}{Var(\tilde{r}_{m,\kappa})} \cdot Cov(\tilde{r}_{j,\kappa}, \tilde{r}_{m,\kappa})}_{=:\Phi_{j,m,\kappa}}\right)} \\ &= \sum_{t=1}^{T} \frac{E(\tilde{d}_{j,t}) \cdot (1 - \tau^{(equ)})^{t}}{\prod_{\kappa=1}^{t} \left(1 - \tau^{(equ)} + r_{f,\kappa} \cdot (1 - \tau^{(debt)}) + \Phi_{j,m,\kappa}\right)}. \end{aligned} \qquad (2)$$

Apparently, in comparison to formula (1), modifications in the numerator and the denominator have been necessary to allow for taxes on capital gains and on dividend or interest income.

In order to employ formula (2) for portfolio optimization purposes we have to assume that the risk premium $\Phi_{j,m,\kappa}$ is the same for all $\kappa = 1, \ldots, T$, i.e. $\Phi_{j,m,\kappa} = \Phi_j$ = const. Moreover, as explicit analysts' dividend forecasts are only publicly available for as little as three years, we follow the dividend growth model by Gordon (1962) in assuming a constant dividend growth rate g_j from t = 3 on. However, forward rates $r_{f,t}$ for periods beyond that from time t–1 = 2 to t = 3 can be calculated. In fact, forward rates are available up to $\hat{T} = 15$, as is described more precisely in Section 3. We assume $r_{r,t} = r_{f,\hat{T}}$ for $t \geq \hat{T}$.

Against this background, formula (2) becomes (see Appendix 1 for details)

$$V_{j,0} = \sum_{t=1}^{3} \frac{E(\tilde{d}_{j,t}) \cdot (1-\tau^{(equ)})^t}{\prod_{\kappa=1}^{t} \left(1-\tau^{(equ)} + r_{f,\kappa} \cdot (1-\tau^{(debt)}) + \Phi_j\right)} + \sum_{t=4}^{15} \frac{E(\tilde{d}_{j,3}) \cdot (1+g_j)^{t-3} \cdot (1-\tau^{(equ)})^t}{\prod_{\kappa=1}^{t} \left(1-\tau^{(equ)} + r_{f,\kappa} \cdot (1-\tau^{(debt)}) + \Phi_j\right)}$$
$$+ \frac{E(\tilde{d}_{j,3}) \cdot (1+g_j)^{13} \cdot (1-\tau^{(equ)})^{16}}{\prod_{\kappa=1}^{15} \left(1-\tau^{(equ)} + r_{f,\kappa} \cdot (1-\tau^{(debt)}) + \Phi_j\right) \cdot \left(1-\tau^{(equ)} + r_{f,15} \cdot (1-\tau^{(debt)}) + \Phi_j - (1+g_j) \cdot (1-\tau^{(debt)})\right)} \quad (3)$$

The first summand gives us the present value of the uncertain dividends at times t = 1, 2, 3, the second summand comprises the present value for dividends from t = 4 to t = $\hat{T}$, that is, until that point in time for which interest rate information is at hand. Thereby, expected dividends are extrapolated from the expectation value of time t = 3. The third summand evaluates (extrapolated expected) dividends from t = $\hat{T}+1$ on. To this end, the term structure of interest rates is assumed to be flat beyond t = $\hat{T}$.

In Appendix 2 it is shown that the expected (one-period) rate of return after personal taxes from holding stock j during the period from t = 0 to t = 1 is $r_{f,1} \cdot (1-\tau^{(debt)}) + \Phi_j$ if equation (3) is not only valid at time t = 0, but also (analogical) at t = 1 and expectations are rational. Apparently, this holds true in the multi-period CAPM with homogeneous expectations and constant security market risk premia over time. However, such a setting is only a sufficient condition for deriving expected one-period (excess) returns for securities from (3). In order to justify our approach, we do not require that all market participants actually share analysts' dividend forecasts. It suffices when analysts' expectations for future dividends are correct and market valuation is characterized by a constant solution for Φ_j at times t = 0 and t = 1 for each security j when referring to analysts' dividend forecasts. Certainly, in such a situation the variables Φ_j cannot be interpreted as security risk premia any longer, because *market* dividend expectations may be completely different from those of the analysts. However, the Φ_j remain relevant for portfolio optimization. We will return to the issue of this important distinction in our empirical section.

Since equation (3) describes the most general case of non-flat term structure as well as a situation with personal income taxes, it is not difficult to use (3) also for the derivation of expected equity return for special situations. In particular, for the setting $\tau^{(equ)} = \tau^{(debt)} = 0$, we arrive at a situation with the neglection of personal income taxes, while $r_{f,t} = r_f$ = const. leads to a situation with a flat term structure of interest rates. When explicitly recognizing taxes, we apply for each of the first three subsequent years the then actually prevailing tax rates thus assuming that investors are informed about future changes in tax rates. This means that we assume investors in 1999 to be already aware of the changes in tax law of the following year 2000 which have been in effect since 2002. Moreover, we assume investors to consider the (correctly anticipated) tax rates at time t+3 to be valid for all future periods t+4,t+5, …. As a consequence, for example, an investor in 1998 is assumed to compute with $\tau^{(equ)} = 0.35$ even in years beyond 2001 due to a lack of knowledge regarding future changes in tax law.

With this in mind, it is now possible to examine empirically potential improvements in performance as a consequence of the explicit recognition of non-constant riskless interest rates and personal income taxes.

3 Non-flat term structures and personal taxes: the empirical setting

We base our empirical examination on monthly data of (all) 16 out of 30 equity shares that belong to the Deutsche Aktienindex (DAX) from 01/01/1994 until 07/01/2004. Data is extracted from the Thomson Financial Datastream database. Riskless interest rates are calculated on the basis of the interest yield curve as provided by the Deutsche Bundesbank for (remaining) maturities of one to fifteen years. With υ_t as the annual rate of return of a zero bond with maturity at time t, the following equation must hold for all t to exclude arbitrage opportunities:

$$(1+(1-\tau^{(\text{debt})})\cdot r_{f,1})\cdot\ldots\cdot(1+(1-\tau^{(\text{debt})})\cdot r_{f,t}) = 1+(1-\tau^{(\text{debt})})\cdot\left[(1+\upsilon_t)^t-1\right]. \tag{4}$$

Equation (4) explicitly accounts for tax considerations. While revolving short-term investments (the left-hand side of equation (4)) imply tax payments at every point in time t = 1, 2, …, T), a zero bond with internal rate of return υ_t is taxed only at the time of maturity (with the redemption value not being subject to taxation). Obviously, equation (4) can be used to compute all forward rates $r_{f,t}$ for given term structure (υ_1, …, υ_T) of (zero bond) interest rates. Annualized returns are transformed to monthly returns as follows:

$$r_{\text{month}} = \sqrt[12]{1+r_{\text{year}}}-1, \tag{5}$$

where r_{month} stands for the monthly return and r_{year} for the corresponding annualized return. Equation (4) is used by us with $\tau^{(\text{debt})}$ = 0 % for all cases "without taxes" and with $\tau^{(\text{debt})}$ = 35 % for the scenarios with explicit tax considerations.

For any point in time t from 12/01/1996 until 06/01/2004 we apply all portfolio selection strategies under consideration. All portfolio selection strategies have in common that (if necessary) we estimate excess return variances and covariances on the basis of historical excess returns with or without taxes. Thereby, we assume pre-tax returns to be stationary over time. This means, that we firstly estimate all excess return variances and covariances on a pre-tax basis and then correct the resulting estimators for the then prevailing tax rates at the time of portfolio selection.

Besides the tax issue, the approaches under consideration only differ with respect to the estimation or consideration of expectation values of excess stock returns. As outlined in Section 1, we take into account four different strategies with estimates of expected excess returns on the basis of analysts' dividend forecasts. In case 1, we apply formula (3) for the special situation with a flat term structure of interest rates, i.e. under the assumption $r_{f,t} = r_{f,1}$ for all t = 1, 2, ..., and without taxes, i.e. under the assumption $\tau^{(debt)} = \tau^{(equ)} = 0$. Case 2 is described by a situation with a flat term structure of interest rates, but positive tax rates. We use 35 % as an average tax rate of a German investor (see, for example, Jonas et al., 2004) when holding debt so that we have $\tau^{(debt)} = \tau^{(equ)} = 0.35$ until 2001 and $\tau^{(debt)} = 0.35$ as well as $\tau^{(equ)} = 0.175$ from 2002 on as current tax rates. Tax rates of future periods are determined under the assumption of perfect foresight for the next three years (only) and extrapolation of the last known tax rates as described above.

Case 3 is based on the assumption of a non-flat term structure of interest rates as described by formula (3) and has $\tau^{(debt)} = \tau^{(equ)} = 0$. Finally, case 4 combines the assumption of a non-flat term structure of interest rates with the notion of positive tax rates $\tau^{(debt)} = 0.35$ and $\tau^{(equ)} = 0.175$ or accordingly $\tau^{(equ)} = 0.35$. For all four situations, it is necessary to define the annual growth rate g_j of the dividends of firm j beyond the horizon of current analysts' dividend forecasts. While Stotz (2004) is using $g_j = g = 6$ % on the basis of the average annual growth rate of the (nominal) gross national income in Germany from 1980 to 1999, we apply the average of the last 5 years of the annual growth rate of the (nominal) gross national income just before the point in time when the respective portfolio selection takes place. We thus take into account time-varying estimators for future national growth rates.

Cases 5 to 7 describe portfolio selection strategies that do not rely on explicit estimations of expected excess returns. In case 5 (holding the "market portfolio"), at each point in time from 12/01/1996 until 06/01/2004 the investor realizes a portfolio structure of risky assets that is identical to that of the whole supply of all equity shares of the 16 companies under consideration. In case 6 we assume that the investor adheres to a risky subportfolio with a share of 1/16 for each of the different stocks. Case 7 is defined by the holding of the variance minimal stock portfolio at each point in time from 12/01/1996 until 06/01/2004.

Cases 8 (without tax considerations, i.e. for $\tau^{(equ)} = \tau^{(debt)} = 0)$ and 9 (with tax considerations) refer to the estimation of expected excess returns at a point in time t as the average of 25 (monthly) excess return realizations from t−24 to t. Tax issues are treated in the same way as with respect to the estimation of the variance-covariance matrix, i.e., we assume return distributions before current personal taxes to be stable over time. In the same way, we handle all other approaches that rely on historical return data and take taxes into account.

Cases 10 (without taxes) and 11 (with taxes) are applications of the famous Fama and French (1993, 1995) three-factor model. According to this approach the expected excess return of any stock j can be described by the following linear equations (before or after taxes):

$$\begin{aligned}
&\mu_j - r_f = \alpha_j + \beta_{jm} \cdot (\mu_m - r_f) + s_j \cdot \mu_{SMB} + h_j \cdot \mu_{HML}, \\
&\mu_j \cdot (1-\tau^{(equ)}) - r_f \cdot (1-\tau^{(debt)}) = \alpha_j + \beta_{jm} \cdot (\mu_m \cdot (1-\tau^{(equ)}) \\
&\qquad\qquad - r_f \cdot (1-\tau^{(debt)})) + (s_j \cdot \mu_{SMB} + h_j \cdot \mu_{HML}) \cdot (1-\tau^{(equ)}).
\end{aligned} \tag{6}$$

In this context, "SMB" stands for "small minus big" and "HML" for "high minus low". In fact, μ_{SMB} is the difference (before taxes) between expected returns of a portfolio that consists of shares of small companies and a portfolio that consists of big companies. Correspondingly, μ_{HML} describes the difference (before taxes) in expected returns between a portfolio of shares with high relations between book value and market value and a portfolio of shares with low such relations.

We proxy the market portfolio return as the average realized return of the DAX for the 25 preceding months. The portfolio composition for calculating μ_{SMB} and μ_{HML} on the basis of our 16 equity stocks is chosen according to Fama and French (1993). Once a year (at the end of June) we divide all 16 stocks into disjoint subsets according to two different criteria. Based on their respective relations between book and market value of equity shares as of December of the preceding year we have five shares forming the group of lowest book-to-market value relations (subset "L"), five more shares with highest relations (subset "H") and six remaining ones with medium levels (subset "M"). Correspondingly, those eight equity shares with the lowest market capitalization are called "small" (subset "S") and the other eight ones are denoted as "big" (subset "B"). Combining both sorting criteria leads to the possibility of six different equity portfolios with all equity shares weighted according to their market values. This gives six return distributions which shall be denoted as $\tilde{r}_{S\cap L}, \tilde{r}_{S\cap M}, \tilde{r}_{S\cap H}, \tilde{r}_{B\cap L}, \tilde{r}_{B\cap M}$, and $\tilde{r}_{B\cap H}$. Following Fama and French (1993), we now define

$$\begin{aligned} \tilde{r}_{SMB} &:= (\tilde{r}_{S\cap L} + \tilde{r}_{S\cap L} + \tilde{r}_{S\cap L})/3 - (\tilde{r}_{B\cap L} + \tilde{r}_{B\cap L} + \tilde{r}_{B\cap L})/3, \\ \tilde{r}_{HML} &:= (\tilde{r}_{S\cap H} + \tilde{r}_{B\cap H})/2 - (\tilde{r}_{S\cap L} + \tilde{r}_{B\cap L})/2. \end{aligned} \tag{7}$$

According to Fama and French (1993), the specific construction of the return distribution for "Small Minus Big" and "High Minus Low" helps to separate the respective influences from each other. Based on (6) and (7) and 25 historical return realizations from t–24 to t, a linear regression can be performed at each point in time from 12/01/1996 until 06/01/2004 in order to determine expected excess returns before or after taxes for each of the 16 stocks under consideration.

Cases 12 and 13 refer to the Bayesian approach of Kempf et al. (2002). In contrast to Jorion (1986), estimation risk is modelled as a second source of risk which is independent of the intrinsic risk. As is typical for Bayesian approaches, a prior estimator of expected stock returns is combined with information on historical return realizations summarized in the vector M_{hist} of average historical stock returns. The prior estimator ϕ is called the grand mean and is just identical to the average historical return realization over all stocks under consideration. The mean of the predictive density function M_{KKM} of expected stock returns then is computed as a weighted average of $\phi \cdot \mathbf{1}$ ($\mathbf{1}$: a vector of 16 ones) and M_{hist}. To be more specific, define C as the estimator of the variance-covariance matrix based on historical return realizations, E as the unit matrix, T as the number of historical return realizations under consideration (for our analysis: T = 25) and τ^2 as the estimated variance of the historical return estimators of each stock in relation to the grand mean as the corresponding expectation value:

$$\tau^2 = \frac{1}{N-1} \cdot \sum_{i=1}^{N} (M_{hist,i} - \phi)^2. \tag{8}$$

Then we have

$$M_{KKM} = (C + T \cdot \tau^2 \cdot E)^{-1} \cdot C \cdot \phi \cdot \mathbf{1} + (C + T \cdot \tau^2 E)^{-1} \cdot T \cdot \tau^2 \cdot M_{hist}. \tag{9}$$

As a peculiarity of Bayesian approaches, we also have to adjust the variance-covariance estimator:

$$\Sigma_{KKM} = C \cdot \left(E + \tau^2 \cdot (C + T \cdot \tau^2 \cdot E)^{-1} \right). \tag{10}$$

We will apply the Bayesian approach sketched above in a pre- and a post-tax version (cases 12 and 13) in the same way as the three-factor model of Fama and French (1993, 1995).

For all 13 cases under consideration we compute 91 successive optimal (myopic) portfolios from 12/01/1996 to 06/01/2004 with a time horizon of one month each subject to short sales constraints $0 \leq x_j \leq 1$ for all stocks j = 1, …, 16 under consideration. Because, according to the two-fund separation theorem introduced by Tobin (1958), the structure of the risky sub-portfolio is independent of the investor’s degree of risk aversion, we are free to define an arbitrary level of risk, for example $\sigma_P = 3$ %, and maximize expected excess return under this restriction at any point in time. Under the assumption that $\sigma_P = 3$ % is actually realized for all sequential 91 portfolio optimizations for all cases under consideration, a higher average excess return directly implies a higher average Sharpe ratio. This is an additional advantage of trying to realize a constant level of risk over the whole time period under consideration. Moreover, the average Sharpe ratio would be the same for any other predetermined fixed level of risk σ_P.

For all 13 cases and 91 periods of revolving portfolio optimizations, we determine corresponding realized portfolio excess rates $r_{P,t+1}^{(exc)}$ of returns after taxes at time t+1: $r_{P,t+1}^{(exc)} := (1-\tau^{(equ)}) \cdot r_{P,t+1} - (1-\tau^{(debt)}) \cdot r_{f,t+1}$ By this procedure, we get 91 excess return realizations for 13 strategies, that means we obtain 13·91=1,183 optimized portfolios. With $\hat{\mu}^{(exc)}$ as the mean excess return over all 91 excess return realizations and $\hat{\sigma}^{(exc)}$ as the corresponding estimator for the excess return standard deviation, we are able to compute (estimators for) resulting Sharpe ratios $\varphi_S := \hat{\mu}^{(exc)} / \hat{\sigma}^{(exc)}$ for any portfolio selection strategy under consideration. These estimators are independent of the desired level of risk σ_P applied to derive optimal structures.

While the time period from 12/01/1996 to 08/01/2000 is characterized by rising stock prices, the second period from 09/01/2000 to 06/01/2004 describes a situation with falling ones. In order to examine the performance of our portfolio selection strategies under consideration for different market settings we therefore determine their performance separately for each of the two subperiods. According to the two-fund separation theorem, the higher the resulting respective Sharpe ratio, the better the portfolio selection strategy under consideration. For such an “efficiency test” of portfolio selection strategies, Jobson and Korkie (1981) and Memmel (2003) were able to derive a test statistic. However, the power of this test is small, as according to Jobson and Korkie (1981), for an underlying number of 60 portfolio optimizations a difference of 0.1 between two Sharpe ratios will lead to a rejection of the null hypothesis of identical Sharpe ratios only in 10 % of all cases. For this reason, we extend our analysis on the basis of portfolio (excess) return realizations to several other performance measures, i.e. Jensen's alpha, the Treynor ratio, the Treynor-Black appraisal ratio, and Carhart's (1997) four-factor approach. For the first three of these alternative performance measures, it is necessary to employ a linear regression of the portfolio excess return realizations on the rate of excess return of a reference portfolio that serves as a proxy of the market portfolio. We use the same proxy for the market portfolio as in the case of portfolio strategy 5, i.e. the sixteen DAX stocks under consideration. While Jensen's alpha corresponds to the constant term in the linear regressions, the Treynor-Black appraisal ratio ranks portfolio strategies according to the quotient of Jensen's alpha and the remaining variance of the error term in the regressions. The Treynor ratio aims at arranging all portfolio selection strategies on the basis of the fraction $\varphi_T := \hat{\mu}^{(exc)} / \hat{\beta}^{(exc)}$, with $\hat{\beta}^{(exc)}$ as the slope of the linear regressions. Carhart's four-factor approach is an extension of the Fama and French (1993, 1995) three-factor model. The fourth factor is applied to take momentum effects into account, i.e. the phenomenon that stocks that performed well in the past often also perform well in future periods. In the same way as with respect to Jensen's alpha, portfolio strategies may be ranked according to their α for Carhart's (1997) four-factor approach.

4 Empirical Results

Table 1 presents our empirical results for the thirteen cases described in the previous section. Obviously, portfolio management based on analysts' dividend forecasts performs indeed quite well particularly in comparison to the three benchmark strategies 5, 6, and 7. Moreover, taking non-flat term structures of interest rates and/or taxes into account (case 4 in comparison to cases 1, 2, and 3) actually increases the resulting Sharpe ratio. Rather remarkably, only with respect to strategies based on analysts' dividend forecasts it seems to pay to explicitly consider taxes. Furthermore, it is noteworthy that strategy 4 performs well both in the first period (characterized by a bullish stock market) *and* in the second period (characterized by a bearish market). In fact, there are only five strategies (four of them based on analysts' dividend forecasts) that are able to attain a positive Sharpe ratio during the bearish market phase. As a consequence, all dividend oriented portfolio selection strategies outperform the simple holding of the market portfolio on a 5 % significance level in the second period according to the Jobson and Korkie efficiency test. Strategies 6 and 7 are outperformed by strategies 1 to 4 in the second period at least on a 20 % significance level (as already pointed out, the Jobson ad Korkie efificiency test is of only limited use, as high significance level are very hard to achieve; as a consequence, results are not significant for the first period, though strategy 4 performs quite well). There are no other "active" portfolio selection strategies under consideration (i.e. strategies 8 to 13) that are able to outperform the three benchmark strategies 5, 6 and 7 on a significance level of 20 % or better.

>>> **Insert Table 1 about here** <<<

Our results of Table 1 are generally verified by the findings for the other performance measures under consideration: Portfolio strategies based on analysts' dividend forecasts are quite advantageous, in particular when based on non-flat term structures of interest rates and after-tax returns. Once again, dividend based approaches perform particularly well in times of falling stock prices (period 2). Only portfolio strategy 4 is able to reach a positive value of Jensen's alpha on a 10 % significance level in both periods. *All* other significantly positive values for Jensen's alpha are also only achieved by dividend based portfolio selection strategies.

Moreover, portfolio strategy 4 is the only one that – on a 10 % level – implies a significantly higher Treynor ratio than the simple holding of the market portfolio (strategy 5) in both subperiods according to a test statistic also developed by Jobson and Korkie (1981) (and corrected by Cadsby, 1986). The same holds true for strategy 4 in comparison to strategy 6 and (on a 20 % significance level) to strategy 7. Once again, all other significantly better performance results in comparison to the holding of the market portfolio are related to the also dividend oriented strategies 1 to 3. That means that strategies 8 to 13 do not significantly beat the passive strategies 5 to 7 neither in the first nor in the second subperiod according to the Treynor ratio.

>>> **Insert Table 2 about here** <<<

The quite good performance of portfolio selection strategies that are based on analysts' dividend forecasts may be somewhat surprising, as there is an extant literature on the biases in analysts' dividend forecasts. Moreover, when the multi-period CAPM actually holds, portfolio optimizations based on (2) are admissible, but they should lead to the optimality of simply holding the market portfolio. It thus seems interesting to elaborate on these issues somewhat deeper. In fact, one may distinguish between the ability of analysts to forecast differences in dividend developments among different firms and their ability of estimating correctly general market trends in dividend levels. While empirical evidence – as always – is to some degree ambiguous, most studies hint at some kind of overconfidence in the analysts' assessments (see, for example Stickel, 1990, Easterwood and Nutt, 1999 and Capstaff et al., 2001). This means that general market trends are overestimated by analysts. However, this does not imply that analysts' "selective" abilities are poor as well. In order to examine the consequences of too optimistic or too pessimistic market assessments by analysts more precisely, we analyzed four additional scenarios with all analysts' dividend forecasts adjusted by +10 %, +20 %, −10 %, or −20 % in comparison to the "true" dividend forecast underlying Tables 1 to 2. Table 3 presents the consequences for the resulting Sharpe ratios of all four strategies based on dividend expectations (notice that Sharpe ratios of other portfolio selection strategies are unchanged). Apparently, such a general forecasting bias is not able to considerably alter the resulting ranking of the four dividend oriented strategies in comparison to the other portfolio selection approaches under consideration. This may be viewed as an indirect evidence that general expectation biases in analysts' forecasts are of only minor relevance for issues of portfolio management. To put it another way: Although analysts' dividends are not based on rational expectations, they may in general hint at the correct relative movements of security prices.

>>> **Insert Table 3 about here** <<<

Figure 1 (not true-to-scale) may further help to understand the reason for our empirical results. The right minimum-variance line is the one as estimated on the basis of analysts' dividend forecasts on 04/01/2002. However, let us assume that these dividend forecasts are positively biased by 20 %. As a consequence, the "true" minimum-variance line as of 04/01/2002 is described by the left graph. Based on the analysts' biased expectations we would arrive at A as the best stock portfolio with estimates $\mu^{(A)} = 0.453357\%$ and $\sigma^{(A)} = 8.15002\%$. The true return moments of this stock portfolio are indeed $\mu^{(B)} = 0.352038\%$ and $\sigma^{(B)} = 8.15002\%$ so that the error with respect to the expectation estimator $\mu^{(A)}$ for $\mu^{(B)}$ amounts to about 28.78 %. Moreover, $\mu^{(C)} = 0.406175\%$ and $\sigma^{(C)} = 10.4342\%$ are the parameters of the correct tangency portfolio. As a consequence, for a given risk level of σ = 3 %, it would have been possible to reach an expected excess return of 0.062327 %, while the expectation bias leads to a loss in expected excess return of 0.002459 % percentage points (3.95 % of 0.062327 %) which is almost negligible. Although the two tangents differ considerably, the relevant lines through the points B and C lie rather near to each other. We are convinced that it is exactly this reason why general market biases in analysts' forecasts are of only minor relevance. In fact, for the same reason, variations of the length of the time period which underlies the estimation of dividend growth rate g do not affect the performance of the dividend based strategies in a significant way: Regardless, of whether g is assumed to be identical to the average annual growth rate of the nominal gross national income over four, five, or six years, portfolio strategy 4 remains the best one for each of the two subperiods.

>>> **Insert Figure 1 about here** <<<

The quite favorable performance results of portfolio selection strategies that are based on analysts' dividend forecasts apparently cast some doubts upon the adequacy of estimations of market risk premia on the basis of such implied expected returns. We turn to this issue in the next section.

5 Market risk premia and analysts' dividend forecasts

As already mentioned, each approach that can be applied as a starting point for the estimation of expected security returns, may also serve as a means for estimating market risk premia. To this end, after estimating individual expected security returns, one simply has to compute the implied expected excess return of the market portfolio for given current security prices. As strategies 5 to 7 do not rely on explicit expected return estimations, we can only refer to the remaining ten strategies of the preceding section to compute market risk premia. For each of these we estimate expected returns (for given estimates of the variance-covariance matrix based on historical return realizations) from 12/01/1996 until 07/01/2004. According to Table 4, (positive) market risk premia estimators are indeed lowest for the strategies 1 and 3 that are based on analysts' earnings forecasts. This result is in line with other studies on market risk premia that utilize implied returns (e.g. Claus and Thomas, 2001). According to the famous paper of Mehra and Prescott (1985) one would expect reasonable risk premia of about only 1 % p.a. Moreover, the strategies 1 and 3 are the only ones that do not imply risk premia (approximately) of or below zero during the period 2 with falling stock market prices. Accordingly, estimates of risk premia vary much more over the two subperiods when looking at the six approaches not based on dividend forecasts which is certainly not very plausible.

>>> **Insert Table 4 about here** <<<

Nevertheless, strategies 2 and 4 are also based on analysts' dividend forecasts, but lead to negative estimators for market risk premia in *both* subperiods. In particular strategy 4 is the one with the best overall performance according to Tables 1 and 2 and for these corresponding expectations holding the market portfolio is quite a bad advice regardless of whether the stock market is bearish or bullish. This circumstance is just reflected in an estimated negative expected excess return even in bullish markets when holding the market portfolio, while at the same it is possible to achieve a positive (ex post) Sharpe ratio when choosing optimal portfolio weights even in bearish markets. Such a constellation verifies the contradiction between applying a method of expectation formation for portfolio optimization on the one side and for assessing market risk premia on the other side. This is not too surprising, because, as already pointed out, investors are not really acting according to analysts' dividend forecasts, because in such a case of homogeneous expectations everyone would hold the market portfolio. As we learnt from the preceding section, this apparently is not the case, because strategy 4 does not result in a reproduction of strategy 5. As a minimum requirement for "reasonable" estimates of market risk premia, one has to choose a scenario that is consistent with market equilibrium. Therefore, the better the performance of a portfolio selection strategy compared to passive approaches, the worse its abilities with respect to assessing market risk premia.

6 Conclusion

Even after fifty years of intense research it still remains quite difficult to design "active" portfolio management strategies that are able to beat "passive" approaches like simply holding the market portfolio. The main objective of this paper was to examine how analysts' dividend forecasts might be utilized for portfolio management purposes. Based on the multi-period CAPM developed by Fama (1977) and extended for German tax laws by Mai (2006) or Wiese (2007) we have been able to derive conditions under which analysts' dividend forecasts result in correct estimators for one-period expected returns. In our empirical section we show the superiority of portfolio selection strategies based on analysts' dividend forecasts over alternative approaches that rely on historical return realizations. Moreover, we try to explain why analysts' dividend forecasts are helpful in portfolio optimization even when they are generally biased. Analysts only have to be able to discriminate between dividend expectations for different stocks. It is not necessary to estimate the general dividend level correctly.

In the literature, analysts' dividend forecasts are typically utilized not for portfolio management purposes but for the computation of market risk premia. However, superior performance results are not in line with the conjecture that analysts' dividend forecasts are helpful in calculating market premia. Moreover, expectations based on these dividend forecasts do not lead to the holding of the market portfolio. They may even imply negative estimators for market risk premia, although – at the same time – they may be used to derive portfolio selection strategies with positive expected excess returns. From all these findings we conclude that analysts' dividend forecasts may indeed be helpful in portfolio optimization, but we are not so sure that market risk premia estimation is another suitable field of application of analysts' dividend forecasts. The relationship between these two different fields should be carefully examined by future research.

Appendix 1:

$$V_{j,0}=\sum_{t=1}^{T}\frac{E(\tilde{d}_{j,t})\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=1}^{t}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\underbrace{\frac{E(\tilde{r}_{m,\kappa})\cdot(1-\tau^{(equ)})-r_{f,\kappa}\cdot(1-\tau^{(debt)})}{Var(\tilde{r}_{m,\kappa})}\cdot Cov(\tilde{r}_{j,\kappa},\tilde{r}_{m,\kappa})}_{=:\Phi_{j,m,\kappa}}\right)}$$

$$=\sum_{t=1}^{3}\frac{E(\tilde{d}_{j,t})\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=1}^{t}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_{j}\right)}+\sum_{t=4}^{\hat{T}}\frac{E(\tilde{d}_{j,3})\cdot(1+g_{j})^{t-3}\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=1}^{t}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_{j}\right)}$$

$$+\sum_{t=\hat{T}+1}^{\infty}\frac{E(\tilde{d}_{j,3})\cdot(1+g_{j})^{t-3}\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=1}^{t}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_{j}\right)}$$

$$=\sum_{t=1}^{3}\frac{E(\tilde{d}_{j,t})\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=1}^{t}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_{j}\right)}+\sum_{t=4}^{\hat{T}}\frac{E(\tilde{d}_{j,3})\cdot(1+g_{j})^{t-3}\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=1}^{t}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_{j}\right)}$$

$$+\sum_{t=\hat{T}+1}^{\infty}\frac{E(\tilde{d}_{j,3})\cdot(1+g_{j})^{t-3}\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=1}^{\hat{T}}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_{j}\right)\cdot\left(1-\tau^{(equ)}+r_{f,\hat{T}}\cdot(1-\tau^{(debt)})+\Phi_{j}\right)^{t-\hat{T}}}$$

$$=\sum_{t=1}^{3}\frac{E(\tilde{d}_{j,t})\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=1}^{t}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_{j}\right)}+\sum_{t=4}^{\hat{T}}\frac{E(\tilde{d}_{j,3})\cdot(1+g_{j})^{t-3}\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=1}^{t}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_{j}\right)}$$

$$+\frac{E(\tilde{d}_{j,3})\cdot(1+g_{j})^{\hat{T}-2}\cdot(1-\tau^{(equ)})^{\hat{T}+1}}{\prod_{\kappa=1}^{\hat{T}}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_{j}\right)\cdot\left(1-\tau^{(equ)}+r_{f,\hat{T}}\cdot(1-\tau^{(debt)})+\Phi_{j}-(1+g_{j})(1-\tau^{(debt)})\right)}$$

Appendix 2:

$$E^{(0)}(\tilde{r}_{i,1})=\frac{E^{(0)}(\tilde{V}_{i,1})+E^{(0)}(\tilde{d}_{i,1})\cdot(1-\tau^{(equ)})}{V_{i,0}}-1$$

$$=\frac{E^{(0)}\left(\sum_{t=2}^{3}\frac{E^{(1)}(d_{i,t})\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=2}^{t}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_i\right)}+\sum_{t=4}^{\hat{T}}\frac{E^{(1)}(d_{i,3})\cdot(1+g)^{t-3}\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=2}^{t}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_i\right)}\right)}{V_{i,0}}$$

$$+\frac{\dfrac{E^{(1)}(d_{i,3})\cdot(1+g)^{\hat{T}-2}\cdot(1-\tau^{(equ)})^{\hat{T}+1}}{\prod_{\kappa=2}^{\hat{T}}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_i\right)\cdot\left(1-\tau^{(equ)}+r_{f,\hat{T}}\cdot(1-\tau^{(debt)})+\Phi_i-(1+g)(1-\tau^{(debt)})\right)}}{V_{i,0}}$$

$$+\frac{E^{(0)}(\tilde{d}_{i,1})\cdot(1-\tau^{(equ)})}{V_{i,0}}-1$$

$$=\left(1-\tau^{(equ)}+r_{f,1}\cdot(1-\tau^{(debt)})+\Phi_i\right)$$

$$\cdot\left(\frac{\left(\sum_{t=2}^{3}\frac{E^{(0)}(d_{i,t})\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=1}^{t}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_i\right)}+\sum_{t=4}^{\hat{T}}\frac{E^{(0)}(d_{i,3})\cdot(1+g)^{t-3}\cdot(1-\tau^{(equ)})^{t}}{\prod_{\kappa=1}^{t}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_i\right)}\right)}{V_{i,0}}\right.$$

$$+\frac{\dfrac{E^{(0)}(d_{i,3})\cdot(1+g)^{\hat{T}-2}\cdot(1-\tau^{(equ)})^{\hat{T}+1}}{\prod_{\kappa=1}^{\hat{T}}\left(1-\tau^{(equ)}+r_{f,\kappa}\cdot(1-\tau^{(debt)})+\Phi_i\right)\cdot\left(1-\tau^{(equ)}+r_{f,\hat{T}}\cdot(1-\tau^{(debt)})+\Phi_i-(1+g)(1-\tau^{(debt)})\right)}}{V_{i,0}}$$

$$\left.+\frac{\dfrac{E^{(0)}(\tilde{d}_{i,1})\cdot(1-\tau^{(equ)})}{\left(1-\tau^{(equ)}+r_{f,1}\cdot(1-\tau^{(debt)})+\Phi_i\right)}}{V_{i,0}}\right)-1$$

$$=\left(1-\tau^{(equ)}+r_{f,1}\cdot(1-\tau^{(debt)})+\Phi_i\right)\cdot\frac{V_{i,0}}{V_{i,0}}-1=-\tau^{(equ)}+r_{f,1}\cdot(1-\tau^{(debt)})+\Phi_i.$$

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Table 1. Sharpe ratios φ_S for thirteen different portfolio optimization strategies

		period 1 (12/96 to 08/00)				period 2 (09/00 to 06/04)			
#	Strategy	$\mu^{(exc)}$ (%)	$\sigma^{(exc)}$ (%)	φ_S	rank	$\mu^{(exc)}$ (%)	$\sigma^{(exc)}$ (%)	φ_S	rank
1	div*: flat, without taxes	0.97	3.54	0.2729	2	0.21	3.27	0.0650	3
2	div*: nonflat, without taxes	0.43	1.77	0.2426	6	0.27	3.20	0.0838	2
3	div*: flat, with taxes	1.42	5.47	0.2605	4	0.21	4.24	0.0492	4
4	div*: nonflat, with taxes	0.61	1.56	0.3923	1	0.39	4.12	0.0955	1
5	market portfolio	1.05	3.97	0.2647	3	-0.57	3.43	-0.1652	
6	equally weighted	0.97	3.74	0.2581	5	-0.30	3.48	-0.0869	
7	variance minimal	1.14	5.41	0.2107	9	-0.43	4.03	-0.1067	
8	math. hist. without taxes	0.53	2.98	0.1769	10	0.04	2.02	0.0182	5
9	math. hist. with taxes	0.81	4.58	0.1769	11	-0.07	2.75	-0.0253	
10	3-Factor-Model without taxes	0.34	2.51	0.1357	12	-0.05	1.61	-0.0296	
11	3-Factor-Model with taxes	0.52	3.86	0.1357	12	-0.08	2.08	-0.0365	
12	Bayes without taxes	0.66	3.15	0.2111	7	-0.12	1.48	-0.0809	
13	Bayes with taxes	1.02	4.84	0.2111	8	-0.21	2.25	-0.0912	

*div: Strategies based on analysts' dividend forecasts

Table 2. Jensen's alphas φ_J, Carhart's alphas φ_C, the Treynor ratios φ_T and Treynor-Black appraisal ratios φ_{TB} for thirteen different portfolio optimization strategies

	Jensen's alpha	period 1 (12/96 to 08/00)		period 2 (09/00 to 06/04)			Carhart's alpha	period 1 (12/96 to 08/00)		period 2 (09/00 to 06/04)	
#	strategy	φ_J	rank	φ_J	rank	#	strategy	φ_C	rank	φ_C	rank
1	div*: flat, without taxes	0.00267	3	0.00483	4	1	div*: flat, without taxes	0.00482	5	0.00073	4
2	div*: nonflat, without taxes	0.00096	5	0.00507	3	2	div*: nonflat, without taxes	-0.00143	13	0.00314	1
3	div*: flat, with taxes	0.00350	2	0.00557	2	3	div*: flat, with taxes	0.00723	2	0.00109	3
4	div*: nonflat, with taxes	0.00437	1	0.00698	1	4	div*: nonflat, with taxes	0.00664	3	0.00243	2
5	market portfolio	0.00099	4	-0.00248	13	5	market portfolio	0.00580	4	-0.00322	9
6	equally weighted	0.00094	6	0.00015	9	6	equally weighted	0.00767	1	-0.00101	7
7	variance minimal	0.00068	7	-0.00129	12	7	variance minimal	-0.00027	12	-0.01042	13
8	math. hist. without taxes	-0.00094	12	0.00157	5	8	math. hist. without taxes	0.00297	8	-0.00224	8
9	math. hist. with taxes	-0.00144	13	0.00090	6	9	math. hist. with taxes	0.00457	6	-0.00361	11
10	3-Factor-Model without taxes	-0.00052	10	0.00034	7	10	3-Factor-Model without taxes	0.00214	10	-0.00070	6
11	3-Factor-Model with taxes	-0.00079	11	0.00027	8	11	3-Factor-Model with taxes	0.00330	7	-0.00059	5
12	Bayes without taxes	0.00004	9	-0.00065	10	12	Bayes without taxes	0.00177	11	-0.00350	10
13	Bayes with taxes	0.00006	8	-0.00124	11	13	Bayes with taxes	0.00273	9	-0.00434	12

	Treynor ratio	period 1 (12/96 to 08/00)		period 2 (09/00 to 06/04)			Treynor-Black appraisal ratio	period 1 (12/96 to 08/00)		period 2 (09/00 to 06/04)	
#	strategy	φ_T	rank	φ_T	rank	#	strategy	φ_{TB}	rank	φ_{TB}	rank
1	div*: flat, without taxes	0.01703	2	0.00459	3	1	div*: flat, without taxes	0.11899	2	0.28377	1
2	div*: nonflat, without taxes	0.01587	4	0.00654	2	2	div*: nonflat, without taxes	0.08030	4	0.24974	3
3	div*: flat, with taxes	0.01635	3	0.00350	4	3	div*: flat, with taxes	0.10031	3	0.24708	4
4	div*: nonflat, with taxes	0.04322	1	0.00753	1	4	div*: nonflat, with taxes	0.31193	1	0.26266	2
5	market portfolio	0.01361	6	-0.01038	11	5	market portfolio	0.07253	5	-0.25581	13
6	equally weighted	0.01366	5	-0.00555	9	6	equally weighted	0.06141	6	0.01336	9
7	variance minimal	0.01311	7	-0.00832	10	7	variance minimal	0.01995	7	-0.05018	11
8	math. hist. without taxes	0.01046	12	0.00179	5	8	math. hist. without taxes	-0.05444	12	0.09814	5
9	math. hist. with taxes	0.01046	13	-0.00255	6	9	math. hist. with taxes	-0.05444	13	0.04064	6
10	3-Factor-Model without taxes	0.01070	11	-0.00340	7	10	3-Factor-Model without taxes	-0.02600	11	0.02481	7
11	3-Factor-Model with taxes	0.01070	10	-0.00432	8	11	3-Factor-Model with taxes	-0.02600	10	0.01488	8
12	Bayes without taxes	0.01240	8	-0.01271	12	12	Bayes without taxes	0.00234	8	-0.04740	10
13	Bayes with taxes	0.01240	9	-0.01478	13	13	Bayes with taxes	0.00234	9	-0.05942	12

Table 3. Sharpe ratios φ_S and overall ranking positions for portfolio optimization strategies based on analysts' dividend forecasts when all expected returns are biased (in comparison to the data underlying Table 1) by Δ

Δ = +10 %		period 1 (12/96 to 08/00)				period 2 (09/00 to 06/04)			
#	strategy	μ in %	σ in %	φ_S	overall rank	μ in %	σ in %	φ_S	overall rank
1	div*: flat, without taxes	0.97	3.54	0.2728	2	0.21	3.28	0.0631	3
2	div*: nonflat, without taxes	0.52	2.29	0.2267	6	0.36	3.25	0.1092	1
3	div*: flat, with taxes	1.43	5.47	0.2607	4	0.19	4.25	0.0446	4
4	div*: nonflat, with taxes	0.61	2.01	0.3025	1	0.43	4.12	0.1036	2
Δ = +20 %		**period 1 (12/96 to 08/00)**				**period 2 (09/00 to 06/04)**			
#	**strategy**	**μ in %**	**σ in %**	**φ_S**	**overall rank**	**μ in %**	**σ in %**	**φ_S**	**overall rank**
1	div*: flat, without taxes	0.98	3.55	0.2750	3	0.19	3.28	0.0592	3
2	div*: nonflat, without taxes	0.78	2.49	0.3125	2	0.33	3.26	0.1001	1
3	div*: flat, with taxes	1.42	5.46	0.2603	5	0.19	4.24	0.0439	4
4	div*: nonflat, with taxes	1.02	2.48	0.4111	1	0.38	4.19	0.0902	2
Δ = –10 %		**period 1 (12/96 to 08/00)**				**period 2 (09/00 to 06/04)**			
#	**strategy**	**μ in %**	**σ in %**	**φ_S**	**overall rank**	**μ in %**	**σ in %**	**φ_S**	**overall rank**
1	div*: flat, without taxes	0.97	3.54	0.2733	3	0.20	3.29	0.0606	3
2	div*: nonflat, without taxes	0.37	1.28	0.2841	2	0.43	2.90	0.1469	1
3	div*: flat, with taxes	1.43	5.47	0.2615	5	0.21	4.24	0.0506	4
4	div*: nonflat, with taxes	0.45	1.44	0.3138	1	0.39	4.10	0.0947	2
Δ = –20 %		**period 1 (12/96 to 08/00)**				**period 2 (09/00 to 06/04)**			
#	**strategy**	**μ in %**	**σ in %**	**φ_S**	**overall rank**	**μ in %**	**σ in %**	**φ_S**	**overall rank**
1	div*: flat, without taxes	0.98	3.54	0.2768	2	0.20	3.30	0.0613	3
2	div*: nonflat, without taxes	0.28	0.97	0.2878	1	0.27	2.84	0.0939	1
3	div*: flat, with taxes	1.43	5.47	0.2618	4	0.23	4.23	0.0552	4
4	div*: nonflat, with taxes	0.32	1.28	0.2531	6	0.25	3.52	0.0698	2

Table 4: Annual market risk premia for ten different approaches

#	strategy	period 1 (12/96 to 08/00)	period 2 (09/00 to 06/04)
1	div*: flat, without taxes	0.01221	0.01576
2	div*: nonflat, without taxes	-0.01371	-0.00690
3	div*: flat, with taxes	0.01129	0.01885
4	div*: nonflat, with taxes	-0.01555	-0.00291
8	math. hist. without taxes	0.26583	-0.00832
9	math. hist. with taxes	0.16620	-0.01336
10	3-Factor-Model without taxes	0.33043	0.00019
11	3-Factor-Model with taxes	0.12027	-0.00095
12	Bayes without taxes	0.20512	-0.02493
13	Bayes with taxes	0.12931	-0.02244

Figure 1. Actual minimum-variance line (left) and estimated (right) for biased dividend forecasts