Open access • Journal Article • DOI:10.1111/J.1468-5957.2012.02286.X

Determinants of Expected Stock Returns: Large Sample Evidence from the German Market — Source link

Sabine Artmann, Philipp Finter, Alexander Kempf

Published on: 01 Jun 2012 - Journal of Business Finance & Accounting (Cologne: Centre for Financial Research)

Topics: Stock market bubble, Capital asset pricing model and Stock (geology)

Artmann, Sabine; Finter, Philipp; Kempf, Alexander

Working Paper

Determinants of expected stock returns: Large sample evidence from the German market

CFR Working Paper, No. 10-01 [rev.]

Provided in Cooperation with:
Centre for Financial Research (CFR), University of Cologne

CFR-Working Paper NO. 10-01

Determinants of Expected Stock Returns: Large Sample Evidence from the German Market

S. Artmann • P. Finter • A. Kempf

centre for financial research
Look deeper

Determinants of Expected Stock Returns: Large Sample Evidence from the German Market

Sabine Artmann, Philipp Finter, and Alexander Kempf*

First Version: June 2009

This Version: July 2011

Abstract

This paper conducts a comprehensive asset pricing study based on a unique dataset for the German stock market. For the period 1963 to 2006 we show that value characteristics and momentum explain the cross-section of stock returns. Corresponding factor portfolios have significant premiums across various double-sorted characteristic-based test assets. In a horse race of competing asset pricing models the Fama-French 3-factor model does a poor job in explaining average stock returns. The Carhart 4-factor model performs much better, but a 4-factor model containing an earnings-to-price factor instead of a size factor does even slightly better.

JEL-Classification Codes: G12

Keywords: asset pricing, characteristics, risk factors, multifactor models, Germany

*Artmann, Finter (finter@wiso.uni-koeln.de), and Kempf (kempf@wiso.uni-koeln.de) are with the Department of Finance, University of Cologne, Albertus-Magnus-Platz, 50923 Cologne, Germany, phone: +49-221-470-2714. Philipp Finter and Alexander Kempf are also at the Centre for Financial Research (CFR) at the University of Cologne, Albertus-Magnus Platz, 50923 Cologne, Germany. We gratefully acknowledge financial support from the Centre for Financial Research (CFR).

Determinants of Expected Stock Returns: Large Sample Evidence from the German Market

Abstract

This paper conducts a comprehensive asset pricing study based on a unique dataset for the German stock market. For the period 1963 to 2006 we show that value characteristics and momentum explain the cross-section of stock returns. Corresponding factor portfolios have significant premiums across various double-sorted characteristic-based test assets. In a horse race of competing asset pricing models the Fama-French 3-factor model does a poor job in explaining average stock returns. The Carhart 4-factor model performs much better and a 4-factor model containing an earnings-to-price factor instead of a size factor does even slightly better.

JEL-Classification Codes: G12

Keywords: asset pricing, characteristics, risk factors, multifactor models, Germany

1. Introduction

What drives expected stock returns? The CAPM of Sharpe (1964), Lintner (1965), and Mossin (1966) is an early attempt to answer this question: Expected stock returns are positively and linearly related to systematic market risk. However, the CAPM has lost ground over the last decades since empirical evidence suggests that betas do not adequately explain cross-sectional differences in average returns. Instead, numerous additional variables have been shown to affect average stock returns, for instance, a firm's size (Banz (1981)), earnings-to-price (Basu (1977, 1983)), book-to-market equity (Rosenberg et al. (1985)), leverage (Bhandari (1988)), profitability (Haugen and Baker (1996)), asset growth (Cooper et al. (2008)), or past stock returns (DeBondt and Thaler (1985), Jegadeesh and Titman (1993)). To capture these return patterns various multifactor models have been suggested, Fama and French (1993) being the most prominent one. Fama and French (1993) model stock returns using three factors: the market, the size, and the value factor. Carhart (1997) extends their model by adding a momentum factor. The Fama-French 3-factor model and the Carhart 4-factor model are nowadays the industry standard in modeling stock returns. The models have relevance to applications that require estimates of expected returns, like evaluating portfolio performance or estimating the cost of capital.

However, there are at least three issues that cast doubt on the general ability of these models to explain stock returns. First, the results of the model tests depend heavily on the underlying test assets (e.g., Lewellen et al. (2010)). Phalippou (2007) shows that a small alternation of the test assets can lead to very different answers regarding the validity of a model. Fama and French (1996, 2008) find that their 3-factor model has impressive explanatory power when explaining the returns of portfolios formed on size and book-to-market equity, but fails to explain the returns of test assets sorted on net stock issues, accruals, and momentum. Second, most tests of the Fama-French and the Carhart model have been carried out using U.S. data only and evidence whether the models work well in other countries is sparse. Third, the use of the size factor in these models is questioned since the size effect seems to have vanished in a growing number of countries when examining more recent data as documented by van Dijk (2011). Given these caveats, there is a clear need for studies that test these models using a wide variety of test assets and data from markets outside the U.S. Our paper contributes to this literature.

We conduct a comprehensive asset pricing study based on a unique dataset for the German stock market, covering 955 German stocks over the period 1963 to 2006. We hand-collected most of our data to assure that our sample virtually covers the complete market capitalization and contains many small stocks. We address three closely related questions: (i) Which firm characteristics explain the cross-sectional variation of average stock returns? (ii) Which factors exhibit significant premiums? (iii) How well do the benchmark models of Fama and French (1993) and Carhart (1997) perform when conducting a horse race with alternative asset pricing models? Thus, our paper is an out-of-sample test of the explanatory power of firm characteristics and factors shown to be important in the U.S. stock markets. Such an out-of-sample test overcomes the data-snooping problems that might occur when working with the heavily researched CRSP and Compustat databases (e.g., Lo and MacKinlay (1990)).

We obtain the following main results: (i) Based on one-dimensional sorts for ten popular firm attributes, we find that average stock returns increase with book-to-market equity, earnings-to-price, market leverage, return on assets, and momentum. In multivariate Fama and MacBeth (1973) regressions, we show that only the two value characteristics (book-to-market equity, earnings-to-price) and momentum have explanatory power for the cross-section of stock returns. (ii) Using a wide range of test assets we show that premiums associated with factors constructed with respect to book-to-market equity, earnings-to-price, and momentum are priced. In contrast, the market factor and the size factor do not exhibit significant premiums. (iii) The Fama-French model does a poor job in explaining the cross-section of average stock returns in Germany. An alternative 3-factor model including two value factors based on book-to-market equity and earnings-to-price besides the market factor clearly outperforms the Fama-French model. When adding an momentum factor, the model performs even better.

Our findings contribute to the international asset pricing literature. We add to the pervasive evidence for the existence of a value and momentum premium. Liew and Vassalou (2000) and Rouwenhorst (1998, 1999), for instance, document significant local momentum premiums for many developed and emerging markets, and Fama and French (1998) provide evidence on a significant value premium in 12 out of 13 developed markets. Our paper comes to similar conclusions with respect to the existence and importance of a value and a momentum premium. Additionally, we show that both an earnings-to-price factor and a book-to-market factor are cross-sectionally priced. Further, we contribute to the ongoing debate on the existence and relevance of the size premium: Hawawini and Keim (2000) and Rouwenhorst (1999), for example, document its international existence, while others do not: Liew and Vassalou (2000) find insignificant local SMB premiums in 6 out of 10 markets, Dimson et al.

(2002) document that the size effect has reversed in 18 out of 19 markets.[1] We find a negative and statistically insignificant size premium in the German stock market. Additionally, we provide evidence that using a size factor or size as a characteristic does not help to explain average returns.

Further, we contribute to the literature that uses formal statistic tests when evaluating the performance of asset pricing models. Of the few papers dealing with comprehensive tests of models outside the U.S., only a minority uses such a test procedure. The evidence of these studies is mixed: Whereas Connor and Sehgal (2001), for instance, support the Fama-French model using data on India, Michou et al. (2007) and Griffin (2002) reject the model for the UK, and for Canada and the UK, respectively. We contribute to this debate by showing that according to the test proposed by Gibbons et al. (1989) (GRS-test) the Fama-French model does a poor job in explaining the cross-section of average German stock returns, while the Carhart model or an alternative 4-factor model containing the earnings-to-price factor instead of the size factor performs better.

Most previous studies of the German stock market (see Sattler (1994), Schlag and Wohlschieß (1997), Stehle (1997), Schiereck et al. (1999), Wallmeier (2000), Schulz and Stehle (2002), Stock (2002), Elsas et al. (2003)) focus on firm characteristics as determinants of expected returns and, thus, relate to our main finding (i). Wallmeier (2000) is the most closely related one. Like we do, he finds (based on a much smaller sample) a significant cross-sectional impact of value-characteristics but no significant impact of beta or firm size. In cross-sectional regressions we additionally document that profitability and reversal effects are absorbed when considering other characteristics. Furthermore, we document a momentum-effect, while we find no evidence of a relation between asset growth and average returns in Germany.

There are only a few German studies which focus on the cross-sectional pricing of factor mimicking portfolios and, thus, relate to our main finding (ii). Koch (2009a) shows that idiosyncratic risk is negatively priced. Koch (2009b) finds that illiquidity is positively priced, but the results heavily rely on the choice of test assets. Breig and Elsas (2009) investigate whether a factor associated with default risk is priced in the cross-section of German stock returns. Using different measures for default risk they show that this is not the case. We differ from these papers by highlighting the price impact of a factor mimicking portfolio associated to earnings-to-price and by drawing our conclusions from a much more comprehensive

[1] See van Dijk (2011) for a survey on the size-effect in the U.S. and many non-U.S. countries.

analysis. Our study is based on more firms, a significantly longer time period and a battery of test assets based on various double-sorts.

The paper most closely related to our main finding (iii) is Ziegler et al. (2007).[2] They are the first to test the Fama-French model for Germany and show that the model outperforms the CAPM. Whereas Ziegler et al. (2007) focus solely on the Fama-French model and draw their conclusion only from portfolios sorted according to size and book-to-market, we test the performance of various multi-factor models, among others the 4-factor model of Carhart (1997), and use multiple sorting criteria. Furthermore, we differ from them with respect to the methodology by adopting the GRS-test to evaluate the performance of the models.

The paper is organized as follows. In Section 2 we present the data and describe the firm characteristics. In Section 3 we look for firm characteristics that explain the cross-section of average stock returns. In Section 4 we run regressions of test assets on factors to test which factors are priced and to evaluate alternative asset-pricing models. Section 5 provides results on the temporal stability of our findings and Section 6 concludes.

2. Sample and Firm Characteristics

Our sample consists of stocks listed at the Frankfurt Stock Exchange between 1963 and 2006.[3] We exclude financial firms since they are subject to special accounting standards and risk factors (see Viale et al. (2009)).[4] Overall, we are left with 955 stocks.

Table I reports the average number of firms for different time periods. We only include a firm in year τ if stock prices for December of year τ-1 and June of year τ are available in our data set. From 1963 to 1980, the number of firms remains almost constant around 200. Due to numerous IPOs in the 1990s, the number of firms rises considerably and reaches a maximum of 598 firms in the year 2000.

2 Earlier papers on the German market like, e.g., Schlag and Wohlschieß (1997) test the CAPM and, typically, find no cross-sectional relationship between beta and return. Elsas and Theissen (2003) find a positive relationship between beta and return once they differentiate between periods with a positive and a negative realized market risk premium. Schrimpf et al. (2007) test a conditional CAPM using the term spread as a conditional variable.

3 Stocks are traded at the market segments “Amtlicher Handel” or “Neuer Markt”. In addition, we include stocks of firms listed at “Geregelter Markt” if they are listed at “Amtlicher Handel” or “Neuer Markt” at any time during our research period. The period starts in 1963 since data on earnings are not available before 1963.

4 Fama and French (1992) provide another reason for excluding financial firms: They argue that firms with high leverage are near-bankruptcy firms. Financial firms are typically high-leveraged even when they are not close to bankruptcy. Thus, being high leveraged has a different interpretation for financial than for non-financial firms.

< Please insert Table I approximately here >

We obtain daily stock prices from Karlsruher Kapitalmarktdatenbank (KKMDB) in Karlsruhe (Germany) and adjust these prices for dividends, splits, and equity offerings using data from KKMDB and Saling/Hoppenstedt Aktienführer, a yearly publication that provides detailed information on listed German firms. Using this data, we calculate monthly stock returns. Additionally, we hand-collect information on number of shares outstanding and accounting data (common book equity, total assets, net earnings) from Saling/Hoppenstedt Aktienführer.

To explain stock returns, we use fundamental and technical firm characteristics that have been suggested in the empirical asset pricing literature. Our two technical firm characteristics, stock momentum and stock reversal, are both calculated using past returns. We calculate the momentum of a stock in month t as the cumulative return from month t-12 to t-2. We skip the most recent month, to avoid the short-term reversal effect first documented by Jegadeesh (1990). The reversal of a stock in month t is calculated as the cumulative return from month t-60 to t-13.

Additionally, we use a number of fundamental firm characteristics on a yearly frequency: size, beta, and six accounting-based attributes (book-to-market equity, earnings-to-price, market leverage, book leverage, return on assets, and asset growth).

We measure size by market capitalization (stock price times shares outstanding) of all share classes at the end of June of each year τ.[5] Stock betas are estimated using rolling five-year regressions with monthly returns.[6] The betas are calculated relative to the Deutscher Aktienforschungsindex (DAFOX), a value-weighted performance index calculated by KKMDB. The DAFOX is available until 12/2004; after that we use the value-weighted CDAX performance index of Deutsche Börse AG as our market portfolio. DAFOX and CDAX have very similar return characteristics. In the overlapping period from 02/1970 to 12/2004 the monthly returns of DAFOX and CDAX are almost perfectly correlated (0.98).[7]

5 There are 52 firms in our sample for which only preferred shares are quoted. In these cases we multiply the total number of ordinary and preferred shares by the price of the listed preferred shares to get a proxy for market capitalization.

6 If there are fewer than 60 observations available due to missing data, we take as many observations as possible and calculate beta only if there are at least 24 observations available.

7 The correlation coefficient between the monthly returns of the combined DAFOX/CDAX and a value-weighted index based on all stocks considered in our study is 0.99. Therefore, the DAFOX/CDAX is an appropriate market proxy for our stock universe.

As a proxy for the risk free rate we take the one-month money market rate reported by Deutsche Bundesbank (series SU0104).

If a company publishes individual and consolidated financial statements, we use consolidated balance sheet data for calculating the accounting-based measures. Firm-years with negative book values are excluded from the analysis. To avoid outliers, we follow Fama and French (1992) and winsorize all financial ratios. The bottom (top) 1% values are set equal to the value corresponding to the 1^{st} (99^{th}) percentile of the empirical distribution.

To calculate book-to-market equity (BE/ME) in year τ, we divide book equity for the fiscal year ending in calendar year τ-1 by the market value of equity at the end of December in calendar year τ-1. In a similar way, we calculate two leverage proxies: market leverage is computed as total assets divided by market value of equity and book leverage as total assets divided by book equity. Earnings-to-price (E/P) is calculated as net earnings divided by market value of equity, but only when net earnings are positive.[8] We calculate return on assets (ROA), our measure of the profitability of a firm, as net earnings divided by total assets. We follow Cooper et al. (2008) and apply the year-on-year percentage change in total assets (asset growth) as a comprehensive measure of firm growth.

< Please insert Table II approximately here >

Panel A of Table II shows summary statistics for firm characteristics. Since our sample contains many small caps, the median of size is considerably smaller than its corresponding mean. The same applies for book-to-market equity, earnings-to-price, and market leverage. For instance, the average size is EUR 904.2 million while the median is only EUR 94.4 million. Likewise, the average book-to-market equity is 69.2% which is substantially higher than its median (54.3%). The average earnings-to-price is 0.068 (median 0.045), equivalent to a price-to-earnings ratio of 14.7 (median 22.2). The average firm growth is 9.7% per year which is considerably higher than its median (4.1%). This suggests that our sample contains many aggressive growth stocks. Panel B of Table II shows the relation between different firm

[8] The non-consideration of negative earnings when calculating earnings-to-price is motivated by Ball (1978) who argues that earnings-to-price is a measure of risk. Therefore, risky stocks with high expected returns are expected to have high earnings-to-price ratios. Fama and French (1992) show that this argument does not make sense for negative earnings.

attributes using average Spearman rank correlations.[9] Though most correlations are fairly low, some characteristics are highly correlated. For example, firms with a high book-to-market ratio tend to have high market leverage and a high earnings-to-price ratio.

3. Explaining Expected Returns Using Firm Characteristics

In this section we identify firm characteristics that explain the cross-sectional variation of average stock returns. We employ two methodologies: one-dimensional sorts, which provide a simple picture of how firm characteristics produce patterns in average returns (Section 3.1), and Fama-MacBeth regressions to estimate marginal effects (Section 3.2).

3.1 One-dimensional Sorts

At the end of June of each year τ we form ten portfolios based on the decile breakpoints for the fundamental firm characteristics. The conservative six-month lag is imposed to ensure that the required accounting data is known by investors when the stocks are ranked. The portfolios are held constant during the following twelve months. Portfolios formed on technical firm characteristics (momentum and reversal) are rearranged every month. To calculate monthly portfolio returns, we apply an equal-weighting since we want to capture the cross-sectional variety of the assets and do not want to highlight the role of investability.[10] Focusing on investability would suggest looking at value-weighted portfolios. Table III shows the mean monthly returns of the portfolios for the period 07/1964 to 12/2006. The last three columns of Table III show the average monthly hedge portfolio returns obtained from long-short positions in deciles 10 and 1, 10 and 5, and 5 and 1, respectively.

< Please insert Table III approximately here >

According to Table III, book-to-market equity, earnings-to-price, market leverage, return on assets, and momentum produce patterns in average returns. Long-short-strategies of buying

9 Average Spearman rank correlations are calculated as follows: We first calculate pairwise Spearman rank correlations based on the rankings of individual stocks for each year separately. We then average the yearly Spearman rank correlations to get mean Spearman rank correlations.

10 See Vaihekoski (2004). Equally weighted portfolios are used, among others, by Lakonishok et al. (1994), Fama and French (1996), Haugen and Baker (1996), and Chan et al. (1998). We checked the robustness of our finding by re-running the analysis based on value-weighted portfolios. The results are qualitatively the same.

stocks with the highest book-to-market equity, earnings-to-price, and market leverage and selling short stocks with the lowest book-to-market equity, earnings-to-price, and market leverage generate significant monthly average returns of 0.90%, 0.99%, and 0.73%, respectively. Furthermore, the average return of the most profitable stocks (0.90%) is more than twice as high as the average return of the least profitable stocks (about 0.43%). Finally, Jegadeesh and Titman's (1993) momentum anomaly is clearly evident in our sample. The difference in average returns between momentum decile 10 (best past performing stocks) and 1 (worst past performing stocks) is 1.35% per month.

Table III shows that one-dimensional sorts on beta, size, asset growth, book leverage, and reversal do not produce variation in average returns. The CAPM predicts a positive relation between expected return and systematic market risk. However, the data show little variation in average returns across portfolios formed on pre-ranking CAPM betas. Portfolio 10, containing the highest beta stocks, even has the lowest average return (0.60%) among all portfolios. Beta remains dead.[11] We also find no evidence of a relation between size and average returns in Germany. The corresponding hedge portfolios generate near-zero average returns. Looking at asset growth and book leverage, the difference in average monthly returns between the extreme portfolios is also near zero. Finally, a pronounced reversal anomaly as first documented by DeBondt and Thaler (1985) is not evident in our sample. Long-term losers have higher average monthly returns than long term winners, but the corresponding average return of the 10-1 hedge portfolio (-0.30) is only marginally different from zero (t-statistic = -1.87). The 5-1 hedge portfolio delivers a mean return close to zero, showing that sorts based on reversal lead to non-linear patterns in average returns.

3.2 Cross-sectional Regressions

The one-dimensional sorts show that momentum, book-to-market equity, earnings-to-price, market leverage, and return on assets lead to significant average hedge portfolio returns. However, since the latter four sorting criteria are correlated (as shown in Table II), the one-dimensional sorts cannot answer the question of which firm characteristics have unique information about average returns. Therefore, we test the marginal explanatory power of each firm characteristic employing the approach of Fama and MacBeth (1973). We estimate the following cross-sectional regression for firm $i = 1, \ldots, N$ in each month t:

---

[11] We also calculate average portfolio betas for all decile portfolios. For almost all sorts we find no trends for portfolio betas. The only exception is the sorting based on size. The average portfolio beta increases monotonically from 0.51 for the lowest size decile to 0.95 for the largest size decile.

$$r_i - r_f = \lambda_0 + \lambda' X_i + \varepsilon_i \tag{1}$$

r_i denotes the return of stock i and r_f is the risk free rate. X_i is the vector of firm characteristics. This vector covers all firm characteristics discussed in the previous section and, in addition, a dummy variable that takes the value of 1 if the stock has negative net earnings. λ is the vector of regression coefficients.

We run the cross-sectional regression for each month separately. We then take the time series of the estimated monthly cross-sectional regression coefficients and calculate the mean regression coefficients. To test their significance, we adjust the standard errors for autocorrelation in the estimated coefficients.[12] The average regression coefficients are reported in Table IV.

< Please insert Table IV approximately here >

According to Table IV, three firm characteristics explain the cross-section of stock returns: momentum and two value characteristics (book-to-market equity and earnings-to-price). The corresponding average slope coefficients are all statistically significant at the 1%-level.[13] This finding is robust when including other firm characteristics discussed in the previous section.

Given that sorts on beta, size, asset growth, and reversal produce no significant variation in average returns, it is not surprising that these variables have no significant impact in the Fama-MacBeth regressions. When employing multivariate regressions instead of one-dimensional sorts, return on assets loses explanatory power whenever the earnings-to-price ratio is included in the regressions. Since high profitable firms tend to have high earnings-to-price ratios (Table II reports a rank correlation of 0.51 between return on assets and earnings-

[12] We adjust the standard errors of the average regression coefficients for autocorrelation by multiplying the standard errors of the average regression coefficients by $\sqrt{\frac{(1+\rho)}{(1-\rho)}}$, where ρ is the first-order autocorrelation in the estimated regression coefficients of the monthly time-series regressions (see, e.g., Chakravarty et al. (2004)).

[13] Since Petersen (2009) has shown that Fama and MacBeth (1973) standard errors might be biased (despite the adjustment made), we carry out a robustness check and run regressions using two way clustered standard errors, which account for two dimensions (firm and time). We find that momentum and value characteristics have the continuing ability to explain the cross-section of stock returns, but only momentum and one of the two value characteristics, book-to-market equity, remain significant at the 1% level. Earnings-to-price is no longer significant at conventional levels.

to-price), our results suggest that the profitability anomaly reported in Section 3.1 is an earnings-to-price anomaly in disguise. Table IV shows that the average slope coefficients of ln(A/ME) and ln(A/BE) have the same absolute value (0.003), but opposite signs, and ln(BE/ME) has an almost identical slope coefficient. Since the difference between ln(A/ME) and ln(A/BE) is equal to ln(BE/ME), the leverage effect is already captured by the book-to-market effect. As shown in Fama and French (1992) there is no need to include the two leverage variables.

4. Explaining Expected Returns Using Factors

In this section we run regressions of test asset returns on factors. Following the advice of Lewellen et al. (2010), we run our asset pricing tests based on a wide array of test assets. First, we construct test assets (Section 4.1) and factors (Section 4.2). Then, we test whether estimated premiums associated with factors are priced in a cross-sectional framework (Section 4.3) and evaluate competing asset-pricing models in a time series set-up (Section 4.4).

4.1 Test Assets

The dependent variables used in the following regressions are the excess returns of 96 equal-weighted portfolios. The portfolios are formed by independent double sorts on size, book-to-market equity, earnings-to-price, and momentum. We form portfolios on the latter three characteristics because each of them leads to a large variation in average returns (see Section 3.1), which is a necessary condition for an adequate test of asset-pricing models (Cochrane (2005)). Although sorts on size alone do not lead to a large variation in average returns (see Section 3.1), we include size in our double sorts to control for size effects affecting the second sorting characteristic.

Our test assets are formed as follows. For each pairwise combination of the sorting criteria we independently categorize stocks into 16 (4x4) portfolios based on the quartile breakpoints and calculate the monthly excess returns of the equal-weighted portfolios.[14] This approach leads us to 96 test portfolios out of six different sorting schemes.

Sorts on size, book-to-market equity, and earnings-to-price are conducted in June of each year. The resulting portfolios are held constant during the following twelve months. The

[14] As shown below, our 4x4 sorting scheme leads to test portfolios which contain fewer stocks than those typically used in U.S. studies. Therefore, it is not sensible to apply a 5x5 sorting scheme as it is usually done in U.S. studies.

momentum sorting is carried out every month and double sorted portfolios based on momentum as one characteristic are rebalanced monthly.

< Please insert Table V approximately here >

Table V provides descriptive statistics on the 96 test assets. While excess return volatility shows little variation across portfolios (Panel B), the double sorts lead to a wide range of average excess returns (Panel A). Across all sorting schemes high book-to-market equity, earnings-to-price, and momentum portfolios have higher average excess returns than lower ones. We find the highest return difference between portfolio (4,4) and portfolio (1,1) for sorts on earnings-to-price and momentum, creating an average hedge portfolio return of 1.75% per month. Almost all test assets contain at least 10 stocks (Panel C). The average number of stocks in the test portfolios ranges from 5 to 26. Panel D to H of Table V report the average size, beta, book-to-market equity, earnings-to-price, and momentum of the test assets. The panels reflect the correlations of the firm attributes presented in Table II. Most interestingly, the panels show that both big and small stocks drive the momentum effect in a similar manner and that all test portfolios have an average beta below 1. The latter results from the equal-weighting of the portfolios in connection with the fact that size and beta are positively correlated (see Table II).

4.2 Factors

By employing one-dimensional sorts (Section 3.1) and cross-sectional regressions (Section 3.2) we identified potential candidates to build factors. In the construction of the factors we follow the methodology of Carhart (1997): At each portfolio formation date, we rank all firms based on a specific firm characteristic (book-to-market equity, earnings-to-price, and momentum). For each characteristic we then sort the firms into three portfolios: the bottom portfolio including the stocks in the bottom 30%, the top portfolio including the stock in the top 30%, and the middle portfolio including the remaining stocks. For the accounting-based characteristics (book-to-market equity and earnings-to-price), we form portfolios in June of each year based on the accounting characteristics of the last year. The momentum portfolios are formed every month. Finally, we calculate the returns of the hedge portfolios as the monthly differences in returns between the equal-weighted top and bottom portfolio.

$HML_{Carhart}$, $EP_{Carhart}$, and $WML_{Carhart}$ denote hedge portfolios formed with respect to book-to-market equity, earnings-to-price, and momentum, respectively.

In addition, we calculate factor portfolios that have been suggested in the empirical literature. The excess market return (RMRF) is calculated as the difference in return between the market portfolio and the risk free rate. The factor portfolios SMB and HML are computed as in Fama and French (1993). SMB is a hedge portfolio that goes long in small stocks and short in large stocks. By construction, SMB is neutral to book-to-market equity effects. HML, a hedge portfolio constructed to be neutral to size-effects, is long in high book-to-market equity stocks and short in low book-to-market equity stocks. SMB and HML are constructed on the basis of six portfolios formed at the interaction of two size (Small, Big) und three book-to-market equity portfolios (Low, Medium, High).

< Please insert Table VI approximately here >

Table VI shows that the average size ranges from 31.3 Mio. Euro for the S/H-portfolio to 1,290 Mio. Euro for the B/M-portfolio. On average, small stocks and big stocks tend to have similar book-to-market ratios. The average number of stocks in the portfolios ranges from 32 to 57. Summary statistics (Panel A) and cross-correlations (Panel B) of the factor portfolios are reported in Table VII.

< Please insert Table VII approximately here >

We find high mean monthly returns for the factor portfolios $EP_{Carhart}$, $HML_{Carhart}$, and $WML_{Carhart}$ of 0.63%, 0.58%, and 0.94% respectively. These average returns are highly significant being at least 5.2 standard errors from 0. The average market excess return (RMRF) is 0.37% per month, only 1.7 standard errors from 0. The mean return of the SMB portfolio (-0.17% per month) is low in economic and statistical terms (t-statistic = -1.24). The HML portfolio constructed as in Fama and French (1993) shows comparable descriptive statistics to the $HML_{Carhart}$ portfolio.

If the returns on several factor portfolios are highly correlated with each other, it is likely that they are picking up similar economic effects. Most correlations are fairly small which indicates that the portfolios proxy for different underlying factors (see Panel B of Table VII).

An exception is the high correlation (0.75) between $HML_{Carhart}$ and HML which is not surprising given that both portfolios are formed using the same firm characteristic.

4.3 Cross-Sectional Pricing

This section addresses the question of whether estimated risk premiums associated with the factors constructed in the previous section are priced. Using the six factors, RMRF, $HML_{Carhart}$, $EP_{Carhart}$, $WML_{Carhart}$, SMB, and HML, we build three sets of models. Our first set of models includes (in addition to the market factor RMRF) the factors related to the characteristics that performed best in Section 3.2 ($EP_{Carhart}$, $HML_{Carhart}$, $WML_{Carhart}$). Our 3-factor model contains RMRF, $HML_{Carhart}$, and $EP_{Carhart}$. In our 4-factor model we add $WML_{Carhart}$. The second set of models represents traditional asset pricing models, the CAPM of Sharpe (1964), Lintner (1965), and Mossin (1966), the Fama and French (1993) 3-factor model, and the 4-factor model of Carhart (1997). In the third set of models we expand the traditional models and include $EP_{Carhart}$ as an additional explanatory variable. This set of models helps us to test the relevance of this factor in comparison to the well-established factors RMRF, SMB, HML, and $WML_{Carhart}$. We run the eight models using our 96 double sorted test assets.

To estimate risk premiums, we employ a standard two-stage approach.[15] In the first step, we run rolling five-year time series regressions to get the factor loadings. We do so for each test asset and each month separately, and thus get an estimated factor loading $\hat{\beta}$ for each month and test asset.[16] In the second step, we take the estimated factor loadings and test whether our factors carry a positive premium. We use the Fama-MacBeth procedure and estimate a cross-sectional regression of excess returns on estimated factor loadings:

$$r_j - r_f = \lambda_0 + \lambda' \hat{\beta}_j + \varepsilon_j. \quad (2)$$

r_j is the return of test asset j and r_f denotes the risk free return. $\hat{\beta}_j$ is the vector of estimated factor loadings from the first stage regression. λ_0 is the constant and λ the vector of cross-sectional regression coefficients. We run the cross-sectional regression (2) for each month

15 The two-stage cross-sectional regression procedure has recently been employed by Brennan et al. (2004), Campbell and Vuolteenaho (2004), and Petkova (2006), for instance.

16 As a robustness check, we run the Fama and MacBeth (1973) regressions with time-invariant factor loadings. The results remain qualitatively unchanged, but we observe a higher variation in premium levels indicating that using time-invariant betas leads to less precise estimations.

separately and obtain time series $\lambda_{0,t}$ and λ_t. The average premium is calculated as the mean of the time series λ_t. The corresponding standard errors are calculated as proposed by Fama and MacBeth (1973) using the correction proposed by Shanken (1992). We estimate premiums for each double sorting scheme and each model specification. As a goodness of fit of each specification, we use the cross-sectional R^2 measure employed by e.g. Jagannathan and Wang (1996) and Petkova (2006). This measure is given by

$$R^2 = \frac{Var_C\left(\overline{r}_j\right) - Var_C\left(\overline{\varepsilon}_j\right)}{Var_C\left(\overline{r}_j\right)}, \tag{3}$$

where Var_C denotes the cross-sectional variance, $\overline{r}_j$ stands for the average excess return of test asset *j*, and $\overline{\varepsilon}_j$ is the average residual for test asset *j*. The second-stage results are presented in Table VIII.

< Please insert Table VIII approximately here >

Panel A of Table VIII shows the average premiums and Shanken (1992) adjusted t-statistics for double sorts on earnings-to-price and momentum. We focus our discussion on sorts based on earnings-to-price and momentum because they deliver the highest spread in average returns (1.75% per month) among the six sorting schemes. The first two rows of Panel A show the results for our 3-factor and 4-factor model, respectively. In both models, $EP_{Carhart}$ yields a highly significant premium of 0.88% and 0.73% per month, respectively. The estimated and marginally significant coefficient of $HML_{Carhart}$ is 0.46% per month when it enters the regression together with $WML_{Carhart}$. $WML_{Carhart}$ exhibits a highly significant premium of 1.11% per month. RMRF carries no premium.

We also find insignificant market premiums when looking at the traditional models. The Fama-French 3-factor model leads to a value premium of 0.67% per month (t-statistic = 2.86) and a size premium of -0.65% per month (t-statistic = -2.33). In all other specifications the size premium is insignificant. The Carhart 4-factor model yields a highly significant premium of 1.11% per month (t-statistic = 6.02) for the momentum factor. The size factor loses significance when adding the momentum factor and the R^2 rises from 86% to 95%.

Adding $EP_{Carhart}$ to the traditional models increases the R^2 by at least 1%. This indicates that the earnings-to-price factor contains additional information relative to the traditional factors. Its premium varies between 0.72% and 0.91% per month.

The overall view does not change when looking at the estimated average factor premiums of the other double sorts. Panel B to F of Table VIII show that the premiums associated with the earnings-to-price factor are significant and positively priced in 26 out of 30 different specifications. Besides the earnings-to-price factor, the momentum factor and the book-to-market equity factor matter. Premiums associated with the book-to-market equity factor (HML or $HML_{Carhart}$) are priced in at least 75% of all specifications, premiums associated with the momentum factor are priced in 72% of all specifications. In contrast, premiums associated with the market factor and the size factor are not priced. They only show significant premiums in rare cases and the estimated premiums are not of the same sign across all specifications.

Overall, our findings suggest that the earnings-to-price factor, the book-to-market-equity factor, and the momentum factor carry significant premiums. The estimated premiums associated with the market factor and the size factor are mostly close to zero and insignificant.

4.4 Evaluating Competing Multifactor Models

Given the previous results, one might suppose that a model including an earnings-to-price, a book-to-market equity, and a momentum factor fits better than the usually applied benchmark models by Fama and French (1993) and Carhart (1997). To test this conjecture, we run the following time series regression:

$$r_t - r_{f,t} = \alpha + \beta' F_t + \varepsilon_t \tag{4}$$

r_t denotes the return of the test asset in month t, $r_{f,t}$ is the risk free rate in month t, and F_t denotes the vector of factors. We run the regression (3) for each test asset j and thus get a cross section of $\hat{\alpha}_j$. Under a well-specified asset-pricing model we would find that all $\hat{\alpha}_j$ are jointly indistinguishable from zero. We employ the F-Test proposed by Gibbons et al. (1989) (GRS-test) to test whether this condition holds.

< Please insert Table IX approximately here >

Table IX shows F-statistics and corresponding p-values from GRS-tests for the eight different models and the six sorting schemes used in Section 4.1. For each model we perform the GRS-test on the 16 estimated intercepts $\hat{\alpha}_j$ resulting from time series regressions to explain excess returns of test assets.[17] Table IX shows that none of the models captures the cross-sectional return variation for all sorting schemes. However, there are differences between the models with respect to the GRS-statistics they deliver.

For example, our 3-factor model with RMRF, $EP_{Carhart}$, and $HML_{Carhart}$ delivers lower GRS-statistics than the Fama-French model in five out of six sorting schemes. The same is true for a simple 2-factor model containing just RMRF and $EP_{Carhart}$. The Fama-French model only shows lower GRS-statistics when explaining portfolio returns based on a double sort on book-to-market equity and size, the two criteria used to construct the explaining factors SMB and HML.

Expanding our 3-factor model to a 4-factor model by adding the momentum factor increases the explanatory power – especially for test assets constructed with respect to momentum as a sorting criterion. This highlights the fact that models tend to perform well when they are tested on test assets whose characteristics have been used to build the factors. This supports the postulation of Lewellen et al. (2010) to confront asset pricing models with a wide array of test assets, as done in this study.

The Carhart 4-factor model and our 4-factor model perform about the same. Though our model shows lower GRS-statistics in four out of six sorting schemes, the differences are fairly small. All other models show inferior explanatory power in almost all cases, sometimes the differences in the GRS-statistic being huge.

5. Stability Over Time

In this section we test whether our results also hold for subperiods. We examine this issue by looking at two subperiods of equal lengths and summarize the results qualitatively. Detailed results are available from the authors upon request.

When repeating the analysis underlying Table III for the two subperiods (07/1964 to 09/1985 and 10/1985 to 12/2006) we find that book-to-market equity, earnings-to-price, market leverage, and momentum deliver highly significant average 10-1 hedge portfolio returns in

[17] For the sake of brevity we do not report the estimated intercepts and factor loadings for each of the 96 test portfolios. The results are available upon request.

both subperiods. Sorts on return on assets produce almost identical average 10-1 hedge portfolio returns in both subperiods, but the average hedge portfolio return loses significance in the second subperiod.

When looking at the slope coefficients from Fama-MacBeth regression in the two subperiods (see Table IV for the overall results), we again find robust results. Book-to-market equity and momentum are highly significant in both subperiods. The earnings-to-price ratio has a positive impact in all specifications, but is only marginally significant in the second subperiod. Interestingly, the average slope coefficient of size changes sign. It is negative in the first period (small stocks deliver higher average returns), but positive in the second period (large stocks deliver higher average returns).

Our main findings remain robust when examining the average premiums in two equal subperiods (see Table VIII for the overall results). The first subperiod ranges from 07/1969 to 03/1988 and the second one from 04/1988 to 12/2006. In both subperiods, only premiums associated with the earnings-to-price factor, the book-to-market equity factor, and the momentum factor are priced in the majority of cases.

When running the model tests for subperiods (see Table IX for the overall results), we again find that the Fama-French model delivers higher GRS-statistics than our 3-factor model and that the 4-factor models typically lead to lower GRS-statistics than the other models. The differences between our 4-factor model and the Carhart (1997) 4-factor model remain small. What strikes us are the lower GRS-statistics in the first subperiod (07/1969 to 03/1988), i.e., in the first subperiod the models do a far better job in explaining portfolio returns than in the second subperiod (04/1988 to 12/2006).

6. Conclusion

The 3-factor model of Fama and French (1993) and the 4-factor model of Carhart (1997) are the dominant models in empirical asset pricing. However, the explanatory power of these models depends on the underlying test assets. In addition, tests for non-U.S. markets show mixed evidence. Given these caveats, there is a clear need for studies which test these models using a wide variety of test assets and data from markets outside the U.S. Our paper contributes by conducting a comprehensive asset pricing study based on a unique dataset for the German stock market.

Our main findings can be summarized as follows: First, by using one-dimensional sorts and multivariate Fama-MacBeth regressions we document a significant positive relation between average returns and three firm characteristics: book-to-market equity, earnings-to-price, and momentum. Second, we run asset pricing tests using factor portfolios constructed with respect to these characteristics and a wide array of test assets. We find significant premiums for value and momentum factors. The market and size factors exhibit insignificant premiums in most specifications. Third, when evaluating competing asset pricing models, we find the Fama-French model to do a poor job in explaining the cross-section of average stock returns in Germany. An alternative 3-factor model including the market factor, the book-to-market factor, and the earnings-to-price factor explains returns better. By adding the momentum factor explanatory power is further increased, but even the 4-factor model is rejected in most cases based on the GRS-statistics.

Summing up, we find that the value and the momentum factors are the main drivers of stock returns, a feature the German stock market shares with many other markets. What is striking is the fact that the value effect is captured not only by the book-to-market ratio, but also by the earnings-to-price ratio. Earnings seem to contain more information in Germany than in other countries – possibly due to differences in the accounting standards. The market factor is in Germany as insignificant as in other markets. The impact of size on returns changes over time in Germany. Whereas in the earlier years small stocks deliver higher average returns than large stocks, the opposite is true in later years. This finding is in line with international evidence documenting that the size effect is not robust for different time periods.

References

Ball, Ray, 1978, Anomalies in Relationships Between Securities' Yields and Yield-Surrogates, *Journal of Financial Economics* 6, 103-126.

Banz, Rolf W., 1981, The Relationship Between Return and Market Value of Common Stocks, *Journal of Financial Economics* 9, 3-18.

Basu, Sanjoy, 1977, Investment Performance of Common Stocks in Relation to Their Price-Earnings Ratios: A Test of the Efficient Market Hypothesis, *Journal of Finance* 32, 663-682.

Basu, Sanjoy, 1983, The Relationship Between Earnings' Yield, Market Value and Return for NYSE Common Stocks: Further Evidence, *Journal of Financial Economics* 12, 129-156.

Bhandari, Laxmi Chand, 1988, Debt/Equity Ratio and Expected Common Stock Returns: Empirical Evidence, *Journal of Finance* 43, 507-528.

Breig, Christoph M. and Ralf Elsas, 2009, Default Risk and Equity Returns: A Comparison of the Bank-Based German and the U.S. Financial System, Working Paper (University of Munich).

Brennan, Michael J., Ashley W. Wang, and Yihong Xia, 2004, Estimation and Test of a Simple Model of Intertemporal Capital Asset Pricing, *Journal of Finance* 59, 1743-1775.

Campbell, John Y. and Tuomo Vuolteenaho, 2004, Bad Beta, Good Beta, *American Economic Review* 94, 1249-1275.

Carhart, Mark M., 1997, On Persistence in Mutual Fund Performance, *Journal of Finance* 52, 57-82.

Chakravarty, Sugato, Huseyin Gulen, and Stewart Mayhew, 2004, Informed Trading in Stock and Option Markets, *Journal of Finance* 59, 1235-1257.

Chan, Louis K. C., Jason Karceski, and Josef Lakonishok, 1998, The Risk and Return from Factors, *Journal of Financial and Quantitative Analysis* 33, 159-188.

Cochrane, John H., 2005, *Asset Pricing* (Princeton New Jersey: Princeton University Press).

Connor, Gregory and Sanjay Sehgal, 2001, Tests of the Fama and French Model in India, Working Paper (London School of Economics).

Cooper, Michael J., Huseyin Gulen, and Michael J. Schill, 2008, Asset Growth and the Cross-Section of Stock Returns, *Journal of Finance* 63, 1609-1651.

DeBondt, Werner F. M. and Richard Thaler, 1985, Does the Stock Market Overreact?, *Journal of Finance* 40, 793-805.

Dimson, Elroy, Paul Marsh, and Mike Staunton, 2002, *Triumph of the Optimists: 101 Years of Global Investment Returns* (Princeton New Jersey: Princeton University Press).

Elsas, Ralf, Mahmoud El-Shaer, and Erik Theissen, 2003, Beta and Returns Revisited: Evidence from the German Stock Market, *Journal of International Financial Markets, Institutions and Money* 13, 1-18.

Fama, Eugene F. and Kenneth R. French, 1992, The Cross-Section of Expected Stock Returns, *Journal of Finance* 47, 427-465.

Fama, Eugene F. and Kenneth R. French, 1993, Common Risk Factors in the Returns on Stocks and Bonds, *Journal of Financial Economics* 3-56.

Fama, Eugene F. and Kenneth R. French, 1996, Multifactor Explanations of Asset Pricing Anomalies, *Journal of Finance* 51, 55-84.

Fama, Eugene F. and Kenneth R. French, 1998, Value versus Growth: The International Evidence, *Journal of Finance* 53, 1975-1999.

Fama, Eugene F. and Kenneth R. French, 2008, Dissecting Anomalies, *Journal of Finance* 63, 1653-1678.

Fama, Eugene F. and James D. MacBeth, 1973, Risk, Return, and Equilibrium: Empirical Tests, *Journal of Political Economy* 81, 607-636.

Gibbons, Michael R., Stephen A. Ross, and Jay Shanken, 1989, A Test of the Efficiency of a Given Portfolio, *Econometrica* 57, 1121-1152.

Griffin, John M., 2002, Are the Fama and French Factors Global or Country Specific?, *Review of Financial Studies* 15, 783-803.

Haugen, Robert A. and Nardin L. Baker, 1996, Commonality in the Determinants of Expected Stock Returns, *Journal of Financial Economics* 41, 401-439.

Hawawini, Gabriel and Donald B. Keim, 2000. *The Cross Section of Common Stock Returns: A Review of the Evidence and Some New Findings* (Cambridge University Press).

Jagannathan, Ravi and Zhenyu Wang. 1996, The Conditional CAPM and the Cross-Section of Expected Returns. *Journal of Finance* 51, 3-53.

Jegadeesh, Narasimhan, 1990, Evidence of Predictable Behavior of Security Returns, *Journal of Finance* 45, 881-898.

Jegadeesh, Narasimhan and Sheridan Titman, 1993, Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency, *Journal of Finance* 48, 65-91.

Koch, Stefan, 2009a, Low Risk and High Returns, Working Paper (University of Bonn).

Koch, Stefan, 2009b, Illiquidity and Stock Returns: Evidence from the German Stock Market, Working Paper (University of Bonn).

Lakonishok, Josef, Andrei Shleifer, and Robert W. Vishny, 1994, Contrarian Investment, Extrapolation, and Risk, *Journal of Finance* 49, 1541-1578.

Lewellen, Jonathan, Stefan Nagel, and Jay Shanken, 2010, A Skeptical Appraisal of Asset Pricing Tests, *Journal of Financial Economics* 96, 175-194.

Liew, Jimmy and Maria Vassalou, 2000, Can Book-to-Market, Size and Momentum Be Risk Factors that Predict Economic Growth?, *Journal of Financial Economics* 57, 221-245.

Lintner, John, 1965, The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets, *Review of Economics and Statistics* 47, 13-37.

Lo, Andrew W. and A. Craig MacKinlay, 1990, Data-Snooping Biases in Tests of Financial Asset Pricing Models, *Review of Financial Studies* 3, 431-467.

Michou, Maria, Sulaiman Mouselli, and Andrew W. Stark, 2007, Estimating the Fama and French Factors in the UK - An Empirical Review, Working Paper (Manchester Business School).

Mossin, Jan, 1966, Equilibrium in a Capital Asset Market, *Econometrica* 34, 768-783.

Petkova, Ralitsa, 2006, Do the Fama-French Factors Proxy for Innovations in Predictive Variables?, *Journal of Finance* 61, 581-612.

Petersen, Mitchell A., 2009, Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches, *Review of Financial Studies* 22, 435-480.

Phalippou, Ludovic, 2007, Can Recent Risk-Based Theories Explain the Value Premium?, *Review of Finance* 11, 143-166.

Rosenberg, Barr, Kenneth Reid, and Ronald Lanstein, 1985, Persuasive Evidence of Market Inefficiency, *Journal of Portfolio Management* 11, 9-16.

Rouwenhorst, K. Geert, 1998, International Momentum Strategies, *Journal of Finance* 53, 267-284.

Rouwenhorst, K. Geert, 1999, Local Return Factors and Turnover in Emerging Stock Markets, *Journal of Finance* 54, 1439-1464.

Schlag, Christian and Volker Wohlschieß, 1997, Is β dead? Results for the German stock market, Working Paper (University of Karlsruhe).

Schrimpf, Andreas, Michael Schröder, and Richard Stehle, 2007, Cross-sectional Tests of Conditional Asset Pricing Models: Evidence from the German Stock Market, *European Financial Management* 13, 880-907.

Schulz, Anja and Richard Stehle, 2002, Buchwert-Marktwert-Verhältnis, Size und Beta als Erklärungsvariable für die Renditen deutscher Aktien, Working Paper (Humboldt University Berlin).

Shanken, Jay, 1992, On the Estimation of Beta-Pricing Models, *Review of Financial Studies* 5, 1-33.

Sharpe, William F., 1964, Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk, *Journal of Finance* 19, 425-442.

Sattler, Ralf R., 1994, Renditeanomalien am deutschen Aktienmarkt (Shaker: Aachen).

Schiereck, Dirk, Werner DeBondt, and Martin Weber, 1999, Contrarian and Momentum Strategies in Germany, *Financial Analysts Journal* 55, 104-116.

Stehle, Richard, 1997, Der Size-Effekt am deutschen Aktienmarkt, *Zeitschrift für Bankrecht und Bankwirtschaft* 9, 237-260.

Stock, Detlev, 2002, Zur Relevanz von Marktmodell-Anomalien für den deutschen Aktienmarkt (Lang, Peter: Frankfurt am Main).

van Dijk, Mathijs A., 2011, Is Size Dead? A Review of the Size Effect in Equity Returns, *Journal of Banking & Finance* (forthcoming).

Vaihekoski, Mika, 2004, Portfolio Construction for Tests of Asset Pricing Models, *Financial Markets, Institutions & Instruments* 13, 1-39.

Viale, Ariel M., James W. Kolari, and Donald R. Fraser, 2009, Common Risk Factors in Bank Stocks, *Journal of Banking & Finance* 33, 464-472.

Wallmeier, Martin, 2000, Determinanten erwarteter Renditen am deutschen Aktienmarkt - Eine empirische Untersuchung anhand ausgewählter Kennzahlen, *Zeitschrift für betriebswirtschaftliche Forschung* 52, 27-57.

Ziegler, Andreas, Michael Schröder, Anja Schulz, and Richard Stehle, 2007, Multifaktormodelle zur Erklärung deutscher Aktienrenditen: Eine empirische Analyse, *Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung* 59, 355-389.

Table I
Number of firms

Period	Average number of firms	Period	Average number of firms
1963-1967	202	1986-1988	245
1968-1970	176	1989-1991	288
1971-1973	175	1992-1994	313
1974-1976	218	1995-1997	334
1977-1979	213	1998-2000	509
1980-1982	212	2001-2003	554
1983-1985	212	2004-2006	488

The table reports the average number of firms for different time periods included in the analysis. Financial firms are excluded from the sample. All firms are listed at the Frankfurt Stock Exchange belonging to the market segments "Amtlicher Handel" or "Neuer Markt". We also consider the entire time series of firms listed at "Geregelter Markt" if they are traded "Amtlicher Handel" or "Neuer Markt" at any time in the sample. We include a firm in year τ only if stock prices for December of year τ-*1* and June of year τ are available in our data set.

Table II

Summary statistics (Panel A) and average Spearman rank correlations (Panel B) for beta, size (market capitalization), BE/ME (book equity/market equity), E/P (pos. net earnings/price), market leverage (total assets/market equity), book leverage (total assets/book equity), ROA (net earnings/total assets), asset growth, momentum (prior 2-12 month returns), and reversal (prior 13-60 month returns): 1962 – 2005, 43 years

	Panel A: Summary Statistics					Panel B: Average Spearman Rank Correlations								
	Mean	Std. Dev.	Median	25th Percentile	75th Percentile	Beta	Size	BE/ME	E/P	Market leverage	Book leverage	ROA	Asset growth	Mom.
Beta	0.715	0.483	0.677	0.352	1.012	1.000								
Size (million €)	904.2	5246.2	94.4	28.6	340.2	0.327	1.000							
BE/ME	0.692	0.571	0.543	0.350	0.841	0.098	-0.172	1.000						
E/P	0.068	0.109	0.045	0.027	0.071	0.112	0.027	0.323	1.000					
Market leverage	2.424	2.582	1.674	0.915	2.910	0.102	-0.108	0.720	0.268	1.000				
Book leverage	3.671	2.971	2.874	2.044	4.243	0.046	0.044	-0.007	0.018	0.623	1.000			
ROA	0.010	0.113	0.023	0.003	0.047	0.005	0.218	-0.311	0.511	-0.530	-0.431	1.000		
Asset growth	0.097	0.353	0.041	-0.029	0.127	0.073	0.201	-0.095	0.106	-0.011	0.101	0.192	1.000	
Momentum	0.066	0.394	0.027	-0.149	0.234	-0.017	0.143	-0.085	0.131	-0.087	-0.020	0.213	0.108	1.000
Reversal	0.344	0.913	0.158	-0.199	0.631	-0.072	0.236	-0.306	0.003	-0.284	-0.078	0.317	0.213	0.363

Panel A shows summary statistics of the firm characteristics. The financial ratio variables are calculated using market equity (stock price times shares outstanding) at the end of December of year τ-1 and accounting data for the fiscal year ending in calendar time year τ-1. Size is measured by market equity at the end of June of year τ. Asset growth is calculated as the year-on-year percentage change in total assets. Firm-years with negative book values are excluded from the analysis. E/P is calculated using only firms with positive net earnings. All financial ratios have been winsorized setting the bottom (top) 1% values equal to the value corresponding to the 1^{st} (99^{th}) percentile of the empirical distribution. Stock betas are estimated using rolling five year regressions with monthly returns, where at least two years of returns must be available. Betas are calculated relative to the DAFOX (CDAX with the beginning of 2005). Summary statistics for momentum (reversal) are reported for cumulative equal-weighted past returns from month t-12 to t-2 (month t-60 to t-13). Panel B reports average Spearman rank correlations computed as follows: For every year from 1963 to 2005 pairwise Spearman rank correlations are computed based on the rankings of individual stocks at the end of June. Mean Spearman rank correlations for each anomaly variable are then calculated for the entire time series.

Table III

Monthly percentage average returns for equal-weighted portfolios formed on beta, size (market capitalization), BE/ME (book equity/market equity), E/P (pos. net earnings/price), market leverage (total assets/market equity), book leverage (total assets/book equity), ROA (net earnings/total assets), asset growth, momentum (prior 2-12 month returns), and reversal (prior 13-60 month returns): 07/1964 – 12/2006, 510 months

	Deciles										Overall					
	1 (low)	2	3	4	5	6	7	8	9	10 (high)	10-5		5-1		10-1	
Beta	0.760	0.788	0.822	0.821	0.716	0.772	0.713	0.818	0.686	0.595	-0.121	(-0.698)	-0.044	(-0.339)	-0.165	(-0.713)
Size	0.821	0.842	0.616	0.547	0.578	0.602	0.660	0.534	0.810	0.740	0.162	(1.147)	-0.243	(-1.845)	-0.081	(-0.425)
BE/ME	0.302	0.374	0.513	0.484	0.673	0.556	0.852	0.865	0.934	1.202	0.529	(4.389)	0.371	(2.575)	0.900	(5.512)
E/P	0.318	0.380	0.516	0.526	0.655	0.767	0.847	0.919	0.944	1.309	0.654	(5.496)	0.336	(2.497)	0.991	(6.668)
Market leverage	0.342	0.437	0.485	0.456	0.748	0.716	0.789	0.845	0.877	1.073	0.324	(2.637)	0.407	(2.417)	0.731	(3.911)
Book leverage	0.622	0.619	0.582	0.561	0.508	0.762	0.836	0.870	0.676	0.740	0.232	(2.102)	-0.114	(-0.892)	0.118	(0.769)
ROA	0.430	0.571	0.637	0.645	0.715	0.673	0.667	0.808	0.753	0.904	0.189	(1.926)	0.285	(1.904)	0.474	(3.080)
Asset growth	0.625	0.808	0.900	0.682	0.831	0.869	0.788	0.673	0.530	0.483	-0.348	(-2.169)	0.206	(1.722)	-0.142	(-0.867)
Momentum	0.120	0.192	0.337	0.506	0.536	0.748	0.792	0.991	1.056	1.466	0.930	(6.284)	0.416	(2.264)	1.346	(6.011)
Reversal	0.928	0.898	0.721	0.677	0.883	0.928	0.886	0.846	0.701	0.631	-0.252	(-1.995)	-0.045	(-0.327)	-0.298	(-1.872)

For each decile portfolio the table shows the mean monthly return. For each hedge portfolio the table shows the average monthly hedge portfolio return obtained from a long-short position in deciles 10 and 5, 5 and 1, and 10 and 1, respectively. Corresponding t-statistics are in parenthesis. Except for momentum and reversal stocks are allocated to ten portfolios at the end of June of each year τ (1964 – 2006). Monthly equal-weighted returns on the portfolios are calculated from July to the following June. The portfolios formed on momentum (reversal) are rearranged every month. The underlying sorting criteria are calculated as follows: Stock betas are estimated using rolling five year regressions with monthly returns. Betas are calculated relative to the DAFOX (CDAX with the beginning of 2005). The financial ratio variables are calculated using market equity (stock price times shares outstanding) at the end of December of year τ-1 and accounting data for the fiscal year ending in calendar year τ-1. Size is measured by market equity at the end of June of year τ. Asset growth is calculated as the year-on-year percentage change in total assets. E/P is calculated using only firms with positive net earnings. Momentum (reversal) uses cumulative equal-weighted past returns from month t-12 to t-2 (month t-60 to t-13). We exclude firm years with negative book equity.

Table IV

Average slope coefficients and t-statistics from monthly Fama and MacBeth (1973) regressions of stock returns on beta, size (market capitalization), BE/ME (book equity/market equity), E/P (pos. net earnings/price), E/P dummy for neg. net earnings, A/ME (market leverage (total assets/market equity)), A/BE (book leverage (total assets/book equity)), ROA (net earnings/total assets), asset growth (year-on-year change in total assets), momentum (prior 2-12 month returns), and reversal (prior 13-60 month returns): 07/1964 – 12/2006, 510 months

Beta	ln (Size)	ln (BE/ME)	E/P	E/P Dummy	ln (A/ME)	ln (A/BE)	ROA	Asset growth	Momentum	Reversal
-0.001	-0.000	0.002	0.021	-0.001			0.005	0.001	0.010	0.000
(-0.60)	(-0.09)	(3.67)	(2.92)	(-0.63)			(0.54)	(0.56)	(4.85)	(0.12)
-0.002	0.000	0.003	0.020	-0.001			0.001	-0.000	0.011	
(-1.34)	(0.46)	(4.10)	(3.04)	(-0.75)			(0.09)	(-0.06)	(5.33)	
-0.002	0.000		0.021	-0.001	0.003	-0.003	0.001	0.000	0.011	
(-1.19)	(0.46)		(2.74)	(-0.70)	(3.81)	(-3.40)	(0.10)	(0.03)	(5.31)	
		0.004					0.019		0.014	
		(4.30)					(2.65)		(6.13)	
		0.003	0.018	-0.001			0.007		0.014	
		(3.82)	(2.85)	(-0.80)			(0.90)		(6.11)	
		0.003	0.019	-0.002					0.014	
		(3.91)	(3.46)	(-1.16)					(6.13)	
		0.003	0.020						0.015	
		(3.29)	(3.57)						(6.21)	

The table shows the average slope coefficients and t-statistics for different Fama-MacBeth regressions. Each double row stands for one combination of characteristics. The standard errors from the regressions are adjusted for autocorrelation in the estimated coefficients. Betas are calculated relative to the DAFOX (CDAX with the beginning of 2005). The natural logarithms of the financial ratio variables are calculated using market equity (stock price times shares outstanding) at the end of December of year τ-1 and accounting data for the fiscal year ending in calendar year τ-1. Size is measured by ln (market equity) at the end of June of year τ. Asset growth is calculated as the year-on-year percentage change in total assets. E/P is calculated using only firms with positive net earnings. E/P dummy is a dummy variable that takes the value of 1 if the firm has negative net earnings. Momentum (reversal) uses cumulative equal-weighted past returns from month t-12 to t-2 (month t-60 to t-13). We exclude firm years with negative book equity.

Table V

Descriptive Statistics for six different (4x4) independently double-sorted portfolios on size (market capitalization), BE/ME (book equity/market equity), E/P (pos. net earnings/price), and momentum (prior 2-12 month returns): 07/1969 – 12/2006, 450 months

		Panel A: Excess Returns				Panel B: Standard Deviation				Panel C: # Stocks				Panel D: Market Capitalization			
		BE/ME				BE/ME				BE/ME				BE/ME			
		1 (low)	2	3	4 (high)	1 (low)	2	3	4 (high)	1 (low)	2	3	4 (high)	1 (low)	2	3	4 (high)
Size	1 (low)	-0.02	0.07	0.33	0.58	4.53	4.33	4.60	4.82	12	14	19	26	19.9	19.7	18.2	17.1
	2	-0.31	0.12	0.05	0.50	5.04	4.34	4.58	4.94	17	17	19	17	63.1	60.7	59.6	65.8
	3	-0.17	-0.07	0.26	0.67	4.93	4.46	4.41	5.13	20	20	17	14	197.0	201.8	196.0	194.0
	4 (high)	-0.07	0.23	0.44	0.66	4.88	4.86	4.69	5.18	22	20	15	13	2,117.5	2,615.1	3,074.8	2,096.1
		E/P				E/P				E/P				E/P			
Size	1 (low)	0.07	0.22	0.50	0.77	4.50	4.83	6.39	4.76	12	9	9	13	17.8	19.0	19.2	20.0
	2	-0.33	0.02	0.43	0.65	5.13	4.40	4.60	4.50	14	13	12	14	60.3	61.4	65.2	63.8
	3	-0.34	0.09	0.26	0.56	5.14	4.54	4.43	4.54	14	16	16	13	193.2	203.9	198.3	191.5
	4 (high)	-0.02	0.34	0.36	0.58	5.22	4.59	4.73	4.82	14	17	18	14	2,729.6	2,277.3	2,537.3	3,470.4
		Momentum				Momentum				Momentum				Momentum			
Size	1 (low)	-0.08	0.25	0.57	0.89	5.51	4.41	3.93	4.50	23	17	15	15	15.6	17.6	19.1	22.9
	2	-0.47	0.08	0.18	0.84	5.72	4.67	3.86	4.50	18	17	17	17	53.6	59.4	64.4	72.5
	3	-0.66	-0.04	0.44	0.69	6.41	4.70	3.93	4.39	16	18	18	18	167.6	186.4	203.5	229.3
	4 (high)	-0.24	-0.02	0.29	0.58	6.71	5.22	4.53	4.67	13	17	20	20	1,604.8	2,496.8	2,636.8	2,818.5
		E/P				E/P				E/P				E/P			
BE/ME	1 (low)	-0.26	0.15	0.13	0.14	4.89	4.46	4.42	5.98	22	18	10	5	1,216.1	885.3	804.1	463.7
	2	-0.29	0.09	0.33	0.44	4.82	4.11	4.45	4.52	13	17	17	11	601.9	1,025.9	1,039.9	1,121.8
	3	0.06	0.18	0.34	0.67	4.40	4.40	4.38	4.30	11	13	16	17	559.7	721.8	919.7	1,136.7
	4 (high)	0.21	0.21	0.60	0.81	5.47	5.26	4.92	4.41	9	8	11	21	405.8	266.1	660.8	839.9
		Momentum				Momentum				Momentum				Momentum			
BE/ME	1 (low)	-0.70	-0.23	0.09	0.51	5.89	4.69	3.80	4.65	19	18	16	17	402.0	802.9	934.5	1,098.1
	2	-0.49	-0.14	0.23	0.73	5.60	4.40	3.76	4.35	17	18	18	17	362.4	921.8	913.1	1,102.0
	3	-0.23	0.06	0.42	0.77	5.90	4.47	4.10	4.16	17	17	18	17	320.9	672.6	947.6	1,016.8
	4 (high)	0.17	0.52	0.68	0.97	6.18	4.90	4.37	4.61	17	17	17	19	286.6	403.1	595.4	640.4
		Momentum				Momentum				Momentum				Momentum			
E/P	1 (low)	-0.70	-0.19	0.12	0.64	6.14	4.85	4.07	4.96	17	14	12	12	387.2	780.4	976.9	1,189.3
	2	-0.31	-0.01	0.35	0.59	5.72	4.59	3.83	4.37	12	15	15	12	372.1	718.0	896.4	1,291.2
	3	-0.38	0.18	0.41	0.83	5.89	4.66	4.25	4.31	11	14	16	14	524.2	910.9	995.2	1,038.3
	4 (high)	-0.03	0.24	0.65	1.05	6.49	4.81	4.07	4.29	8	12	15	18	519.7	1,012.0	1,067.6	942.8

Table V (continued)

		Panel E: Beta				Panel F: Book-to-Market				Panel G: Earnings-to-Price				Panel H: Momentum			
		BE/ME				BE/ME				BE/ME				BE/ME			
		1 (low)	2	3	4 (high)	1 (low)	2	3	4 (high)	1 (low)	2	3	4 (high)	1 (low)	2	3	4 (high)
Size	1 (low)	0.48	0.53	0.56	0.65	0.27	0.47	0.69	1.38	0.065	0.057	0.074	0.118	0.018	0.018	0.042	0.076
	2	0.57	0.64	0.72	0.68	0.26	0.46	0.69	1.25	0.040	0.054	0.065	0.085	0.054	0.061	0.075	0.114
	3	0.61	0.76	0.81	0.83	0.26	0.46	0.68	1.19	0.036	0.051	0.061	0.074	0.079	0.088	0.109	0.115
	4 (high)	0.80	0.88	0.91	0.89	0.26	0.46	0.68	1.17	0.039	0.055	0.072	0.095	0.107	0.100	0.111	0.132
		E/P				E/P				E/P				E/P			
Size	1 (low)	0.51	0.52	0.62	0.60	0.75	0.64	0.75	1.03	0.014	0.037	0.057	0.192	0.015	0.035	0.064	0.140
	2	0.65	0.63	0.65	0.66	0.55	0.59	0.62	0.81	0.016	0.037	0.057	0.135	0.016	0.069	0.098	0.173
	3	0.65	0.74	0.81	0.78	0.47	0.51	0.60	0.75	0.015	0.037	0.057	0.110	0.056	0.071	0.115	0.154
	4 (high)	0.84	0.85	0.91	0.88	0.45	0.47	0.58	0.81	0.017	0.038	0.056	0.145	0.091	0.099	0.109	0.161
		Momentum				Momentum				Momentum				Momentum			
Size	1 (low)	0.62	0.55	0.53	0.57	0.82	0.83	0.84	0.87	0.081	0.070	0.085	0.105	-0.236	-0.028	0.126	0.469
	2	0.72	0.62	0.61	0.65	0.67	0.67	0.67	0.64	0.047	0.061	0.068	0.071	-0.222	-0.026	0.128	0.455
	3	0.80	0.74	0.72	0.77	0.66	0.60	0.58	0.57	0.044	0.051	0.056	0.060	-0.216	-0.025	0.128	0.454
	4 (high)	0.92	0.88	0.84	0.87	0.59	0.60	0.56	0.58	0.051	0.063	0.058	0.067	-0.199	-0.023	0.129	0.422
		E/P				E/P				E/P				E/P			
BE/ME	1 (low)	0.61	0.69	0.72	0.60	0.23	0.28	0.30	0.30	0.017	0.037	0.055	0.148	0.063	0.091	0.116	0.161
	2	0.66	0.70	0.77	0.72	0.46	0.46	0.47	0.47	0.017	0.038	0.056	0.122	0.025	0.065	0.100	0.142
	3	0.66	0.74	0.80	0.75	0.68	0.66	0.67	0.69	0.015	0.038	0.057	0.133	0.038	0.074	0.096	0.161
	4 (high)	0.74	0.69	0.76	0.75	1.24	1.15	1.13	1.36	0.012	0.038	0.058	0.171	0.048	0.069	0.105	0.158
		Momentum				Momentum				Momentum				Momentum			
BE/ME	1 (low)	0.68	0.63	0.60	0.65	0.25	0.26	0.27	0.26	0.041	0.040	0.042	0.044	-0.225	-0.028	0.128	0.472
	2	0.77	0.71	0.68	0.73	0.46	0.47	0.47	0.46	0.051	0.053	0.055	0.060	-0.219	-0.025	0.127	0.427
	3	0.78	0.73	0.73	0.73	0.68	0.68	0.68	0.68	0.052	0.066	0.064	0.084	-0.219	-0.025	0.129	0.433
	4 (high)	0.78	0.73	0.71	0.76	1.30	1.27	1.27	1.28	0.089	0.089	0.102	0.114	-0.222	-0.025	0.129	0.454
		Momentum				Momentum				Momentum				Momentum			
E/P	1 (low)	0.71	0.65	0.62	0.68	0.59	0.57	0.53	0.51	0.015	0.016	0.016	0.015	-0.227	-0.028	0.127	0.467
	2	0.76	0.71	0.68	0.71	0.60	0.54	0.52	0.50	0.037	0.037	0.038	0.037	-0.206	-0.025	0.128	0.418
	3	0.80	0.75	0.76	0.77	0.70	0.62	0.61	0.57	0.056	0.057	0.056	0.057	-0.202	-0.021	0.129	0.415
	4 (high)	0.77	0.74	0.71	0.73	0.91	0.89	0.86	0.83	0.159	0.147	0.137	0.146	-0.205	-0.022	0.131	0.456

The table reports monthly mean excess returns (Panel A), standard deviations (Panel B), the average number of stocks per portfolio (Panel C), the average firm size in Mio. Euro (Panel D), the average beta (Panel E), the average book-to-market equity (Panel F), the average earnings-to-price ratio (Panel G), and the average momentum (Panel H) for the test assets. The test assets are formed as follows: For each pairwise combination of the sorting criteria we independently categorize stocks into 16 (4x4) portfolios based on the quartile breakpoints and calculate the equal-weighted monthly excess-returns of the portfolios. For the characteristics size, book-to-market equity, and earnings-to-price the sorts are conducted in June of each year. The resulting portfolios are held constant during the following twelve months. Momentum sorts are carried out every month. Therefore, double sorted portfolios based on momentum as one characteristic are rebalanced monthly.

Table VI
Average BE/ME, Size (in Mio. €) and number of stocks for the 6 Fama-French-Portfolios, 07/1964 to 12/2006 (510 months)

	S-L	S-M	S-H	B-L	B-M	B-H
BE/ME	0.28	0.57	1.25	0.28	0.55	1.09
Size (in Mio. €)	44.9	36.8	31.3	1,106.0	1,290.1	992.4
# Stocks	33	54	51	50	57	32

The table reports the average book-to-market equity, the average firm size in Mio. Euro and the average number of stocks for the six portfolios used to construct the Fama and French (1993) factors SMB and HML. The six portfolios are formed at the intersection of two size (Small, Big) und three book-to-market equity portfolios (Low, Medium, High).

Table VII

Summary statistics and cross-correlations for factor mimicking portfolios, 07/1964 to 12/2006 (510 months)

	Panel A: Summary Statistics				Panel B: Cross-Correlations					
Factor Mimicking Portfolio	Mean	Std. Dev.	Median	t-Stat. Mean=0	$EP_{Carhart}$	$HML_{Carhart}$	$WML_{Carhart}$	RMRF	SMB	HML
$EP_{Carhart}$	0.632	2.633	0.594	5.425	1.000					
$HML_{Carhart}$	0.575	2.480	0.405	5.240	0.345	1.000				
$WML_{Carhart}$	0.943	3.537	1.008	6.024	0.497	-0.101	1.000			
RMRF	0.369	4.898	0.476	1.699	0.005	0.086	-0.209	1.000		
SMB	-0.167	3.039	-0.051	-1.242	-0.270	0.103	-0.101	-0.553	1.000	
HML	0.525	2.814	0.419	4.215	0.396	0.750	0.190	0.040	-0.038	1.000

The table reports summary statistics and correlation coefficients for factor portfolios. $EP_{Carhart}$ and $HML_{Carhart}$ are hedge portfolios formed with respect to earnings-to-price and book-to-market equity. $WML_{Carhart}$ captures Jegadeesh and Titman's (1993) momentum anomaly and is long in short-term winner stocks and short in short-term loser stocks (Carhart (1997)). RMRF is the market factor, the excess market return. SMB and HML are the Fama and French (1993) factors, hedge portfolios long in small (high BE/ME) stocks and short in big (low BE/ME) stocks.

Table VIII
Fama and MacBeth (1973) regressions on test assets

Panel A: Regressions on 16 independent double-sorted earnings-to-price and momentum portfolios

λ_0	λ_{RMRF}	λ_{SMB}	λ_{HML}	$\lambda_{WML\_Carhart}$	$\lambda_{EP\_Carhart}$	$\lambda_{HML\_Carhart}$	R^2
0.0057*	-0.0011				0.0088***	0.0004	0.88
(1.80)	(-0.25)				(5.22)	(0.19)	
0.0024	0.0034			0.0111***	0.0073***	0.0046*	0.95
(0.75)	(0.84)			(5.92)	(4.24)	(1.85)	
0.0039	-0.0028						0.39
(1.45)	(-0.70)						
0.0057*	-0.0003	-0.0065**	0.0067***				0.86
(1.83)	(-0.07)	(-2.33)	(2.86)				
-0.0000	0.0052	-0.0031	0.0075***	0.0111***			0.95
(-0.00)	(1.34)	(-1.13)	(3.14)	(6.02)			
0.0052	-0.0008				0.0091***		0.79
(1.60)	(-0.17)				(5.68)		
0.0046	-0.0016	-0.0022	0.0039		0.0072***		0.91
(1.40)	(-0.38)	(-0.78)	(1.59)		(4.67)		
0.0001	0.0042	-0.0030	0.0040	0.0110***	0.0077***		0.96
(0.03)	(1.03)	(-1.03)	(5.89)	(5.99)	(4.68)		

Panel B: Regressions on 16 independent double-sorted size and book-to-market equity portfolios

λ_0	λ_{RMRF}	λ_{SMB}	λ_{HML}	$\lambda_{WML\_Carhart}$	$\lambda_{EP\_Carhart}$	$\lambda_{HML\_Carhart}$	R^2
0.0020	0.0020				0.0046***	0.0058***	0.86
(0.82)	(0.60)				(2.82)	(5.01)	
0.0038	-0.0006			0.0005	0.0050***	0.0056***	0.86
(1.47)	(-0.18)			(0.19)	(2.94)	(4.79)	
0.0008	0.0008						0.28
(0.39)	(0.28)						
0.0024	0.0013	-0.0019	0.0086***				0.84
(0.92)	(0.38)	(-1.18)	(5.27)				
0.0030	0.0001	-0.0018	0.0089***	-0.0008			0.89
(1.11)	(0.02)	(-1.13)	(4.89)	(-0.28)			
0.0003	0.0039				0.0040**		0.62
(0.14)	(1.25)				(2.51)		
0.0021	0.0027	-0.0019	0.0066***		0.0035**		0.84
(0.79)	(0.74)	(-1.16)	(3.56)		(2.09)		
0.0036	-0.0004	-0.0016	0.0081***	-0.0021	0.0039**		0.87
(1.25)	(-0.11)	(-1.00)	(4.37)	(-0.65)	(2.22)		

Table VIII (continued)
Fama and MacBeth (1973) regressions on test assets

Panel C: Regressions on 16 independent double-sorted earnings-to-price and book-to-market equity portfolios

λ_0	λ_{RMRF}	λ_{SMB}	λ_{HML}	$\lambda_{WML\_Carhart}$	$\lambda_{EP\_Carhart}$	$\lambda_{HML\_Carhart}$	R^2
0.0016	0.0020				0.0064***	0.0049***	0.77
(0.51)	(0.49)				(4.27)	(3.47)	
0.0024	0.0020			0.0048*	0.0067***	0.0050***	0.76
(0.73)	(0.50)			(1.67)	(4.30)	(3.55)	
-0.0043*	0.0083**						0.49
(-1.70)	(2.41)						
-0.0007	0.0068**	-0.0055**	0.0087***				0.68
(-0.26)	(1.97)	(-2.34)	(4.63)				
0.0004	0.0053	-0.0042*	0.0091***	0.0050*			0.77
(0.13)	(1.43)	(-1.70)	(4.97)	(1.79)			
-0.0030	0.0086**				0.0061***		0.75
(-1.01)	(2.27)				(4.20)		
0.0017	0.0021	-0.0027	0.0078***		0.0069***		0.78
(0.49)	(0.51)	(-1.07)	(4.23)		(4.33)		
0.0019	0.0026	-0.0027	0.0084***	0.0052*	0.0067***		0.81
(0.54)	(0.62)	(-1.05)	(4.50)	(1.71)	(3.93)		

Panel D: Regressions on 16 independent double-sorted size and earnings-to-price portfolios

λ_0	λ_{RMRF}	λ_{SMB}	λ_{HML}	$\lambda_{WML\_Carhart}$	$\lambda_{EP\_Carhart}$	$\lambda_{HML\_Carhart}$	R^2
0.0041	-0.0004				0.0074***	0.0054***	0.79
(1.49)	(-0.10)				(4.55)	(2.76)	
0.0036	0.0002			0.0005	0.0072***	0.0051**	0.81
(1.30)	(0.04)			(0.19)	(4.08)	(2.43)	
0.0007	0.0019						0.10
(0.31)	(0.58)						
0.0010	0.0035	-0.0004	0.0080***				0.57
(0.34)	(0.92)	(-0.23)	(3.66)				
0.0018	0.0034	-0.0004	0.0073***	0.0047*			0.68
(0.58)	(0.89)	(-0.23)	(3.15)	(1.65)			
0.0042*	0.0001				0.0079***		0.73
(1.68)	(0.02)				(5.37)		
0.0043	-0.0006	-0.0003	0.0053*		0.0077***		0.82
(1.36)	(-0.16)	(-0.17)	(1.88)		(4.39)		
0.0042	-0.0004	-0.0007	0.0049*	0.0018	0.0073***		0.84
(1.34)	(-0.12)	(-0.39)	(1.66)	(0.65)	(3.84)		

Table VIII (continued)
Fama and MacBeth (1973) regressions on test assets

Panel E: Regressions on 16 independent double-sorted book-to-market equity and momentum portfolios

λ_0	λ_{RMRF}	λ_{SMB}	λ_{HML}	$\lambda_{WML\_Carhart}$	$\lambda_{EP\_Carhart}$	$\lambda_{HML\_Carhart}$	R^2
0.0079**	-0.0054				0.0057***	0.0058***	0.88
(2.41)	(-1.17)				(2.96)	(5.06)	
0.0058**	-0.0039			0.0097***	0.0004	0.0065***	0.96
(1.89)	(-0.93)			(5.66)	(0.22)	(5.42)	
0.0063**	-0.0065						0.43
(2.11)	(-1.43)						
0.0076**	-0.0037	-0.0026	0.0090***				0.88
(2.28)	(-0.77)	(-0.79)	(4.67)				
0.0020	-0.0013	0.0065**	0.0050***	0.0099***			0.94
(0.62)	(-0.32)	(2.15)	(2.67)	(5.73)			
0.0025	0.0039				0.0087***		0.75
(0.80)	(0.85)				(4.83)		
0.0037	-0.0011	0.0017	0.0058***		0.0055***		0.89
(1.11)	(-0.24)	(0.55)	(3.14)		(2.92)		
0.0029	-0.0028	0.0068**	0.0045**	0.0099***	0.0024		0.94
(0.82)	(-0.63)	(2.15)	(2.32)	(5.66)	(1.20)		

Panel F: Regressions on 16 independent double-sorted size and momentum portfolios

λ_0	λ_{RMRF}	λ_{SMB}	λ_{HML}	$\lambda_{WML\_Carhart}$	$\lambda_{EP\_Carhart}$	$\lambda_{HML\_Carhart}$	R^2
0.0086***	-0.0074**				0.0065***	0.0008	0.72
(3.22)	(-2.08)				(3.28)	(0.38)	
0.0068**	-0.0043			0.0097***	-0.0005	-0.0011	0.91
(2.30)	(-1.25)			(5.59)	(-0.31)	(-0.53)	
0.0077***	-0.0090***						0.35
(3.60)	(-2.63)						
0.0138***	-0.0129***	-0.0011	0.0029				0.69
(4.27)	(-3.17)	(-0.71)	(1.21)				
0.0104***	-0.0088**	0.0005	0.0002	0.0095***			0.91
(3.22)	(-2.34)	(0.33)	(0.07)	(5.47)			
0.0097***	-0.0083**				0.0070***		0.64
(4.05)	(-2.47)				(3.48)		
0.0128***	-0.0123***	-0.0002	0.0003		0.0038**		0.85
(3.86)	(-3.12)	(-0.10)	(0.10)		(2.08)		
0.0100***	-0.0088**	0.0004	0.0007	0.0094***	0.0002		0.91
(3.05)	(-2.27)	(0.27)	(0.24)	(5.43)	(0.13)		

* Significant at the 10%-level, ** significant at the 5%-level, *** significant at the 1%-level. The table reports Fama and MacBeth (1993) factor premiums, Shanken (1992) adjusted t-statistics, and R^2 as employed by e.g. Jagannathan and Wang (1996) or Petkova (2006). RMRF is the market factor, the excess market return. SMB and HML are the Fama and French (1993) factors, hedge portfolios long in small (high BE/ME) stocks and short in big (low BE/ME) stocks. $WML_{Carhart}$ captures Jegadeesh and Titman's (1993) momentum anomaly and is long in short-term winner stocks and short in short-term loser stocks (Carhart (1997)). $EP_{Carhart}$ and $HML_{Carhart}$ are hedge portfolios formed with respect to earnings-to-price and book-to-market equity.

Table IX
GRS test results for time series regressions on asset pricing models

		RMRF + $EP_{Carhart}$ + $HML_{Carhart}$	RMRF + $EP_{Carhart}$ + $HML_{Carhart}$ + $WML_{Carhart}$	RMRF	RMRF + SMB + HML	RMRF + SMB + HML + $WML_{Carhart}$	RMRF + $EP_{Carhart}$	RMRF + SMB + HML + $EP_{Carhart}$	RMRF + SMB + HML + $WML_{Carhart}$ + $EP_{Carhart}$
Momentum & E/P	GRS-Statistic	**3.176**	**2.314**	**5.295**	**4.223**	**2.375**	**3.555**	**3.373**	**2.328**
	p-Value	0.000	0.003	0.000	0.000	0.002	0.000	0.000	0.003
BE/ME & Size	GRS-Statistic	**2.436**	**2.570**	**3.261**	**2.033**	**2.250**	**3.031**	**2.747**	**2.863**
	p-Value	0.002	0.001	0.000	0.010	0.004	0.000	0.000	0.000
BE/ME & E/P	GRS-Statistic	**1.919**	**2.043**	**3.911**	**2.759**	**2.085**	**2.283**	**1.968**	**1.987**
	p-Value	0.017	0.010	0.000	0.000	0.008	0.003	0.014	0.013
Momentum & BE/ME	GRS-Statistic	**3.429**	**2.365**	**5.299**	**4.169**	**2.190**	**4.051**	**3.772**	**2.558**
	p-Value	0.000	0.002	0.000	0.000	0.005	0.000	0.000	0.001
Momentum & Size	GRS-Statistic	**3.033**	**1.956**	**4.579**	**4.009**	**2.053**	**3.688**	**3.786**	**2.540**
	p-Value	0.000	0.015	0.000	0.000	0.010	0.000	0.000	0.001
Size & E/P	GRS-Statistic	**1.581**	**1.415**	**3.856**	**2.699**	**1.691**	**2.166**	**1.874**	**1.641**
	p-Value	0.070	0.130	0.000	0.000	0.045	0.006	0.021	0.056

This table shows F-statistics and corresponding p-values from the GRS test for eight different models and six sorting schemes. RMRF is the market factor, the excess market return. $EP_{Carhart}$ and $HML_{Carhart}$ are hedge portfolios formed with respect to earnings-to-price and book-to-market equity. $WML_{Carhart}$ captures Jegadeesh and Titman's (1993) momentum anomaly and is long in short-term winner stocks and short in short-term loser stocks (Carhart (1997)). SMB and HML are the Fama and French (1993) factors, hedge portfolios long in small (high BE/ME) stocks and short in big (low BE/ME) stocks.

cfr working paper series

centre for financial research
cologne

cfr working papers are available for download from **www.cfr-cologne.de**.

Hardcopies can be ordered from: centre for financial research (cfr), Albertus Magnus Platz, 50923 Koeln, Germany.

2011

No.	Author(s)	Title
11-10	A. Kempf, O. Korn, S. Saßning	Portfolio Optimization Using Forward-Looking Information
11-09	V. Agarwal, S. Ray	Determinants and Implications of Fee Changes in the Hedge Fund Industry
11-08	G. Cici, L.-F. Palacios	On the Use of Options by Mutual Funds: Do They Know What They Are Doing?
11-07	V. Agarwal, G. D. Gay, L. Ling	Window Dressing in Mutual Funds
11-06	N. Hautsch, D. Hess, D. Veredas	The Impact of Macroeconomic News on Quote Adjustments, Noise, and Informational Volatility
11-05	G. Cici	The Prevalence of the Disposition Effect in Mutual Funds' Trades
11-04	S. Jank	Mutual Fund Flows, Expected Returns and the Real Economy
11-03	G.Fellner, E.Theissen	Short Sale Constraints, Divergence of Opinion and Asset Value: Evidence from the Laboratory
11-02	S.Jank	Are There Disadvantaged Clienteles in Mutual Funds?
11-01	V. Agarwal, C. Meneghetti	The role of Hedge Funds as Primary Lenders

2010

No.	Author(s)	Title
10-20	G. Cici, S. Gibson, J.J. Merrick Jr.	Missing the Marks? Dispersion in Corporate Bond Valuations Across Mutual Funds
10-19	J. Hengelbrock, E. Theissen, C. Westheide	Market Response to Investor Sentiment
10-18	G. Cici, S. Gibson	The Performance of Corporate-Bond Mutual Funds: Evidence Based on Security-Level Holdings
10-17	D. Hess, D. Kreutzmann, O. Pucker	Projected Earnings Accuracy and the Profitability of Stock Recommendations

10-16	S. Jank, M. Wedow	Sturm und Drang in Money Market Funds: When Money Market Funds Cease to Be Narrow
10-15	G. Cici, A. Kempf, A. Puetz	Caught in the Act: How Hedge Funds Manipulate their Equity Positions
10-14	J. Grammig, S. Jank	Creative Destruction and Asset Prices
10-13	S. Jank, M. Wedow	Purchase and Redemption Decisions of Mutual Fund Investors and the Role of Fund Families
10-12	S. Artmann, P. Finter, A. Kempf, S. Koch, E. Theissen	The Cross-Section of German Stock Returns: New Data and New Evidence
10-11	M. Chesney, A. Kempf	The Value of Tradeability
10-10	S. Frey, P. Herbst	The Influence of Buy-side Analysts on Mutual Fund Trading
10-09	V. Agarwal, W. Jiang, Y. Tang, B. Yang	Uncovering Hedge Fund Skill from the Portfolio Holdings They Hide
10-08	V. Agarwal, V. Fos, W. Jiang	Inferring Reporting Biases in Hedge Fund Databases from Hedge Fund Equity Holdings
10-07	V. Agarwal, G. Bakshi, J. Huij	Do Higher-Moment Equity Risks Explain Hedge Fund Returns?
10-06	J. Grammig, F. J. Peter	Tell-Tale Tails
10-05	K. Drachter, A. Kempf	Vergütung von Managern deutscher Aktienfonds: Höhe, Struktur, Determinanten und Anreizwirkungen
10-04	J. Fang, A. Kempf, M. Trapp	Fund Manager Allocation
10-03	P. Finter, A. Niessen-Ruenzi, S. Ruenzi	The Impact of Investor Sentiment on the German Stock Market
10-02	D. Hunter, E. Kandel, S. Kandel, R. Wermers	Endogenous Benchmarks
10-01	S. Artmann, P. Finter, A. Kempf	Determinants of Expected Stock Returns: Large Sample Evidence from the German Market

2009

No.	Author(s)	Title
09-17	E. Theissen	Price Discovery in Spot and Futures Markets: A Reconsideration
09-16	M. Trapp	Trading the Bond-CDS Basis – The Role of Credit Risk and Liquidity
09-14	A. Kempf, O. Korn, M. Uhrig-Homburg	The Term Structure of Illiquidity Premia
09-13	W. Bühler, M. Trapp	Time-Varying Credit Risk and Liquidity Premia in Bond and CDS Markets
09-12	W. Bühler, M. Trapp	Explaining the Bond-CDS Basis – The Role of Credit Risk and Liquidity
09-11	S. J. Taylor, P. K. Yadav, Y. Zhang	Cross-sectional analysis of risk-neutral skewness

09-10	A. Kempf, C. Merkle, A. Niessen	Low Risk and High Return - How Emotions Shape Expectations on the Stock Market
09-09	V. Fotak, V. Raman, P. K. Yadav	Naked Short Selling: The Emperor`s New Clothes?
09-08	F. Bardong, S.M. Bartram, P.K. Yadav	Informed Trading, Information Asymmetry and Pricing of Information Risk: Empirical Evidence from the NYSE
09-07	S. J. Taylor , P. K. Yadav, Y. Zhang	The information content of implied volatilities and model-free volatility expectations: Evidence from options written on individual stocks
09-06	S. Frey, P. Sandas	The Impact of Iceberg Orders in Limit Order Books
09-05	H. Beltran-Lopez, P. Giot, J. Grammig	Commonalities in the Order Book
09-04	J. Fang, S. Ruenzi	Rapid Trading bei deutschen Aktienfonds: Evidenz aus einer großen deutschen Fondsgesellschaft
09-03	A. Banegas, B. Gillen, A. Timmermann, R. Wermers	The Performance of European Equity Mutual Funds
09-02	J. Grammig, A. Schrimpf, M. Schuppli	Long-Horizon Consumption Risk and the Cross-Section of Returns: New Tests and International Evidence
09-01	O. Korn, P. Koziol	The Term Structure of Currency Hedge Ratios

2008

No.	Author(s)	Title
08-12	U. Bonenkamp, C. Homburg, A. Kempf	Fundamental Information in Technical Trading Strategies
08-11	O. Korn	Risk Management with Default-risky Forwards
08-10	J. Grammig, F.J. Peter	International Price Discovery in the Presence of Market Microstructure Effects
08-09	C. M. Kuhnen, A. Niessen	Public Opinion and Executive Compensation
08-08	A. Pütz, S. Ruenzi	Overconfidence among Professional Investors: Evidence from Mutual Fund Managers
08-07	P. Osthoff	What matters to SRI investors?
08-06	A. Betzer, E. Theissen	Sooner Or Later: Delays in Trade Reporting by Corporate Insiders
08-05	P. Linge, E. Theissen	Determinanten der Aktionärspräsenz auf Hauptversammlungen deutscher Aktiengesellschaften
08-04	N. Hautsch, D. Hess, C. Müller	Price Adjustment to News with Uncertain Precision
08-03	D. Hess, H. Huang, A. Niessen	How Do Commodity Futures Respond to Macroeconomic News?
08-02	R. Chakrabarti, W. Megginson, P. Yadav	Corporate Governance in India
08-01	C. Andres, E. Theissen	Setting a Fox to Keep the Geese - Does the Comply-or-Explain Principle Work?

2007

No.	Author(s)	Title
07-16	M. Bär, A. Niessen, S. Ruenzi	The Impact of Work Group Diversity on Performance: Large Sample Evidence from the Mutual Fund Industry
07-15	A. Niessen, S. Ruenzi	Political Connectedness and Firm Performance: Evidence From Germany
07-14	O. Korn	Hedging Price Risk when Payment Dates are Uncertain
07-13	A. Kempf, P. Osthoff	SRI Funds: Nomen est Omen
07-12	J. Grammig, E. Theissen, O. Wuensche	Time and Price Impact of a Trade: A Structural Approach
07-11	V. Agarwal, J. R. Kale	On the Relative Performance of Multi-Strategy and Funds of Hedge Funds
07-10	M. Kasch-Haroutounian, E. Theissen	Competition Between Exchanges: Euronext versus Xetra
07-09	V. Agarwal, N. D. Daniel, N. Y. Naik	Do hedge funds manage their reported returns?
07-08	N. C. Brown, K. D. Wei, R. Wermers	Analyst Recommendations, Mutual Fund Herding, and Overreaction in Stock Prices
07-07	A. Betzer, E. Theissen	Insider Trading and Corporate Governance: The Case of Germany
07-06	V. Agarwal, L. Wang	Transaction Costs and Value Premium
07-05	J. Grammig, A. Schrimpf	Asset Pricing with a Reference Level of Consumption: New Evidence from the Cross-Section of Stock Returns
07-04	V. Agarwal, N.M. Boyson, N.Y. Naik	Hedge Funds for retail investors? An examination of hedged mutual funds
07-03	D. Hess, A. Niessen	The Early News Catches the Attention: On the Relative Price Impact of Similar Economic Indicators
07-02	A. Kempf, S. Ruenzi, T. Thiele	Employment Risk, Compensation Incentives and Managerial Risk Taking - Evidence from the Mutual Fund Industry -
07-01	M. Hagemeister, A. Kempf	CAPM und erwartete Renditen: Eine Untersuchung auf Basis der Erwartung von Marktteilnehmern

2006

No.	Author(s)	Title
06-13	S. Čeljo-Hörhager, A. Niessen	How do Self-fulfilling Prophecies affect Financial Ratings? - An experimental study
06-12	R. Wermers, Y. Wu, J. Zechner	Portfolio Performance, Discount Dynamics, and the Turnover of Closed-End Fund Managers
06-11	U. v. Lilienfeld-Toal, S. Ruenzi	Why Managers Hold Shares of Their Firm: An Empirical Analysis
06-10	A. Kempf, P. Osthoff	The Effect of Socially Responsible Investing on Portfolio Performance
06-09	R. Wermers, T. Yao, J. Zhao	The Investment Value of Mutual Fund Portfolio Disclosure

06-08	M. Hoffmann, B. Kempa	The Poole Analysis in the New Open Economy Macroeconomic Framework
06-07	K. Drachter, A. Kempf, M. Wagner	Decision Processes in German Mutual Fund Companies: Evidence from a Telephone Survey
06-06	J.P. Krahnen, F.A. Schmid, E. Theissen	Investment Performance and Market Share: A Study of the German Mutual Fund Industry
06-05	S. Ber, S. Ruenzi	On the Usability of Synthetic Measures of Mutual Fund Net-Flows
06-04	A. Kempf, D. Mayston	Liquidity Commonality Beyond Best Prices
06-03	O. Korn, C. Koziol	Bond Portfolio Optimization: A Risk-Return Approach
06-02	O. Scaillet, L. Barras, R. Wermers	False Discoveries in Mutual Fund Performance: Measuring Luck in Estimated Alphas
06-01	A. Niessen, S. Ruenzi	Sex Matters: Gender Differences in a Professional Setting

2005

No.	Author(s)	Title
05-16	E. Theissen	An Analysis of Private Investors´ Stock Market Return Forecasts
05-15	T. Foucault, S. Moinas, E. Theissen	Does Anonymity Matter in Electronic Limit Order Markets
05-14	R. Kosowski, A. Timmermann, R. Wermers, H. White	Can Mutual Fund „Stars“ Really Pick Stocks? New Evidence from a Bootstrap Analysis
05-13	D. Avramov, R. Wermers	Investing in Mutual Funds when Returns are Predictable
05-12	K. Griese, A. Kempf	Liquiditätsdynamik am deutschen Aktienmarkt
05-11	S. Ber, A. Kempf, S. Ruenzi	Determinanten der Mittelzuflüsse bei deutschen Aktienfonds
05-10	M. Bär, A. Kempf, S. Ruenzi	Is a Team Different From the Sum of Its Parts? Evidence from Mutual Fund Managers
05-09	M. Hoffmann	Saving, Investment and the Net Foreign Asset Position
05-08	S. Ruenzi	Mutual Fund Growth in Standard and Specialist Market Segments
05-07	A. Kempf, S. Ruenzi	Status Quo Bias and the Number of Alternatives - An Empirical Illustration from the Mutual Fund Industry –
05-06	J. Grammig, E. Theissen	Is Best Really Better? Internalization of Orders in an Open Limit Order Book
05-05	H. Beltran, J. Grammig, A.J. Menkveld	Understanding the Limit Order Book: Conditioning on Trade Informativeness
05-04	M. Hoffmann	Compensating Wages under different Exchange rate Regimes
05-03	M. Hoffmann	Fixed versus Flexible Exchange Rates: Evidence from Developing Countries
05-02	A. Kempf, C. Memmel	On the Estimation of the Global Minimum Variance Portfolio
05-01	S. Frey, J. Grammig	Liquidity supply and adverse selection in a pure limit order book market

2004

No.	Author(s)	Title
04-10	N. Hautsch, D. Hess	Bayesian Learning in Financial Markets – Testing for the Relevance of Information Precision in Price Discovery
04-09	A. Kempf, K. Kreuzberg	Portfolio Disclosure, Portfolio Selection and Mutual Fund Performance Evaluation
04-08	N.F. Carline, S.C. Linn, P.K. Yadav	Operating performance changes associated with corporate mergers and the role of corporate governance
04-07	J.J. Merrick, Jr., N.Y. Naik, P.K. Yadav	Strategic Trading Behavior and Price Distortion in a Manipulated Market: Anatomy of a Squeeze
04-06	N.Y. Naik, P.K. Yadav	Trading Costs of Public Investors with Obligatory and Voluntary Market-Making: Evidence from Market Reforms
04-05	A. Kempf, S. Ruenzi	Family Matters: Rankings Within Fund Families and Fund Inflows
04-04	V. Agarwal, N.D. Daniel, N.Y. Naik	Role of Managerial Incentives and Discretion in Hedge Fund Performance
04-03	V. Agarwal, W.H. Fung, J.C. Loon, N.Y. Naik	Risk and Return in Convertible Arbitrage: Evidence from the Convertible Bond Market
04-02	A. Kempf, S. Ruenzi	Tournaments in Mutual Fund Families
04-01	I. Chowdhury, M. Hoffmann, A. Schabert	Inflation Dynamics and the Cost Channel of Monetary Transmission

centre for financial research
cfr/university of cologne
Albertus-Magnus-Platz
D-50923 cologne
fon +49(0)221-470-6995
fax +49(0)221-470-3992
kempf@cfr-cologne.de
www.cfr-cologne.de