Do the Fama and French Factors Proxy for State Variables that Predict Macroeconomic Growth in the Eurozone?*

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Abstract

Fama and French, amongst others, provide international evidence that a large percentage of the cross-sectional variation in average equity returns can be explained by the market factor as well as firm size and book-to-market characteristics. Carhart suggests momentum as a fourth factor for explaining equity returns. Under the assumption that European markets are integrated, we test whether these four factors contain explanatory power across the Eurozone and for specific industries in this region; i.e., we construct the four risk factors for a region-wide model as well as for specific industries. Our findings suggest that industry specific four factor models are more suitable to price assets in the Eurozone than a pan-European four factor model. Furthermore, following Liew and Vassalou, we examine whether our constructed risk factors contain explanatory power with respect to future GDP growth in the Eurozone. We document that a region-wide size effect contains robust information regarding future real economic activity. Besides, the explanatory power of firm size holds especially for the retail/wholesale sector as well as durable industries. The return based anomalies book-to-market and momentum do not have the same predictive power. Our results are in line with an ICAPM explanation for the empirical success of the Fama and French factors, even though they have often been criticized to lack economic rationale.

Keywords: Asset pricing; Fama-French factors; industry factors; European integration; euro area stock market; GDP growth; diversification

EFM Classification Codes: 310, 330, 630

1 Introduction

Do the Fama and French factors (Fama and French, 1992, 1993) proxy for state variables that predict macroeconomic growth in the Eurozone? Based on the existing literature and past empirical findings an answer is not yet identifiable. The stated problem is, however, threefold.

First, analyzing whether the Fama and French factors may serve as leading indicators for future macroeconomic growth begs the question whether there exist a relationship between equity returns and future real economic activity in the first place. In case the latter holds, a decomposition of equity returns into a size effect and book-to-market effect as proposed by Fama and French may enhance the explanatory power with respect to future economic development. So far only one study by Liew and Vassalou (2000) has provided empirical evidence that size and book-to-market may serve as attributes that predict economic growth. This paper intends to add further to this discussion considering for the first time a monetary union rather than individual countries.

Second, albeit the vast success of the Fama and French model and its predominant role in empirical finance, a fair amount of academic debate has emerged over the economic rationale of using size and book-to-market in pricing assets. To date, there is still no clear consensus among economists and financial scholars on whether these two firm attributes may serve as suitable state variables in the context of Merton's (1973) Intertemporal Capital Asset Pricing Model (ICAPM). A few studies have already provided some tentative explanations of the economic rationale for using size and book-to-market when pricing assets. This study intends to add to this discussion.

Third, although the cross-sectional evidence reported by Fama and French (1992, 1993, 1995, 1996, 1998), amongst others, has had a tremendous impact on the area of asset pricing, the empirical results so far have only been obtained for individual countries. Hence, the findings of Fama and French and other scholars may be biased with respect to the nations for which the analyses have been conducted. Whether size and book-to-market may, however, be used to price assets in a financially integrated region, such as the Eurozone, has yet to be answered, both theoretically and empirically. This research means to fill this gap.

However, any empirical results for a size and book-to-market effect in the common Eurozone market are conditioned on the degree of stock market integration. Although the general globalization has facilitated short-term interlinkages among financial markets and reduced previous institutional constraints, these short-run linkages should play a minor role in explaining long-term financial market integration, and consequently equity returns. In the long-run, the interrelation among financial markets in the Eurozone should primarily be attributed to the economic convergence of the member states of the European Economic and Monetary Union (EMU). This implies that if economic harmonization in the EMU is related to long-run equilibrium relations among equity returns in the Eurozone, then a potential asset pricing model needs to have a stochastic discount factor that contains proxies for innovations in pan-European state variables which may successfully explain equity returns in the EMU. In the context of the Fama and French model, this triggers the question whether book-to-market and size proxy for exactly these factors. As such, this paper may be be seen as a further response to the criticism of Fama (1998) and Cochrane (2005) who remark that the ICAPM should not serve as a "fishing license" for choosing factors that have high explanatory power but intrinsically lack the ability to forecast future investment opportunities.

Besides, finding an answer on whether size and book to market may contain explanatory power with respect to future macroeconomic growth and providing further evidence on the degree of European financial market integration may potentially benefit investors, policy-makers, and researchers in the field of international finance. For instance, if stock markets serve as proxies for future economic growth, output, wealth, and hence consumption, then European policy-makers should aim at achieving price stability within the stock markets of the Eurozone. Contingent stock market reactions of possible changes in EMU policies, may provide European policy-makers with immediate and fruitful feedback. This implies that economic convergences and stability amongst EMU member states can be achieved and interpreted by the degree of interrelation and integration of European stock markets.

In order to test the predicative relation of a size and book-to-market effect with respect to macroeconomic growth in the Eurozone, we follow up on the methodology employed by Liew and Vassalou (2000). Given the findings of Carhart (1997) that momentum also contains power in explaining equity returns, we extend our analyses by this attribute as well. This is also in line with Liew and Vassalou (2000), who use multiple least square regressions with future growth in the gross domestic product (GDP) as dependent variable and *SMB*, *HML*, as well as *WML* as explanatory variables. Yet, we extend Liew and Vassalou's methodology given the recent empirical findings on the increasing explanatory power of industry effects relative to country characteristics in pricing equity in the Eurozone as a result of the economic convergence among EMU member states. Besides, considering industry characteristics is highly important under the consideration that some industries are more sensitive to business cycle movements than others. In particular, we test not only the link of the three risk factors to future GDP growth using a general euro area portfolio, but also consider industry (rather than country) portfolios. To separate the total risk of the market factor, *SMB*, *HML*, and *WML* into (i) an industry specific and (ii) a remaining component, we follow the methodology developed by Griffin (2002) and Moerman (2005). Additionally, in order to determine to what extent our results may be biased with respect to the state of nature of the economy, we also compute the returns of the trading strategies during good and bad state of the business cycle.

The remainder of the paper is structured as follows. Section 2 presents a brief review of related literature. Section 3 introduces the research methods of this paper. Section 4 depicts the data set and construction of the portfolio that serve as proxies for a size and book-to-market effect. Section 5 provides a discussion of our analyses. We conclude in Section 6 with a summary of our findings and suggestions for future research.

2 Literature Review

Empirical results suggest that there exist a predictive relationship between stock market returns and real economic activity. For example, Fischer and Merton (1984) as well as Aylward and Glen (2000) document international evidence that aggregate market returns can be used as leading indicators of future economic growth. Fama (1981, 1990), Geske and Roll (1983), Barro (1990), and Schwert (1990) report that US stock returns are positively related to future macroeconomic growth. Mullins and Wadhwani (1989) find a similar relation pattern for Germany and the United Kingdom. These findings are corroborated by Wahlroos and Berglund (1986) and Wasserfallen (1989, 1990) who identify a positive relation between market returns and future real economic activity for a variety of European countries. Binswanger (2000a,b, 2004) also shows that a substantial fraction of fluctuations in macroeconomic growth can be explained by lagged aggregate stock returns in industrialized countries.

Another line of research has focused on the decomposition of asset returns. Albeit the unconditional capital asset pricing model (CAPM) (Sharpe, 1964; Lintner, 1965; Treynor, 1965) is up to now perhaps the most widely used model in asset pricing, it lacks power in explaining the cross-sectional variation of asset returns. Besides, the CAPM is based on a strong set of assumptions. These drawbacks have triggered scholars to derive more advanced asset pricing models. For instance, Merton (1973) extends the CAPM by state variables that aim at forecasting changes in the investment opportunity set of agents. Ross (1976), on the other hand, proposes an Arbitrage Pricing Theory (APT) model. This relative asset pricing model is based on the law of one price and considers a factor structure for the return generating process. A variety of scholars have, however, criticized the APT for being based on data rather than economic theory (see Black, 1995; Dhrymes et al., 1984; Connor and Korajczyk, 1988).[1]

Among the enormous number of asset pricing models proposed, the cross-sectional evidence reported by Fama and French (1992, 1993, 1995, 1996, 1998) has had a tremendous impact on the area of asset pricing. Fama and French suggest that their three-factor model (3FM) explains a large percentage of the cross-sectional variation in average returns of portfolios that are sorted by book-to-market and size. The three factors that Fama and French propose are (1) the risk premium of the market portfolio, (2) the return on a portfolio that is long on small stocks and short on big stocks (*SMB*, small minus big), and (3) the return on a portfolio that is long in high-book-to-market stocks and short in low-book-to-market stocks (*HML*, high minus low). Carhart (1997) extends the 3FM incorporating as a fourth factor the return on a portfolio that is long in past winner stocks and short on past loser stocks (*WML*, winner minus loser stocks).

Concatenating the empirical evidences that show that there exist a relation between equity returns and future real economic activity with the apparent strong explanatory power of the Fama and French (1993) factors in explaining equity returns, begs the question whether size and book-to-market contain explanatory power with respect to future macroeconomic

[1] A brief history of modern asset pricing literature is presented by Dimson and Mussavian (1999). Campbell et al. (1997), and Cochrane (2005) provides a thorough presentation of the modern theory of asset pricing.

growth as well. It is generally acknowledged that accounting ratios, such as the book-to-market ratio, are supposed to convey growth expectations. In particular, they represent scaled prices with respect to the future. Although studies by Campbell et al. (1997) and Cochrane (1999) prove that the propositions of Fama and French are very hard to rationalize, Liew and Vassalou (2000) link value and small-firm returns to macroeconomic events.[2] They document that *HML* and *SMB* help to forecast future rates of economic growth in various countries as proxied by growth in GDP.[3]

Albeit Liew and Vassalou (2000) conduct their study for various countries, they do not provide any indication on whether their findings may hold for a monetary union, such as the Eurozone, as well. In other words, the findings of Liew and Vassalou may be biased with respect to the countries for which the analyses have been conducted. Besides, they do not provide any indication to what extent the returns on *HML* and *SMB* may be due to industry specifications captured by the creation of the portfolios that act as their proxies for a size and book-to-market effect. Although, past studies have remarked that industry portfolios are difficult to price using the conventional CAPM or the Fama and French three factor model (Fama and French, 1997; Moerman, 2004; Van Vliet and Post, 2004), the use of such portfolios, may be considered highly important under the consideration that some industries are more sensitive to business cycle movements than others (Berman and Pfleeger, 1997; Hornstein, 2000; Gourio, 2006). For example, industries such as retail and durables consumer goods may be considered to be more sensitive to fluctuations to real economic activities than industries such as utilities, oil, telecommunication, and gas.

Besides, taking industry characterizations into account may be especially of interest when considering a pan-European market. First of all, GDP growth in the Eurozone is to a large percentage driven by the two biggest economies in this area, namely Germany and France. Thence, the use of a common area model or country factor models would be strongly biased with respect to the economic activities in these two countries. Secondly, recent findings suggest that industry characteristics have become more important than country factors in explaining equity returns in the Eurozone (Urias et al., 1998; Baca et al., 2000; Cavaglia

[2] Value firms are considered companies that have high-book-to-market rations; on the other hand, growth firms are companies with low book-to-market ratios

[3] Other studies by Fama and French (1996); Heaton and Lucas (2000); Liew and Vassalou (2000); Lettau and Ludvigson (2001); Perez-Quiros and Timmermann (2000), and Petkova (2006), amongst others, aim to provide macroeconomic explanations behind the Fama and French factors as well.

et al., 2000; Diermeier and Solnik, 2001; Cavaglia and Moroz, 2002; Brooks and Catao, 2000; L'Her et al., 2002; Wang et al., 2003; Ferreira and Gama, 2005; Flavin, 2004; Isakov and Sonney, 2004; Campa and Fernandes, 2006; Moerman, 2008; Taing and Worthington, 2005).

The rationale behind the increasing importance of industry considerations relative to country attributes may lie within the progression of the European Monetary Union (EMU) and especially the advent of the euro in 1999. The harmonization of monetary, fiscal, and political policies has resulted in a breakup of country borders, while industry barriers have mainly remained stable. Danthine et al. (2000), for instance, remark that the economic convergence has provoked a surge in investments and cross-border trading due to a reduction of implicit and explicit transaction costs and an increased price transparency. This suggests that over the last decade, European investors have become stimulated to hold non-domestic European assets that used to be too costly and risky prior to the arrival of the euro.[4]

To thoroughly determine the factors that persistently drive equity returns in the Eurozone requires the examination of the long-run linkage between economic convergence among EMU member states and the integration of financial markets within the Eurozone. Abbot and Chow (1993), Serletis and King (1997), Prati and Schinasi (1997), and Worthington et al. (2003), amongst others, document that economic integration among EMU member states is a crucial explanation for long-run stock market integration within the European Union. Thus, if the integration of financial markets in the Eurozone is due to the economic convergence of the EMU member states, then, in the long run, any equity prices should be affected by economic variables that reflect economic activities undertaken by the EMU. These economic variables, in turn, are exactly those proxied for by potential state variables in the ICAPM.

The implication of this relationship is that the Fama and French factors may proxy for state variables within the context of the ICAPM, if there is empirical evidence that size and book-to-market are attributes that contain explanatory power in pricing assets in the Eurozone. This needs to hold since economic theory suggests that stock prices are nothing else than the discounted value of expected future dividends. However, on the reverse, if there was no long-run relationship between the financial markets of the Eurozone and the economic convergence of the EMU, then the Fama and French model may rather be considered an asset pricing model in the context of the Arbitrage Pricing Theory (APT) Ross (1976). However,

[4] Eijffinger and Lemmen (1995); Guiso et al. (2004); Adjaoute and Danthine (2002); Baele et al. (2004), and Hardouvelis et al. (2006) provide detailed discussions on regulatory changes.

no previous study has performed necessary tests to validate this statement.

3 Research Methodology

In order to test the relation between the return on the various trading strategies, i.e., the different risk factors *SMB*, *HML*, and *WML* and macroeconomic growth in the Eurozone, we use multiple ordinary least square (OLS) regressions with future growth in *GDP* as dependent variable. The approach is analogous to the methodology employed by Liew and Vassalou (2000). Yet, given the recent discussions and findings on the increasing explanatory power of industry effects relative to country characteristics in pricing assets, we extend the empirical technique by Liew and Vassalou (2000) by testing not only the link of the three risk factors to future GDP growth using a general euro area portfolio, but also considering industry corrected portfolios.

Liew and Vassalou's (1997) model finds its roots in the Carhart (1997) four factor model, which is simply an extension of the Fama and French (1993) model by a momentum effect.[5] However, in order to decompose the aggregate returns of the excess market return, i.e., the market risk factor *MRF*, and the returns on the trading strategies *HML*, *SMB*, and *WML*, presented in Carhart (1997) into industry components, we follow Griffin (2002) and Moerman (2004) and divide the total industry risk of each factor into two weighted components, i.e., (1) a risk factor for a specific industry and (2) a risk factor for the remaining industries. It follows,

$$MRF_t = x_{It-1} IMRF_t + x_{Ot-1} OMRF_t \tag{1}$$

where $IMRF_t$ and $OMRF_t$ are respectively the industry specific excess market return and the excess market return of the remaining industries at time t. The weight x_{It-1} equals the market capitalization of the specific industry in the previous period over the totally aggregated industry market capitalization in the previous period; x_{Ot-1} refers to the relative weight for all other industries in comparison to the total industry market capitalization. By definition $x_{It-1}$and x_{Ot-1} sum up to 1 (or 100%). The other three risk factors (i.e.,

[5] The Carhart (1997) four factor model is defined as follows:

$$E(R_{it}) - R_{ft} = \beta_{it}[E(R_{mt}) - R_{ft}] + h_{it}E(HML_t) + s_{it}E(SMB_t) + w_{it}E(WML_t)$$

where $E(R_i)$ and $E(R_m)$ are the expect return on an asset (or portfolio) i and the market m, respectively. R_f denotes the risk-free rate and $[E(R_m) - R_f]$, $E(HML)$, $E(SMB)$, as well as $E(WML)$ are expected premiums.

SMB, HML and *WML*) are defined analogously. With the help of equation 1, we are able to disaggregate the Carhart (1997) four factor model into an eight factor (8FM) international industry model as follows

$$\begin{aligned} R_{it} - R_{ft} &= \alpha_{it} + \beta_{Iit}(x_{It-1}IMRF_t) + h_{Iit}(x_{It-1}IHML_t) \\ &+ s_{Iit}(x_{It-1}ISMB_t) + w_{Iit}(x_{It-1}IWML_t) \\ &+ \beta_{Oit}(x_{Ot-1}OMRF_t) + h_{Oit}(x_{Ot-1}OHML_t) \\ &+ s_{Oit}(x_{Ot-1}OSMB_t) + w_{Oit}(x_{Ot-1}OWML_t + \epsilon_{it} \end{aligned} \quad (2)$$

where the intercept α_{it} is the pricing error of the equation, ϵ_{it} reveals the error term, and $IMRF_t$, $IHML_t$,$ISMB_t$, and $IWML_t$ are the corresponding factors for a specific industry and $OMRF_t$, $OHML_t$, $OSMB_t$, and $OWML_t$ are the respective risk factors for the other industries. The factor loadings β_i, h_i, s_i, and w_i are the slopes in the stochastic regression. This parameterization approach allows for the identification of the factors that have the most influential impact on the cross-section of returns. Assuming that the other industry factors (i.e., $OMRF_t$, $OHML_t$ $OSMB_t$, and $OWML_t$) are irrelevant, the international industry model can be reduced to the specific four factor (4FM) industry model, which reads as follows

$$R_{it} - R_{ft} = \alpha_{it} + \beta_{it}IMRF_t + h_{it}IHML_t + s_{it}ISMB_t + w_{it}IWML_t + \epsilon_{it}. \quad (3)$$

In accordance with Griffin (2002) and Moerman (2004), we examine the performance of these different asset pricing models (i.e., prior to relating the risk factors to macroeconomic growth) considering (1) the adjusted R^2s of the different regressions and (2) the pricing error of the regression, α_{it}.

3.1 The Relation Between the Risk Factors and the Macroeconomy

3.1.1 The One Factor Model

To test the relation between past holding period returns on the *HML*, *SMB*, and *WML* trading strategies (proxying for a book-to-market, size, and momentum effect, respectively) and future growth in GDP in the euro area, we employ the same methodology as Liew and

Vassalou (2000). All regressions employ quarterly data and take on the form

$$GDP_{growth(t,t+4)} = \alpha + \beta FactorRet_{t-4,t} + \epsilon_{t,t+4} \quad (4)$$

where GDP_{growth} is the continuously compounded growth rate of the euro area one period hence. *FactorRet* represents either *MRF, HML, SMB,* or *WML* and $\epsilon_{(t,t+4)}$ is the residual term of the regression. The four quarter (i.e., one year) time lag between GDP_{growth} and the independent variables is required in order to test for the prediction of real activity based on current (or previous) risk factors. Presuming that the parameterization approach results in the irrelevance of the other industry factors and thus the industry model [i.e., equation 2] can be reduced to the specific industry four factor model [i.e., equation 3], *FacorRet* becomes either *IMRF*, *IHML*, *ISMB*, or *IWML*, which in turn may reduce the pricing error of the regression, and may result in higher explanatory power of the model.

Based on the findings of Liew and Vassalou (2000) and Moerman (2004) we expect that the performances of *MRF*, *HML*, *SMB*, and *WML* are positively related to future economic growth. Additionally, based on the superiority of the specific industry model, we assume that the positive relation between economic growth and *IMRF*, *IHML*, *ISMB*, and *IWML* is even stronger. In general, a positive relation exists, if high returns in *HML*, *SMB*, and *WML* (or *IHML*, *ISMB*, and *IWML*, respectively) are associated with a GDP growth in the euro area. More specifically, high book-to-market, small capitalization, and past winner stocks are better able to thrive than low book-to-market, big capitalization and past loser stocks in times of economic booms.

As GDP growth rates are observed at quarterly frequencies, successive annual growth rates have three overlapping quarters. This causes autocorrelation among the residuals of equation 4. We correct for the presence of autocorrelation and heteroscedasticity of the error terms using the Newey and West (1987) estimator, setting the lags equal to three.

3.1.2 Multifactor Regressions Including the Market Factor

Employing multiple regressions allows for the comparison of the various additional risk factors relative to the excess market return. In a first step, and again analogous to Liew and Vassalou (2000), we use a bivariate regression that simultaneously includes the market (or industry) factor, i.e., either *MRF* (as proxy for the general euro area excess market return) or *IMRF* (for the specific industry portfolios), and the return on one trading strategy, i.e., *FactorRet*. It follows for the general euro area market model

$$GDP_{growth(t,t+4)} = \alpha + \beta MRF_{t-4,t} + \gamma FactorRet_{t-4,t} + \epsilon_{t,t+4} \tag{5}$$

or for the industry specific model where *FactorRet* is either *HML, SMB*, or *WML*. For the industry specific model it follows correspondingly

$$GDP_{growth(t,t+4)} = \alpha + \beta IMRF_{t-4,t} + \gamma FactorRet_{t-4,t} + \epsilon_{t,t+4} \tag{6}$$

where *FactorRet* is this time either *IHML*, *ISMB*, and *IWML*. Again, even by incorporating the (industry) market excess return as a permanent factor, we expect that the other coefficients remain positive, implying positive relationship with economic growth. In addition, the adjusted R^2s are expected to be higher than those of the univariate analysis (Liew and Vassalou, 2000). If the slope coefficient γ turns out to be non-zero at a significant level, the additional risk factors contain information about the future state of the macroeconomy in the euro area that cannot be fully explained by the (industry) market factor.

Using a multi-factor regression, in a next step, may provide further insights about the risk factor that has the strongest explanatory power, given the joint slope coefficients of the risk factors. In particular, the general euro market model becomes

$$\begin{aligned} GDP_{growth(t,t+4)} &= \alpha + \beta MRF_{t-4,t} + hHML_{t-4,t}. \\ &+ sSMB_{t-4,t} + wWML_{t-4,t} + \epsilon_{t,t+4} \end{aligned} \tag{7}$$

The specific industry model takes the form

$$\begin{aligned} GDP_{growth(t,t+4)} &= \alpha + \beta MRF_{t-4,t} + hHML_{t-4,t} \\ &+ sSMB_{t-4,t} + wWML_{t-4,t} + \epsilon_{t,t+4}. \end{aligned} \tag{8}$$

The higher the unconditional factor loading per risk factor h, s, and w is, the higher is the explanatory power of this factor with respect to forecasting the growth of the macroeconomy.

4 Data & Descriptive Statistics

4.1 Sample Period and Data Sources

We focus on ten industries in the euro area over the time period December 1995 through December 2003. The industry portfolios are classified analogous to Fama and French's 10 industry portfolios, i.e., based on each firm's primary SIC code (cf. Table I in the Appendix).[6] As the euro area we consider the twelve countries of the Eurozone as of 2003, i.e., Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. For each stock we obtain the quarterly stock return, the book-to-market ratio (as of December each year) and market capitalization per quarter. We use the world market index proxied by the Morgan Stanley Capital International Index (MSCI) as market factor. The return on a one-month ecu-market deposit (quoted in London) serves as a risk-free asset. In order to make the variables comparable, they need to be converted into a common currency. Therefore, prior to the introduction of the euro in 1999, all asset returns are converted into Deutschmark (DM). As of January 1, 1999, the risk factors are euro-denominated. All data are primarily ascertained via DataStream and Thomson One. *GDP* growth rates per quarter, per semi-annum, and per annum are obtained from the Organization for Economic Co-Operation and Development (OECD) database.[7]

A disadvantage of using European data as opposed to US data is the amount of data available per stock. Table II in the Appendix shows the number of stocks per portfolio per quarter. The number of stocks may vary due to new stock issues, mergers, takeovers, and bankruptcies, or simply due to a lack of data availability. Table II also reveals that there are significant differences in the number of stocks per industry.[8] The number of stocks differs between eight stocks in the telecom industry in the first quarter of 1996 and 621 stocks in the shops (i.e., wholesale and retail) sector between the fourth quarter of 2001 and the third quarter of 2002. Given this lack of data for some industries, we only focus our investigation on five industries and the general euro area market model, being comprised of

[6] cf. K. R. French's website, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html, last visited May 2007

[7] *GDP* growth refers to the growth rate of the twelve countries of the Eurozone as of 2003.

[8] As countries like Germany and France, which are the largest countries in the Eurozone, have the highest proportion of stocks in our data sample one could perhaps argue that some industries are to some extent country specific, since they comprise only a few stocks of smaller countries (such as Greece and Ireland) participating in the Eurozone.

all stocks in the sample. The sectors examined are *non durables consumer goods* (01 Consumers NonDurables), *durables consumer goods* (02 Consumers Durables), *manufacturing* (05 Manufacturing), *wholesale and retail* (08 Shops), and *finance* (09 Money).

Based on the previous discussion on the degree of market integration in the euro area, the selection of the sample period depicts a dilemma. The chosen time frame from December 1995 through December 2003 represents a somewhat short sample period. However, the longer the time period, the higher the probability that an industry might be fairly underrepresented relative to other industries as less data becomes available. As a consequence, the longer the time period, the lower becomes the number of stocks per industry, and as such, the lower the explanatory power and reliability of the data set. In addition, as the European Monetary Union was just officially launched on January 1, 1999, implementing data way prior to this date may seem inappropriate under market integration considerations. In other words, there exists a trade-off between the availability of data versus the compliance with the null hypothesis of integrated markets.

4.2 Portfolio Construction

For the construction of the (industry) portfolios, we follow Liew and Vassalou (2000) rather than Fama and French (1993) or Carhart (1997). Liew and Vassalou (2000) approach differs to some extent from Fama and French's classification. The former employ a smaller sample size and use, hence, a three sequential sort rather than two independent classifications that created the *HML* and *SMB* trading strategies of Fama and French. The construction considers all the three anomalies (i.e., *SMB*, *HML*, and *WML*) simultaneously. We only consider stocks that have a positive book-to-market ratio at any point in time. In order to calculate the momentum of a stock, we only use stocks for which we are able to derive the market capitalization of at least twelve months in a row. As previously mentioned, we incorporate only a twelve month momentum strategy.[9] The momentum strategy is implemented by deriving the mean of past year's returns, excluding however the most recent month.[10] Winners are defined as the top third of the total stocks (or the top third per industry) with the highest

[9] Due to a lack of past data, the momentums of Q4 1995 and Q1 1996 are based on the last eight months and eleven month, respectively, excluding however the most recent month.

[10] Liew and Vassalou (2000) suggest to exclude the most recent month in order to eliminate problems that are associated with microstructure issues such as the bid-ask spread.

last year's average return. Correspondingly, losers comprise the bottom third of the entire sample (or the industry, respectively). The medium stocks are the remaining (middle) third of the sample.

To build the portfolios, we sort all stocks by their book-to-market ratio in December of year t-1, and classify them into three different groups, i.e., high, medium, and low book-to-market ratios. We then take each of these portfolios and re-sort all stocks according to their market capitalization (i.e., small, medium, and big market capitalization). Thereby, three portfolios within each book-to-market group are created. This leads to nine portfolios. In a next step, those nine portfolios are again subdivided based on each stock's momentum (i.e., losers, middle group, and winners). Eventually, we obtain 27 portfolios, which are numbered *P1* through *P27*.[11] Table 1 provides an overview on the portfolio construction.

Table 1: Portfolio Construction

This table shows the portfolio construction procedure which is in accordance with Liew and Vassalou (2000).

Book-to-market	**Market capitalization**	**Past year's returns (excl. last month)**	**Portfolio**
High	Small	Losers	P1
		Medium	P2
		Winners	P3
	Medium	Losers	P4
		Medium	P5
		Winners	P6
	Big	Losers	P7
		Medium	P8
		Winners	P9
Medium	Small	Losers	P10
		Medium	P11
		Winners	P12
	Medium	Losers	P13
		Medium	P14
		Winners	P15
	Big	Losers	P16
		Medium	P17
		Winners	P18
Low	Small	Losers	P19
		Medium	P20
		Winners	P21
	Medium	Losers	P22
		Medium	P23
		Winners	P24
	Big	Losers	P25
		Medium	P26
		Winners	P27

[11] Since we create 27 portfolios (per industry), the number of the securities per portfolio is divisible by 27. If one industry has more stocks than a multiple of 27, then we randomly eliminate stocks until we obtain a value that is a multiple of 27.

These 27 portfolios represent the ingredients for the three risk factors, i.e., *HML*, *SMB*, and *WML*. This is in line with the existing literature. In particular, the factors are computed as follows:

$$HML = 1/9 * \begin{bmatrix} (P1 - P19) + (P2 - P20) + (P3 - P21) + (P4 - P22) + (P5 - P23) \\ + (P6 - P24) + (P7 - P25) + (P8 - P26) + (P9 - P27) \end{bmatrix}$$

$$SMB = 1/9 * \begin{bmatrix} (P1 - P7) + (P2 - P8) + (P3 - P9) + (P10 - P16) + (P11 - P17) \\ + (P12 - P18) + (P19 - P25) + (P20 - P26) + (P21 - P27) \end{bmatrix}$$

$$WML = 1/9 * \begin{bmatrix} (P3 - P1) + (P6 - P4) + (P9 - P7) + (P12 - P10) + (P15 - P13) \\ + (P18 - P16) + (P21 - P19) + (P24 - P22) + (P27 - P25) \end{bmatrix}$$

In summary, *HML* describes the return on a portfolio that is long on high book-to-market firms and short on low book-to-market firms; simultaneously controlling for *SMB* and *WML*, *HML* becomes size and momentum neutral. Accordingly, *SMB* and *WML* are corrected for a book-to-market and momentum or size effect.

The individual risk factor returns are derived for quarterly, semi-annual and annual rebalancing frequencies, with December end book-to-market values, June end market capitalization data, and past 12 months of returns prior to July for the annual rebalancing. Correspondingly, the rebalancing for semi-annual portfolios is made at the end of June and the end of December. For the quarterly rebalancing, we adjust the portfolios at the end of March, June, September, and December. Unlike the data for market capitalization and momentum, which are available on a quarterly basis, we use book-to-market values as of December. The reasons are twofold. Firstly, for European stocks, book-to-market values are barely available more than once a year. Secondly, we ensure that the book-to-market value is available to the public as the portfolios are formed.

4.2.1 Descriptive Characteristics of the ***HML***, ***SMB***, and ***WML*** strategies

Before we proceed with the main test of the paper, i.e., in how far the risk factors *HML*, *SMB*, and *WML* are able to predict macroeconomic growth in the Eurozone, we study the performance of each of these trading strategies for the common euro area model and per industry. Table 2 summarizes the returns of each trading strategy over the time period December 1995 (Q4 1995) through December 2003 (Q4 2003) considering a quarterly, semi-annually, and annually rebalancing of the portfolios.

Our results are in line with those of Fama and French (1998) and Liew and Vassalou (2000) who remark that a value premium is pervasive. For each industry, we find that a *HML* portfolio that is long on high book-to-market stocks and short on low book-to-market stocks yields above average market returns, ranging between a mean return of 12.99 per cent for a quarterly rebalanced finance portfolio and 19.55 per cent for an annually rebalanced portfolio comprised of wholesale and retail stocks. However, we fail to find a clear pattern that more frequently rebalanced portfolios result in higher annual returns of *HML*. Particularly, while a more frequent turnover results in higher returns of *HML* for the total sample, durable consumer goods stocks, and manufacturing stocks, the reverse holds for the other industries investigated.[12]

Unlike Banz (1981), Fama and French (1993), and Liew and Vassalou (2000), we fail to find the existence of a size premium, i.e., the average returns are expected to be consistently higher for small firm portfolios relative to big firm portfolios. In fact, our results corroborate rather the findings of Otten and Bams (2002) who suggest the existence of a growth effect (i.e., big stocks outperform small stocks) in the major European markets. Table 2 shows that all *SMB* portfolios result in negative average returns for all industries and all turnover frequencies. In general, with the exception of the finance sector, the average return becomes worse for higher frequently rebalanced portfolios. This implies that small capitalization stocks perform worse relative to big capitalization stocks the shorter the time period becomes (comparing quarterly and annually rebalanced portfolios only); put differently, the longer the time period, the better the performance of small capitalization stocks relative to big

[12]This holds for comparing the annual returns of quarterly rebalanced portfolios with the annual returns of annually rebalanced portfolios. When considering semi-annually rebalanced portfolios, then there is no clear pattern for a superior rebalancing frequency.

Table 2: Summary of HML, SMB, and WML Performance over Different Rebalancing Horizons (Q4 1995 to Q4 2003)

HML is the return on a portfolio that is long on high book-to-market stocks and short on low book-to-market securities, holding size and momentum characteristics of the portfolio constant. SMB is the return on a portfolio that is long on small capitalization stocks and short on big capitalization securities, holding book-to-market and momentum characteristics of the portfolio constant. WML is the return on a portfolio that is long on the best performinbg stocks of the past year ('winners') and short on the worst performing securities of the previous year ('losers') holding book-to-market and size characteristics of the portfolio constant. All returns and standard deviations are reported annualized.

Industry	**Quarterly Rebalancing**			**Semi-annual Rebalancing**			**Annual Rebalancing**		
	Mean (%)	Median (%)	Std. (%)	Mean (%)	Median (%)	Std. (%)	Mean (%)	Median (%)	Std. (%)
Total Sample									
HML	17.85	11.48	14.00	17.85	14.03	16.11	17.67	11.04	19.95
SMB	-7.48	-13.52	11.96	-6.13	-8.04	12.57	-5.27	-7.70	11.59
WML	22.64	24.42	20.24	17.86	16.28	21.08	8.74	6.36	20.85
01 NoDur									
HML	14.10	4.38	16.11	14.95	9.80	15.08	15.24	10.69	17.93
SMB	-3.27	-5.79	14.57	-3.93	-4.66	14.00	-2.84	-4.14	12.80
WML	13.87	10.67	18.52	11.51	6.38	20.38	3.99	5.56	19.17
02 Dur									
HML	14.50	9.71	12.55	12.65	7.95	13.63	13.67	9.41	16.31
SMB	-9.99	-2.85	19.36	-7.72	-4.65	20.20	-6.60	-12.55	19.45
WML	21.87	21.65	18.16	18.06	14.91	17.56	11.54	8.14	18.10
05 Manuf									
HML	18.46	7.93	16.28	17.37	12.98	18.34	16.79	10.23	20.44
SMB	-6.62	-11.58	13.75	-6.25	-6.13	11.61	-4.00	-3.51	8.90
WML	19.11	21.84	19.55	14.20	16.81	19.67	7.35	6.33	18.31
08 Shops									
HML	18.17	13.09	20.72	19.07	14.84	23.51	19.55	15.24	29.29
SMB	-3.44	-3.92	13.10	-2.33	-5.18	12.02	-0.73	-3.69	11.88
WML	28.38	31.02	21.08	24.67	21.12	23.83	14.54	12.04	25.60
09 Money									
HML	12.99	7.88	11.60	13.11	13.07	13.51	13.77	10.35	17.05
SMB	-8.15	-16.03	14.67	-7.76	-10.78	15.34	-8.44	-9.26	14.77
WML	20.68	18.96	18.05	18.04	17.71	18.37	11.39	7.04	18.36

capitalization securities. Therefore, provided that one would expect small capitalization stocks to outperform their big capitalization counterparts (Banz, 1981) the size characteristic tends to be persistent over time. Two explanations for the discrepancy of our results and the findings of past studies might be that we use European rather than US stocks and that our sample period is rather short and differs from the periods investigated by past scholars.

Regarding the profitability of a momentum strategy, our findings support the results of Jegadeesh and Titman (1993), Rouwenhorst (1998), and Liew and Vassalou (2000). It appears that past winners outperform past losers in the short term. The results in Table 2 clearly reveal that momentum is very sensitive to the rebalancing frequency. The more often the portfolios are rebalanced, the higher becomes the average return. In other words, returns to *WML* decrease significantly as the turnover interval increases. This holds for all industries investigated. The highest *WML* returns are in the wholesale and retail sector with an average annual return of 28.38 per cent (quarterly rebalanced). The lowest mean return reveals the non durables consumer goods sector with an average annual return of 3.99 per cent (annually rebalanced).

Finally, the returns of *WML* portfolios are significantly higher than the returns for *HML* portfolios for quarterly rebalancing frequencies and for all industries under consideration, except for the non durables consumer goods sector. For the semi-annual frequencies, the returns for *WML* portfolios are higher than those of *HML* portfolios in three out of six cases. In two out of six cases, *HML* portfolios outperform *WML* portfolios. In one case, i.e., in case of the general euro area model, the returns are identical. Regarding annual rebalancing, *HML* portfolios have always higher average returns than *WML* portfolios. Overall, for all trading strategies and throughout all industries the standard deviation of returns remains relatively stable or increases slightly the less frequent the portfolios are rebalanced. This is not necessarily surprising, given that portfolios are less adjusted for risk when rebalanced at less frequencies.

These findings have various implications. Firstly, a momentum strategy appears to result in above average market returns regardless of the industry. Yet, it is not necessarily a very time persistent strategy. The size characteristic tends to be lasting, i.e., the longer the time period, the higher the performance of small capitalization stocks relative to big capitalization firms, irrespective of the sector. We fail to find any persistence pattern for the book-to-market factor. The results indicate that from a practical perspective, the implementation of a *WML* strategy is more expensive than a *SMB* and *HML* strategy, since the portfolios need to be rebalanced more frequently in order to obtain higher returns. Thus higher returns may be consumed by higher transaction costs. Secondly, segmenting the common euro area market into individual industries may allow for obtaining higher returns by just investing in one particular industry. In turn, however, the portfolio of the investor becomes less diversified and hence more risky, reflecting a positive risk return relationship.

4.3 Returns on *HML*, *SMB*, and *WML* at Different States of the Economy

Like Liew and Vassalou (2000) we study the returns on the *HML*, *SMB*, and *WML* trading strategies at different states of the economy. We use quarterly observations and associate next year's annual *GDP* growth with past year's annual return per trading strategy. We sort by growth in *GDP* every quarter. For the different states of the future economy we differentiate between two stages: We define as 'good states' those periods that exhibit the highest 24.24 per cent of future *GDP* growth.[13] We denote 'bad states' those phases with the lowest 24.24 per cent of future *GDP* growth. The findings are depicted in Table 3.

The results indicate that *HML* and *SMB* are positively related to future growth in *GDP*. This is in line with Liew and Vassalou (2000). In both cases, higher returns can generally be associated with higher future growth in the macroeconomy. In case of *HML*, the difference between the returns of the good states and bad states of the economy is positive in all six cases and significant at the 5 per cent significance level in five out of six cases.[14] This may serve as some support for Lettau and Ludvigson (2001) who document that *HML* is sensitive to bad news in bad times. Regarding the returns of the *SMB* portfolios, we find that the difference between the good and bad states is positive in five out of six cases. Four out of those five cases are significant at the 5 per cent significance level. The negative difference of -0.09 per cent between the states in the non durables consumer goods sector may be considered negligible (t-value of -0.03). It is worthy to note especially the relatively big

[13] As our observations include 33 quarters (rather than 32), we cannot use 25 per cent since this would reflect 8.25 states of the economy. 8 states in turn comprise 24.24 per cent.

[14] The t-statistic is computed by dividing the difference between the returns on the 'good states' and 'bad states' by the quotient of the standard deviation of the returns over the square root of the number of observations. More formally: $[R_{GS} - R_{BS]}/\frac{\sigma}{\sqrt{n}}$.

Table 3: The performance of HML, SMB, and WML at 'good states' and 'bad states' of the economy

The results are based on annually rebalanced HML, SMB, and WML portfolios using quarterly observations. HML is the annual return on a portfolio that is long on high book-to-market stocks and short on low book-to-market securities, holding size and momentum characteristics of the portfolio constant. SMB is the annual return on a portfolio that is long on small capitalization stocks and short on big capitalization securities, holding book-to-market and momentum characteristics of the portfolio constant. WML is the annual return on a portfolio that is long on the best performing stocks of the past year ('winners') and short on the worst performing securities of the previous year ('losers') holding book-to-market and size characteristics of the portfolio constant. The macroeconomy is represented by GDP. GDP is calculated as the continously compounded growth rate in the EMU. The GDP is seasonally adjusted. We define as 'good states' of the ecomony those states that exhibit the highest 24.24% of future GDP growth, , and 'bad states' those with the the lowest 24.24% of future GDP growth. We do not use 25% since our observations include 33 quarters. 25% would reflect 8.25 states of the economy, while 8 states represent 24.24%. T-values are computed for the difference between the return in good states and bad states of the economy.

Past year return on factor sorted by future GDP growth: quarterly observations

Industry	**HML**				**SMB**				**WML**			
	Good States (%)	Bad States (%)	Difference (%)	T-values	Good States (%)	Bad States (%)	Difference (%)	T-values	Good States (%)	Bad States (%)	Difference (%)	T-values
Total Sample	23.78	10.50	13.28	2.50	1.01	-6.74	7.75	3.10	-0.40	10.66	-11.06	-2.12
01 NoDur	28.99	11.62	17.37	3.29	-5.33	-5.24	-0.09	-0.03	-0.22	6.72	-6.93	-1.08
02 Dur	20.41	5.27	15.14	3.60	7.26	-22.69	29.95	5.75	4.97	19.68	-14.71	-2.92
05 Manuf	16.92	6.65	10.27	2.02	-0.92	-4.52	3.60	1.88	-0.21	11.62	-11.83	-2.51
08 Shops	34.60	8.56	26.04	3.37	10.22	-3.76	13.99	4.38	14.30	9.04	5.26	0.81
09 Money	13.97	12.71	1.27	0.39	-4.39	-11.14	6.75	2.44	1.07	17.22	-16.15	-3.63

and significant difference in returns for the durables and retail and wholesale sector. These observations may further support the suggestion of Perez-Quiros and Timmermann (2000) that the returns on small firms are more volatile during economic recessions than peaks, given the increased sensitivity of investors towards risk. In other words, small firms operating in these sectors are extremely sensitive to economic swings, due to e.g., liquidity constraints and a lack of diversification.

Contrary, *WML* results in a negative difference between the good and bad states in five out of six cases, of which four are significant at the 5 per cent significance level. The positive difference of 5.26 per cent in the wholesale and retail sector is not necessarily small, but also not statistical significant. Our results are analogous to the findings of Liew and Vassalou (2000), who document a negative difference in eight out of ten cases; yet they fail to find statistical differences for *WML* between the good and bad states of the economy. It appears that there is a negative relationship between the future state of the macroeconomy and a momentum strategy in the euro area. High *WML* portfolio returns precede periods with low future *GDP* growth and vice versa. This may imply that investors do not behave rationally and tend to overreact to good news, i.e., they start investing aggressively in past winner stocks until they realize that the fundamentals of the firm are actually worse than expected, triggering a decrease of the equity price thereafter.

5 Regression Results and Implications

This section provides firtsly a brief discussion on the goodness-of-fit statistics for the individual factor asset pricing models. We thereby determine why annually rebalanced 4 industry factor models may be considered more appropriate in pricing assets in the Eurozone than the classical 4FM presented by Carhart (1997). For our purposes, we denote the latter the general euro area model. In a subsequent step we present our findings for regressing future GDP growth in the Eurozone on the respective industry specific risk factors.

5.1 The Superiority of the Four Factor Asset Pricing Model

In order to determine the asset pricing model that has the highest explanatory power regarding the Eurozone, we examine various goodness-of-fit statistics for the individual pricing models presented in the methodological section of this paper. More precisely we examine

Table 4: Performance Measures of Portfolios (Q4 1995 to Q4 2003)

This table depicts the three performance measures resulting from regressing the book-to-market, size and momentum sorted portfolios of the industries considered. Due to a lack of data no regressions were run for the industries 03 Oil, 04 Chems, 06 Telcm, 07 Utils, and 10 Others. The total sample does yet include data from all industries. The total sample 4FM is the Carthart four factor model for all stocks investigated. The industry models 8FM are eight factor models that seperates specific industry factors from other industry factors. The industry 4FM are specifc four factor industry models. The first three columns show the performance measures for quarterly rebalanced portfolios. The fourth, fifth, and sixth column show the same performance measures for annually rebalanced portfolios. For each model the mean absolute pricing error α, the F-statistic, and the average adjusted R^2 are stated.

	Quarterly Rebalancing			**Annual Rebalancing**		
	Av. $\lvert\alpha\rvert$	F-statistic	Av. R^2	Av. $\lvert\alpha\rvert$	F-statistic	$Av.R^2$
Total Sample 4FM	0.04	28.18	0.77	0.17	79.82	0.91
Industry Models 8FM						
01 NoDur	0.03	81.22	0.95	0.13	67.91	0.94
02 Dur	0.02	65.86	0.94	0.21	110.73	0.96
05 Manuf	0.02	239.65	0.98	0.10	116.88	0.97
08 Shops	0.02	76.15	0.95	0.13	153.78	0.97
09 Money	0.01	101.14	0.96	0.05	202.36	0.98
Industry 4FM						
01 NoDur	0.01	63.27	0.89	0.03	33.11	0.80
02 Dur	0.01	126.65	0.94	0.04	93.89	0.92
05 Manuf	0.02	278.97	0.97	0.10	116.97	0.94
08 Shops	0.01	167.67	0.95	0.10	283.62	0.97
09 Money	0.00	119.61	0.94	0.14	157.52	0.95

whether industry specific 4FM are better able to price assets than the more extended 8FM or the general euro area model. Table 4 depicts the three performance measures under consideration, i.e., the mean absolute pricing errors (Av. $|\alpha|$), the F-statistic, and the explanatory power of the regression, i.e., the adjusted R^2 for both quarterly as well as annually rebalanced portfolios.

Considering all goodness-of-fit measures, the 4FM industry models appear on average to be superior in pricing assets than any 8FM, or, especially, the general euro area model, which obtains the weakest results for all measures. Especially the mean absolute pricing errors (Av. $|\alpha|$) and the F-statistics provide statistical support for preferring the 4FM relative to the 8FM, or the poorer general euro area model. On the other hand, however, the average adjusted R^2 values imply that an industry 8FM appears to be better able to price assets in the Eurozone than an industry 4FM. This suggests that the additional factors have some marginal explanatory power. Nevertheless, given parsimony considerations, the lower mean pricing errors of the industry 4FMs relative to the industry 8FMs, and only marginal differences in the adjusted R^2 values, we conclude that the industry four factor models are more appropriate in explaining the cross-section of industry returns than both their eight factor industry model counterparts as well as the general euro area model. This is in accordance with Moerman (2004).

Moreover, at first glance, a quarterly rebalancing frequency appears to be somewhat superior than an annual rebalancing, especially when considering the mean absolute pricing errors (Av. $|\alpha|$). However, the presented adjusted R^2 values indicate only marginal differences between the rebalancing periods, if any differences at all. Besides, taking the F-statistics into consideration, the question on whether quarterly rebalanced portfolios are to be preferred to annually rebalanced ones cannot straightforwardly be answered, given the mixed tendencies for either of the rebalancing frequencies. In other words, no clear trend can be determined. Usually, one may expect that quarterly rebalanced portfolios show a superior performance because a more frequent turnover implies the use of more recent data. When portfolios are rebalanced more frequently the not entirely lasting explanatory power of the risk factors *HML*, *SMB*, and *WML* may be grasped more effectively.[15]

Nonetheless, taking practical considerations that allow for transaction costs into account, any potential gains associated with a high frequency strategy may be consumed by the costs associated with rebuilding the portfolios. Besides, as the book-to-market value is only available once per year, i.e., usually as of December 31, for European stocks, it appears more coherent to consider primarily annual rebalanced portfolios. For intra-annual rebalancing frequencies the *HML* factor is inconsistent, because it is always based on the book-to-market value at the end of the year, given the lack of data availability. More importantly, empirical evidence has shown that the degree of correlation between real stock returns and production growth rates increases with an extension of the time period for which growth rates and returns are computed (Fama, 1981). Hence, when linking *GDP* growth to the returns on the risk factors *HML*, *SMB*, and *WML* an annual rebalancing may be considered more powerful.

Overall the regression findings indicate that the industry factor contains considerable power in pricing assets. Given this, we expect that the specific industry four factor models are better able to predict economic development in the Eurozone than the common euro area model. Thus, in order to test the hypothesis that the explanatory power of the industry four

[15] For instance, while the book-to-market ratio serves as an extremely good performance predictor of future return for well diversified portfolios Haugen (1999), the prospects of stocks alter and assets may change from expensive to cheap and back.

factor models is persistent and relatively superior to the general sample model, we focus on both the industry 4FM and the euro area model for the rest of the analyses, considering annual rebalancing frequencies. The results for quarterly and semi-annual frequencies are presented in the Appendix of this paper.

5.2 The Explanatory Power of *HML*, *SMB*, and *WML* with Respect to Future GDP Growth in the Eurozone

The following paragraphs discuss our regression results that reflect the relation between the various trading strategies, i.e., *HML*, *SMB*, and *WML*, and future growth in *GDP* in the Eurozone. Given the findings above, we focus our analysis on annually rebalanced portfolios.[16] The parameters depicted are corrected for heteroscedasticity and autocorrelation, up to three lags, using the Newey and West (1987) estimator.

5.2.1 One-Factor Models

Albeit Fama (1981) and Liew and Vassalou (2000) argue that a positive and statistically significant relation between the market factor and the economic growth in several countries exist, we fail to confirm their results when testing the relationship between several industry market factors and future economic growth in the Eurozone using annual excess returns. Table 5 depicts the results from various univariate regressions of future annual growth in GDP on past annual holding returns on *HML*, *SMB*, *WML*, and on past annual excess returns on the market factor *MRF*.

The results show a positive and almost significant relation between the market factor of the total sample and future growth in GDP. This is in line with Fama (1981) and Liew and Vassalou (2000). Surprisingly, however, for the industry market factors there appears to be a negative relationship with future economic growth. One explanation for this may be that we use an equally weighted index per industry that considers evenly the returns of all stocks per industry investigated. These industry indices may thus not be representative and should perhaps be substituted by a weighted index that accounts for market capitalization. As such, the results presented in Table 5 regarding the market factor (*MRF*) of the industries should be treated with caution. This is moreover underpinned by non significant t-values.

[16]The results for semi-annual and quarterly rebalancing frequencies can be requested from the authors

Table 5: One-Factor Regressions of GDP Growth Rates (annually rebalanced)

$$GDPgrowth_{(t,t+4)} = \alpha + \beta FactorRet_{(t-4,t)} + \epsilon_{(t,t+4)}$$

In the regression notation, 'FactorRet' refers to MRF, HML, SMB, and WML. MRF is the annual excess return on the industry index (an equally weighted index of the stocks per industry). In case of the total sample the excess return is derived from the world market index proxied by the Morgan Stanley Capital International Index. The risk free rate is given by the one-month ecu deposit quoted in London. The regressions use the annually rebalanced HML, SMB, and WML portfolios. HML is the annual return on a portfolio that is long on high book-to-market stocks and short on low book-to-market securities, holding size and momentum characteristics of the portfolio constant. SMB is the annual return on a portfolio that is long on small capitalization stocks and short on big capitalization securities, holding book-to-market and momentum characteristics of the portfolio constant. WML is the annual return on a portfolio that is long on the best performing stocks of the past year ('winners') and short on the worst performing securities of the previous year ('losers') holding book-to-market and size characteristics of the portfolio constant. GDP is calculated as the continously compounded growth rate in the EMU. The GDP is seasonally adjusted. T-values are corrected for heteroscedasticity and autocorrelation, up to three lags, using the Newey and West (1987) estimator.

Industry	**Slope coefficients**				**T-values**				**Coeff. of determination (%) - Adjusted R^2**			
	MRF	HML	SMB	WML	MRF	HML	SMB	WML	MRF	HML	SMB	WML
Total Sample	0.015	0.005	0.028	-0.010	1.95	0.49	2.10	-1.50	11.37	-2.06	8.82	1.85
01 NoDur	-0.009	0.012	-0.001	-0.008	-0.86	1.87	-0.09	-0.67	0.32	1.87	-3.19	-0.47
02 Dur	-0.003	0.015	0.032	-0.009	-0.38	1.53	3.20	-1.45	-2.46	3.65	41.77	0.08
05 Manuf	-0.002	0.003	0.037	-0.012	-0.29	0.28	2.18	-1.93	-2.72	-2.70	9.49	2.79
08 Shops	-0.001	0.007	0.035	0.000	-0.28	1.12	2.86	0.01	-2.88	1.21	17.21	-3.23
09 Money	-0.001	-0.003	0.013	-0.019	-0.06	-0.28	2.09	-2.30	-3.21	-2.94	0.92	10.17

More importantly, Table 5 reveals that there exist a positive relationship between *HML*, *SMB* and future economic growth. This implies that high book-to-market and small capitalization firms are better able to thrive than low book-to-market and big capitalization stocks when strong economic growth is expected. Thence, investors would rather hold stocks whose returns are relatively high when they realize that the economy is in a downturn (Liew and Vassalou, 2000). Table 5 depicts that in five out of six cases the slope coefficients of *HML* and *SMB* are positive. Given the t-values, it appears that the relation between *SMB* (five significant t-values at the 5 per cent significance level, the exception being the non durables consumer goods sector) and future economic growth is stronger than in case of *HML* (no significant t-value at the 5 per cent significance level).

In line with the previous section, the negative slope coefficients of *WML* indicate a negative relation between future annual *GDP* growth and past annual momentum returns. In general, with respect to the t-values, the *WML* strategy seems to contain only little information about future economic growth in the Eurozone (only one significant t-value at the 5 per cent significance level). Once again, one explanation for the low level of information content might be that investors tend to mistakenly project a continuation of abnormal profit levels long periods into the future. This is not necessarily in accordance with real economic activity. In consequence, successful firms become overvalued and unsuccessful ones undervalued vis-à-vis the firms' fundamentals. This implies that the market reacts inefficiently. The market develops a belief that a few positive or negative events cause a run that will persist for long periods into the future. Haugen (1999), for instance, argues that if a firm's earnings per share have increased quickly over the last quarters, the market assumes that this foretells continuous success for many more quarters into the future. Therefore, the price of the share becomes inflated on the basis of this expectation. The market is wrong as past success does not foretell prolonged future success. Due to this inefficiency, there may be no clear traceable pattern between *WML* and future real economic activity. The small explanatory power of the industry market factors and the *HML* and *WML* strategy is also reflected by the small, and sometimes even negative adjusted R^2 values.

On the whole, the regression results imply that from all three trading strategies considered, *SMB* is the only one that shows a positive and significant relation with future GDP growth. This is further underpinned when considering quarterly and semi-annual rebalancing frequencies as presented in the Appendix. Put differently, with respect to macroeconomic growth *SMB* has additional explanatory power above the market itself. Although the results are not very robust, *HML* appears to have a positive relationship with future real economic activities. The *WML* strategy seems to contain only little information about future economic growth, and if so, not as expected as the relation appears to be negative rather than positive.

5.2.2 Two-Factor Models

In this section we compare the information content of *HML*, *SMB*, and *WML* with that of *MRF* to determine whether any of the three trading strategies comprises explanatory power about the future state of the economy above the information contained in the market factor, i.e., we regress future GDP growth simultaneously on the market factor and one of the three risk factors (cf. equations 5 and 6). Given the results of the previous section, we explicitly focus on the information content of the *SMB* trading strategy. Table 6 reports the results for annually rebalanced portfolios. Even in the presence of the market factor, all but one slope coefficient for *SMB* remain positive with only minor variations in their magnitude. Only three out of six *SMB* coefficients remain significant at the 5 per cent significance level. The coefficients are significant for the durables consumer goods sector, the manufacturing sector, and the wholesale and retail sector. It is, however, worthy to note that the adjusted R^2 values in Table 6 are still very low.

The information content of *SMB*, especially for the durables consumer good and wholesale and retail sector, with respect to future GDP growth may perhaps be explained by business cycle sensitivities. While some industries are very vulnerable to economic fluctuations, other sectors are relatively immune to economic swings. For instance, albeit the profitability of oil, chemicals, utilities, and telecom companies may be subject to changes in the business cycle, there is a permanent demand of the respective goods offered by theses sectors. The relative inelasticity of oil may serve as an indicator for a certain degree of immunity to variations in economic activities. Additionally, smaller firms may react more sensitive to changes in the business cycle than bigger ones since the latter are usually more diversified than the former and may on top possess more financial and productive reserves that allow them to equalize economic swings. This may provide some economic rationale on why *SMB* may contain explanatory power regarding future *GDP* growth.

Table 6: Two-Factor Regressions of GDP Growth Rates (Annually Rebalanced)

$$GDPgrowth_{(t,t+4)} = \alpha + \beta MRF_{(t-4,t)} + \gamma FactorRet_{(t-4,t)} + \epsilon_{(t,t+4)}$$

In the regression notation, MRF is the annual excess return on the industry index (an equally weighted index of the stocks per industry). In case of the total sampl, the excess return is derived from the world market index proxied by the Morgan Stanley Capital International Index. The risk free rate is given by the one-month ecu deposit quoted in London. 'FactorRet' refers to HML, SMB, and WML. The regressions use the annually rebalanced HML, SMB, and WML portfolios. HML is the annual return on a portfolio that is long on high book-to-market stocks and short on low book-to-market securities, holding size and momentum characteristics of the portfolio constant. SMB is the annual return on a portfolio that is long on small capitalization stocks and short on big capitalization securities, holding book-to-market and momentum characteristics of the portfolio constant. WML is the annual return on a portfolio that is long on the best performing stocks of the past year ('winners') and short on the worst performing securities of the previous year ('losers') holding book-to-market and size characteristics of the portfolio constant. GDP is calculated as the continously compounded growth rate in the EMU. The GDP is seasonally adjusted. T-values are corrected for heteroscedasticity and autocorrelation, up to three lags, using the Newey and West (1987) estimator.

Industry	**MRF**		**HML**		**Adjusted R^2 (%)**
	Slope	T-value	Slope	T-Value	
Total Sample	0.016	2.40	0.007	0.81	11.0
01 NoDur	-0.005	-0.49	0.009	1.15	-0.3
02 Dur	0.006	0.64	0.021	1.95	1.9
05 Manuf	-0.001	-0.15	0.002	0.15	-6.0
08 Shops	0.004	0.88	0.011	1.61	-0.5
09 Money	-0.007	-0.61	-0.010	-0.87	-5.4
Industry	**MRF**		**SMB**		**Adjusted R^2 (%)**
	Slope	T-value	Slope	T-Value	
Total Sample	0.014	1.63	0.025	1.83	18.0
01 NoDur	-0.009	-0.84	-0.002	-0.15	-2.9
02 Dur	-0.004	-0.89	0.032	3.19	41.1
05 Manuf	-0.004	-0.49	0.039	2.14	7.8
08 Shops	-0.006	-1.32	0.042	2.63	20.0
09 Money	-0.004	-0.41	0.015	1.90	-1.7
Industry	**MRF**		**WML**		**Adjusted R^2 (%)**
	Slope	T-value	Slope	T-Value	
Total Sample	0.014	1.73	-0.004	-0.94	9.2
01 NoDur	0.004	1.461	-0.001	-0.33	-1.9
02 Dur	0.003	1.49	-0.002	-0.57	-0.8
05 Manuf	0.002	0.79	-0.004	-1.06	1.4
08 Shops	0.002	1.03	0.002	0.75	-1.0
09 Money	0.001	0.29	-0.007	-1.60	5.8

The predictive ability of the market factor remains nearly unchanged. We find a positive slope coefficient for the common euro area market model and negative coefficients for the industry market factors. Once again, the negative slope coefficients of the industry market factors can be traced back to the equally weighted compositions of the indices. These indices may therefore not be representative. We also fail to find significant results for the *HML* and *WML*. The slope coefficients depicted in Table 6 are consistent with the results found in the previous section. With the exception of the finance sector, the slope coefficients are positive for all *HML* factors. As regards the momentum strategy, our results suggest that there appears to be a negative relation between *WML* and future GDP growth. Five out of six coefficients have a negative value. We are only able to find a positive coefficient for the wholesale and retail sector, while for the finance sector the coefficient comes closest to a significant value. Overall, however, the findings for *HML* and *WML* are not very robust, i.e., both factors appear to be too limited to explain future economic growth.

5.2.3 Multifactor Models

In a final step we run a regression for the proposed 4FM which contains all annually rebalanced risk factors simultaneously. Table 7 depicts the results. Focusing on the joint slope coefficients of the risk factors, this dog-race provides insights about the trading strategy that has the strongest explanatory power with respect to future GDP growth in the euro area. A comparison of the results presented in Table 7 with the slope coefficients depicted in Table 5 and Table 6 shows that for most industries the sign and magnitude of the coefficients remain relatively stable for *SMB*, even in the presence of the other factors. Furthermore, in three out of six industries the loading factors for *SMB* are statistically significant. Throughout all regression analyses, the durables consumer sectors and the wholesale and retail sector are significant at the 5 per cent significance level in case of *SMB*. This indicates that these specific industry *SMB* portfolios contain explanatory power with respect to future *GDP* growth in the Eurozone.

For *HML* the coefficients presented in Table 7 are similar to the previous results with all slope coefficients being positive except for the finance sector. Although none of the coefficients is significantly strong, we conclude, in line with Liew and Vassalou (2000), that in general *HML* and future *GDP* are positively related. Yet, the results lack robust and

Table 7: Multifactor Regressions of GDP Growth Rates (annually rebalanced)

$$GDPgrowth_{(t,t+4)} = \alpha + \beta MRF_{(t-4,t)} + hHML_{(t-4,t)} + sSMB_{(t-4,t)} + wWML_{(t-4,t)} + \epsilon_{(t,t+4)}$$

In the regression notation, MRF is the annual excess return on the industry index (an equally weighted index of the stocks per industry). In case of the total sample, the excess return is derived from the world market index proxied by the Morgan Stanley Capital International Index. The risk free rate is given by the one-month ecu deposit quoted in London. The regressions use the annually rebalanced HML, SMB, and WML portfolios. HML is the annual return on a portfolio that is long on high book-to-market stocks and short on low book-to-market securities, holding size and momentum characteristics of the portfolio constant. SMB is the annual return on a portfolio that is long on small capitalization stocks and short on big capitalization securities, holding book-to-market and momentum characteristics of the portfolio constant. WML is the annual return on a portfolio that is long on the best performing stocks of the past year ('winners') and short on the worst performing securities of the previous year ('losers') holding book-to-market and size characteristics of the portfolio constant. GDP is calculated as the continously compounded growth rate in the EMU. The GDP is seasonally adjusted. T-values are corrected for heteroscedasticity and autocorrelation, up to three lags, using the Newey and West (1987) estimator.

Industry	**MRF**		**HML**		**SMB**		**WML**		**Adjusted R^2 (%)**
	Slope	T-value	Slope	T-Value	Slope	T-Value	Slope	T-Value	
Total Sample	0.016	2.38	0.013	1.52	0.032	2.30	0.004	0.87	19.4
01 NoDur	-0.005	-0.41	0.008	0.88	0.002	0.12	-0.005	-0.50	-6.3
02 Dur	0.004	0.53	0.015	1.60	0.032	3.05	0.005	0.57	40.3
05 Manuf	-0.004	-0.44	0.001	0.06	0.033	1.56	-0.006	-0.51	2.3
08 Shops	-0.004	-0.62	0.004	0.53	0.040	2.06	-0.001	-0.19	15.6
09 Money	-0.024	-1.29	-0.016	-0.79	0.009	0.79	-0.029	-2.44	14.4

significant empirical support.In case of *WML*, we fail to find significant results in five out of six cases, with the finance sector showing the only significant, and again negative, slope coefficient. From the remaining five coefficients, three are negative while the remaining two are positive. With respect to the results presented in Table 5 and Table 6, we fail to find a clear pattern for the slope coefficients. Summarizing the results for *WML* shown so far, we conclude that if there was indeed a relationship between future growth in *GDP* and a momentum strategy, this relationship would be negative rather than positive and only robust to some extent for the finance sector.

Multifactor Analyses without *WML*

Given our previous findings that reveal that *WML* appears to have limited ability to explain future economic growth, we finally run - in accordance with Liew and Vassalou (2000) - a multifactor regression with all factors except *WML*. The results are presented in Table 8. Once again, we are able to find positive slope coefficients for *SMB* for all industries. Four out of six are significant at the 5 per cent significance level. Among those are again the durables consumer goods sector and the wholesale and retail sector. For *HML* the coefficients are all positive, with the exception of the finance sector again. However, none of the coefficients is significant at the 5 per cent significance level.

6 Conclusion

The primary aim of this study was to test the extent to which the profitability of the trading strategies *HML*, *SMB*, and *WML* can be related to future economic growth in the Eurozone. Using data for five different industries and a general euro area market model, and under the consideration of no transaction costs, the previously presented results highlight that out of the three trading strategies only *SMB* seems to contain strong and robust information with respect to future growth in GDP.[17] As expected, and in line with Liew and Vassalou (2000), the relation is positive, indicating that small capitalization firms are better able to prosper than big capitalization stocks whenever strong economic growth is expected. The

[17] The frequent turnover and rebalancing of the portfolios causes transaction costs that we do not consider in this study. These transaction costs in turn consume some of the returns gained. This holds especially for the not very persistent momentum strategy, which results in higher profits if the portfolio is turned over more frequently. In general, *HML* and *SMB* strategies are cheaper to implement than *WML* strategies, because they generate lower transaction costs based on their persistency.

Table 8: Multifactor regressions of GDP growth rates excl. WML (annually rebalanced)

$$GDPgrowth_{(t,t+4)} = \alpha + \beta MRF_{(t-4,t)} + hHML_{(t-4,t)} + sSMB_{(t-4,t)} + \epsilon_{(t,t+4)}$$

In the regression notation, MRF is the annual excess return on the industry index (an equally weighted index of the stocks per industry). In case of the total sample the excess return is derived from the world market index proxied by the Morgan Stanley Capital International Index. The risk free rate is given by the one-month ecu deposit quoted in London. The regressions use the annually rebalanced HML, and SMB, portfolios. HML is the annual return on a portfolio that is long on high book-to-market stocks and short on low book-to-market securities, holding size and momentum characteristics of the portfolio constant. SMB is the annual return on a portfolio that is long on small capitalization stocks and short on big capitalization securities, holding book-to-market and momentum characteristics of the portfolio constant. GDP is calculated as the continously compounded growth rate in the EMU. The GDP is seasonally adjusted. T-values are corrected for heteroscedasticity and autocorrelation, up to three lags, using the Newey and West (1987) estimator.

Industry	**MRF**		**HML**		**SMB**		**Adjusted R^2 (%)**
	Slope	T-value	Slope	T-Value	Slope	T-Value	
Total Sample	0.015	2.06	0.012	1.50	0.030	2.20	21.6
01 NoDur	-0.005	-0.46	0.009	1.04	0.000	0.01	-3.8
02 Dur	0.001	0.21	0.013	1.20	0.031	2.89	41.9
05 Manuf	-0.001	-0.11	0.005	0.40	0.040	2.22	5.2
08 Shops	-0.003	-0.64	0.005	0.70	0.040	2.27	18.4
09 Money	-0.005	-0.51	-0.003	-0.25	0.014	1.67	-5.0

strong and robust information content of *SMB* with respect to future real economic activity holds especially for the durables consumer goods sector and the wholesale and retail sector. Nonetheless, the regression results also indicate that the explanatory power of *SMB* is not necessarily industry specific; with the exception of the non durables consumer goods sector, the slope coefficients are always positive (for the annual rebalancing frequencies). In case of the univariate regression all coefficients are even statistical significant. However, the reasonably and relatively high adjusted R^2 values of all regressions that include *SMB* in the durables consumer goods sector imply that the explanatory power of *SMB,* and thus its information content with respect to future growth in GDP, is considerably strong in this specific industry. The predictive ability of *SMB* is to a large extent independent of any information contained in the market factor.

For *HML*, there appears to be a positive, though not significant, relationship between the return on a portfolio that is long in high book-to-market stocks and short in low book-to-market securities and future GDP growth. Generally, the results indicate that with the exception of the finance sector, high book-to-market firms are more likely to thrive as we expect an economic upturn. The slope coefficients of all regressions conducted are positive for all but the finance sector. This may imply that *HML* is industry specific for the finance sector only. The positive relationship between *HML* and future real economic activity is in line with Liew and Vassalou (2000). The information content about the future state of the economy above the market factor itself is nevertheless limited.

Like the findings of Liew and Vassalou (2000) our analyses reveal little evidence to support that the returns of a momentum strategy, i.e., *WML*, are related to future growth in the macroeconomy. If there was a relationship, then this would be expected to be negative rather than positive. One explanation for the low level of information content might be that investors tend to mistakenly project a continuation of abnormal profit levels long periods into the future. This, however, is not in accordance with real economic activity and firms' fundamentals. Successful firms become overvalued and unsuccessful ones become undervalued and the market reacts inefficiently. The market develops a false belief that a few positive or negative events cause a run that will persist for long periods into the future. The market is wrong as past success is not able to project prolonged future success. Consequently, no clear traceable pattern between *WML* and future real economic activity may be detected.

From a theoretical perspective, the findings of this study indicate that at least *SMB*, and to some extent *HML*, may serve as state variable(s) (Fama and French, 1993, 1996, 1998) that predict future changes in the investment opportunity set in the context of the Intertemporal Capital Asset Pricing Model (Merton, 1973). This study also reveals that market anomalies do not only serve as profitable investment strategies, but also as suitable predictors for economic development in the euro area. This holds especially for a *SMB* trading strategy. Under these considerations, the insights of this study, especially with respect to *SMB,* may be used to verify existing GDP forecast in the euro area or to make more reliable forecast in the future.

This study has also shown that specific four factor industry asset pricing models are better able to price assets in the Eurozone than a general euro area four factor model. This is regardless of the rebalancing frequencies of the portfolios. Our findings are therefore able to support Moerman's (2004) hypothesis that industry specific models are superior to a common euro area model. Additionally, our results underpin the more recent results that industry characteristics have gained explanatory power relative to country effects (Urias et al., 1998; Baca et al., 2000; Cavaglia et al., 2000; Diermeier and Solnik, 2001; Cavaglia and Moroz, 2002; Brooks and Catao, 2000; L'Her et al., 2002; Wang et al., 2003; Ferreira and Gama, 2005; Flavin, 2004; Isakov and Sonney, 2004; Campa and Fernandes, 2006; Moerman, 2008; Taing and Worthington, 2005). The superiority of industry asset pricing models reflects that a general switch from investments along country lines towards investments along industry sectors has occurred and may continue to do so in the medium term. This is in line with (Danthine et al., 2000).

The economic explanation for the fact that industry characteristics have become more important in explaining equity returns in the Eurozone may also seen as a further indication for long-term European market integration. The interdependence among equity markets through cointegration relations implies that some of the stochastic trends are shared. Hence, stocks traded in these markets are to a certain extent subject to the same externalities. Consequently, if stock markets are integrated, then fewer assets become available to investors to obtain long-run diversification gains. Given homogenous effects within European financial markets, and hence diversification considerations, investors need to either (i) select appropriate stock markets outside the Eurozone that are unrelated to the latter or (ii) find a way on how to diversify their portfolios European-wide when they are reluctant to invest outside the Eurozone market. The latter may occur perhaps due to the so-called home-bias-puzzle (see Lewis, 1995; Coval and Moskowitz, 1999; Gordon and Bovenberg, 1996; Matsen, 2001; Tesar and Werner, 1995).

Yet, intuitive interpretations that Eurozone financial markets become eventually unattractive for diversification do not necessarily imply that this turns out to be true. This holds regardless of preliminary findings indicating that EMU stock markets appear to be integrated. For instance, even though the importance of country borders within the Eurozone have diminished, industry barriers have nearly remained unchanged. Thus, in order to diversify portfolios within the EMU area, a general switch from investments along country lines towards investments along industry sectors may occur. Besides, investors may gain from other aspects when just investing in EMU markets. For example, they may better evaluate the prospects of their investment, given lower information asymmetries (see Akerlof, 1970) as opposed to investing in non-EMU markets. Additionally, investors may benefit from the fact that EMU markets are subject to the same political, economic and other exogenous trends. This, in turn, also implies that long-run interrelations between financial markets of the Eurozone and the convergence of key economic variables may reaffirm theoretical propositions that these factors proxy for the innovations in state variables that explain expected stock returns. As such, investors possessing stock portfolios that invest in stock markets of the Eurozone should monitor changes in European policies and the level of economic convergence among EMU member states when evaluating long-run prospectus of their stock portfolios. Nonetheless, future studies may conduct further analysis on the integration of European stock markets.

Further research may also address the concern of using linear regression models to test the relation between the different trading strategies and future GDP growth. For instance, using panel data for 25 countries, Henry et al. (2004) argue that there is strong evidence to suggest that a linear regression model would be inaccurate and would probably provide misleading inference by relating stock market returns to economic output. They remark that different states of the economy produce asymmetric output patterns, i.e., marginal output growth recovers more strongly after a recession than marginal output declines after a boom. In particular, they denote that stock returns are most useful in predicting economic output when an economy is in a recession. Though, Henry et al. (2004) do not employ the same explanatory variables as used in this study, running a switching regression approach that accounts for different states of the economy, may provide further insights into the information content of *HML, SMB*, and *WML* with respect to future growth in GDP.

In order to find out more about the information content of *HML*, *SMB*, and *WML* regarding future growth in the economy, one could run further regressions with additional explanatory variables. For instance, Liew and Vassalou (2000) suggest to use the return on a market portfolio (*MRF*), a dividend yield, short-term interest rates, term spreads (e.g., ten year government yield minus the yield on a treasury bill or the call money rate) and the industrial production as indicators for the business cycle. Liew and Vassalou (2000) show that there exists some overlap in the information content of *HML*, *SMB* and the business cycle variables. This is also corroborated by Petkova (2006). It would perhaps be interesting to see whether this holds for industry corrected models as well. Yet, it should not necessarily be the aim to propose a new model for the prediction of future growth in the macroeconomy. The question is more, whether *SMB* or any of the other trading strategies may contain some additional information above the market factor itself.

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A Appendix

Table I: SIC Industry Classification Codes

This table shows Fama and French's classification of ten different industry portfolios based on each stock's primary SIC code

1 NoDur	Consumer NonDurables	0100-0999
		2000-2399
		2700-2749
		2770-2799
		3100-3199
		3940-3989
2 Durbl	Consumer Durables	2400-2439
		2500-2519
		2590-2599
		3000-3099
		3630-3659
		3710-3711
		3714-3714
		3716-3716
		3750-3751
		3792-3792
		3910-3939
		3990-3999
3 Oil	Oil, Gas, and Coal Extraction and Products	1200-1399
		2900-2999
4 Chems	Chemicals and Allied Products	2800-2899
5 Manuf	Manufacturing	2440-2499
		2520-2589
		2600-2699
		2750-2769
		3200-3629
		3660-3709
		3712-3713
		3715-3715
		3717-3749
		3752-3791
		3793-3909
6 Telcm	Telephones and Television	4800-4899
7 Utils	Utilities	4900-4949
8 Shops	Wholesale, Retail, and Some Services	5000-5999
		7000-7999
9 Money	Finance	6000-6999
10 Other	Everything Else	

Table II: Number of Stocks per Portfolio

This table reports the number of stocks that meet the following criteria: The security must have a listed price for the respective quarter, the market capitalization of that respetive quarter should be known and the book-to-market ratio for December of the previous year should also be available. The security must also have listed prices one year prior to the respective quarter, in order to determine a 12 months momentum. For the quarters Q4 '95 and Q' 96 we are only able to calculate the momentum for 6 months or 9 months, respectively, due to a lack of data. The number of securities varies a lot over time due to new issues, mergers, takeovers and bankruptcies, or simply due to a lack of data for the earlier quarters. The industries marked with a star (*) are those for which we develop industry specific factor models. The number of the securities for these portfolios are divisible by 27 since we create 27 portfolios per industry. If one industry has more stocks than a mutilpe of 27, then stocks are randomly elimianted down to a value that is a multiple of 27.

Industry	**1995**	1996				1997				1998				1999			
	Q4	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
01 NoDur *	135	108	108	108	135	135	135	135	135	135	135	135	162	162	162	162	189
02 Dur *	54	54	54	54	54	54	54	54	54	54	54	54	81	81	81	81	81
03 Oil	12	12	12	13	16	17	17	17	16	17	15	14	18	19	17	20	17
04 Chems	41	40	41	39	49	48	55	56	58	56	54	58	58	61	63	60	64
05 Manuf *	189	189	189	189	216	216	216	216	243	243	243	243	270	270	270	270	270
06 Telcm	9	8	9	10	11	11	12	13	14	15	14	14	15	20	19	24	25
07 Utils	25	24	22	20	22	22	22	23	26	24	24	27	27	26	27	25	30
08 Shops *	162	162	135	162	189	189	189	216	216	216	216	216	243	243	243	270	270
09 Money *	216	216	216	189	243	243	243	270	270	270	270	243	270	270	270	270	270
10 Others	102	105	159	161	226	199	191	215	237	212	217	238	179	225	225	249	296
Total *	**945**	**918**	**945**	**945**	**1161**	**1134**	**1134**	**1215**	**1269**	**1242**	**1242**	**1242**	**1323**	**1377**	**1377**	**1431**	**1512**

Industry	2000				2001				2002				2003				**Av. Q4 '95**
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**- Q4 '03**
01 NoDur *	189	189	189	189	216	216	216	243	243	216	216	189	189	189	189	189	**171**
02 Dur *	81	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	**83.5**
03 Oil	22	21	21	22	22	22	22	23	23	23	23	23	23	23	23	24	**19.1**
04 Chems	70	74	72	72	80	82	83	80	82	84	85	79	82	83	83	78	**65.8**
05 Manuf *	324	324	324	324	378	378	378	405	405	405	405	378	378	405	405	378	**301**
06 Telcm	28	28	30	32	36	41	45	55	56	56	56	54	53	54	55	55	**29.6**
07 Utils	30	29	28	26	32	31	35	38	41	41	40	45	45	46	47	47	**30.8**
08 Shops *	324	378	405	405	486	540	567	621	621	621	621	567	567	567	567	567	**362**
09 Money *	324	324	324	324	324	378	378	378	405	378	405	378	405	378	405	378	**307**
10 Others	282	280	254	307	316	283	355	290	311	363	336	285	337	334	305	282	**253**
Total *	**1674**	**1755**	**1755**	**1809**	**1998**	**2079**	**2187**	**2241**	**2295**	**2295**	**2295**	**2106**	**2187**	**2187**	**2187**	**2106**	**1623**