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Centre for Economic Policy Research
90–98 Goswell Rd
London EC1V 7RR
Tel: (44 171) 878 2900
Fax: (44 171) 878 2999
Email: cepr@cepr.org

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ABSTRACT

Can Book-to-Market, Size and Momentum Be Risk Factors That Predict Economic Growth?

We examine the extent to which the profitability of the HML, SMB and WML trading strategies can be linked to future GDP growth. Using a large cross-section of securities from ten developed markets, we find that the HML and SMB portfolios contain significant information about future GDP growth. The predictive ability of these strategies is to a large degree independent of any information contained in the domestic market factor, which is known to be a leading indicator of economic growth. Even in the presence of popular business cycle variables, HML and SMB retain their ability to predict future economic growth in some of the countries examined. Our results support a risk-based explanation for the performance of the HML and SMB trading strategies. Little evidence was found to support such an explanation in the case of the WML trading strategy.

JEL Classification: G11, G12, G15

Keywords: book-to-market, size, momentum, trading strategies, GDP growth

Maria Vassalou and Jimmy Liew*

Graduate School of Business

Columbia University

416 Uris Hall

3022 Broadway

New York

NY 10027

USA

Tel: (1 212) 854 4104

Fax: (1 212) 316 9180

Email: mv91@columbia.edu

*Jimmy Liew is now with Morgan Stanley Dean Witter. This work was completed while Jimmy Liew was a Ph.D student at Columbia Business School and prior to his employment at Morgan Stanley Dean Witter.

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NON-TECHNICAL SUMMARY

Although the Capital Asset Pricing Model (CAPM) has been the cornerstone of finance theory since its development in the sixties, research findings in the nineties have shown that the CAPM can no longer adequately explain equity returns. This result has devastating consequences, since it means that we no longer have a good model to calculate the cost of capital of an investment and we can no longer quantify and characterize the risk of a portfolio.

Fama and French (1992, 1993, 1995, 1998) have proposed an alternative asset-pricing model. It includes a factor based on book-to-market information for common stocks, a factor that considers the size of the companies traded in the market and a factor that takes into account the past year's performance of stocks in the market. This model has been the subject of controversy since the factors proposed were previously considered 'anomalies' and there has been no evidence to suggest that the returns on portfolios constructed based on book-to-market, size and past year's performance information are related to underlying risk factors in the economy.

This Paper examines the characteristics of the proposed factors in ten developed markets. Portfolios constructed according to these factors have long positions on stocks that exhibit high book-to-market, small size and good performance over the past year and short positions on stocks with low book-to-market, large size and poor performance over the past year. Although such portfolios are in fact zero investment portfolios, they provide in general positive returns that are statistically significant. This surprising result was first found using Japanese and US securities and it has now been confirmed for many more countries.

Our Paper goes a step further than simply showing that strategies based on book-to-market, size and past year's performance characteristics can be profitable. It tries to explain what gives rise to the performance of these strategies.

We show that the performance of such strategies is related to fundamental risk in the macroeconomy. Our analysis suggests that the portfolio strategies constructed on the basis of book-to-market, size and past year's return information have predictive ability over future economic growth. High returns for these strategies are followed by high rates of GDP growth whereas low returns are followed by periods of low GDP growth.

Regression analysis shows that the returns of these strategies can predict future GDP growth even in the presence of other popular business cycle variables. Furthermore, the information about future economic growth that is

contained in the returns of these strategies, seems to be largely independent of the information contained in the return of the market factor, a known leading indicator of economic growth. The results suggest that the returns of these strategies are related to fundamental risk in the macroeconomy.

We track the composition of the portfolios over the life of the strategies and find that portfolios constructed on the basis of book-to-market and size information have substantially lower turnover than portfolios that are constructed on the basis of information about past year's returns. Stocks that are classified as high or low book-to-market tend to retain this characteristic for several years. A similar observation is made for small and large capitalization stocks. In both cases, about 50% of the securities in the book-to-market and size portfolio strategies remain the same over a period of three years. In most countries, more than 30% of the stocks never exit the initial portfolios over the life of the trading strategies. It appears that book-to-market and size characteristics of stocks are persistent over time. High book-to-market stocks remain high book-to-market for prolonged periods of time. Similarly, small capitalization stocks remain in that category for many years.

Our results imply that persistently high book-to-market stocks face a higher risk of distress and they are more likely to survive when the economic outlook is good rather than bad. Similarly, small capitalization stocks are more likely to do well during periods of economic growth and more likely to be the first to disappear during periods of economic slowdown. It appears that this potential vulnerability of the high book-to-market and small capitalization stocks gives rise to the link between the performance of the high book-to-market and size strategies and future economic growth. Little evidence in support of this hypothesis is found for the strategy which is based on past year's performance of common stocks.

Since the book-to-market and size characteristics of securities are rather persistent over time, the market is aware of them and investors require an additional risk premium to hold such securities. This premium is captured by the strategies examined, since they go long on high book-to-market and small capitalization stocks and short on low book-to-market and large capitalization stocks, respectively.

The fact that the return of the book-to-market and size strategies is related to fundamental risk in the macroeconomy is important for asset management and risk management purposes.

A growing body of research shows that certain empirical anomalies found in the U.S. stock market appear to also exist in international markets. Fama and French (1998) show that there exists a strong value premium in global stock markets. Rouwenhorst (1998) finds international evidence for a momentum effect. Following Banz (1981), many authors have investigated whether small capitalization stocks outperform large capitalization stocks on a risk-adjusted basis, with varying degrees of success.¹ However, researchers have so far found little evidence of a relation between these three return-based anomalies and intuitive economic risk factors. This paper takes one step in that direction by linking the unidentified return-based factors to future growth in the macro economy.

We construct the HML, SMB, and WML portfolio strategies using security returns from ten developed markets. For each market, HML is the return to a portfolio strategy that is long on high book-to-market stocks and short on low book-to-market stocks, holding the other two attributes (size and momentum) constant. Likewise, SMB and WML are returns to long-short portfolios constructed using market capitalization and past year's returns information (momentum), respectively, holding the other two attributes constant.

The core results of the paper reveal that the HML and SMB portfolios are related to future growth in the real economy. This is documented using regression analysis but also by calculating the returns of the trading strategies during both good and bad states of the business cycle in each country. The predictability of HML and SMB is not subsumed when the market factor is included in the regression model. Inclusion of other business

cycle variables does not eliminate the forecasting ability of HML and SMB. We find, however, little evidence of a relation between the returns of the WML strategy and the real economy.

It is known that there exists a positive relation between the return on the market portfolio and future economic growth. Our results show that the relation between the performance of HML and SMB and future economic growth is also positive. Furthermore, the slope coefficients of HML and SMB are of similar economic importance as those of the market portfolio. This is despite the fact that the information contained in HML and SMB is largely independent of the information contained in the returns of the market factor.

The book-to-market (B/M) and size characteristics of stocks are found to be persistent over time. This means that stocks that comprise the HML and SMB portfolios are largely entrenched in their respective categories. This characteristic may make them more vulnerable to changes in future economic conditions than it is the case for the average stock in the market. Risk averse investors are likely to require a risk premium to hold stocks with persistently high B/M and small capitalization characteristics.

Since the performance of HML and SMB is linked to future economic growth, the hypothesis of Fama and French (1992, 1993, 1995, 1998) that they act as state variables in the context of Merton's (1973) Intertemporal Capital Asset Pricing Model (ICAPM) is supported by our results.

Our analysis also confirms previous findings that the HML, SMB and WML zero investment portfolios provide positive returns. In most countries these returns are both economically and statistically significant. The momentum portfolio strategy yields the

highest returns of the three portfolio strategies examined. Conspicuously absent is a momentum effect in Japan. Momentum strategies are particularly profitable when the portfolios are re-balanced on a quarterly basis.ⁱⁱ The HML and SMB strategies are more profitable in larger, more liquid markets. Both of these strategies generate lower turnover than the WML strategy.

The paper is organized as follows: Section 1 describes the dataset, and details our portfolio construction. Section 2 briefly summarizes the characteristics and performance of the three strategies internationally. In Section 3 we present our results on the relation between the returns on the trading strategies and the macroeconomy. Section 4 examines the composition of the portfolios generated by the trading strategies, by tracking the turnover of stocks in the portfolios over the life of the strategies. It also examines their industry breakdown. We conclude in Section 5 with a summary of our results.

1.1: Dataset Description

Our data are obtained from Datastream International. They include securities from Australia, Canada, France, Germany, Italy, Japan, the Netherlands, Switzerland, the United Kingdom, and the United States. We use end-of-month prices, dividend yields, price-to-book ratios, and market capitalization data both for currently trading and defunct securities. In the US and the UK, we restrict the number of defunct stocks examined to those that have at least 60 observations of prices.ⁱⁱⁱ We excluded from our database duplicates, cross listings, as well as preferred shares, warrants, and unit trusts.

To provide an idea of the number of stocks used in the portfolios over the life of the strategies, Table 1 summarizes the number of securities used when the HML, SMB, and WML portfolio strategies are rebalanced annually. It discloses how many stocks are used in the portfolios each year, and the length of time during which the trading strategies were performed. Note that for Italy, the Netherlands, and Switzerland, the number of securities is much smaller than for the other countries. This means that since our portfolio construction procedure, which is discussed in Section 1.2, results in the creation of 27 portfolios, some of the portfolios for these three countries may contain as few as 1 to 3 stocks. Therefore, the results for these countries should be interpreted with caution, especially those referring to the relationship of HML, SMB, and WML with macroeconomic growth.

Monthly local currency total returns are calculated by spreading evenly the monthly dividends throughout each year. This method, which represents the only option we had available, may smooth the series to some extent, but it does not affect the means. All returns in our analysis are reported annualized.

As a quality control of our data, we used our database to construct market capitalization weighted country indexes and compared them with those provided by Morgan Stanley Capital International (MSCI). The results, not reported here, show that the distributional characteristics of the two sets of indexes are very similar. Furthermore, the correlations between the constructed indexes and those of MSCI are of the order of 0.98 in all countries except Japan where it is 0.92. The advantage of our dataset compared to the constituents of the MSCI indexes used in the Fama and French (1998) study is that

our data include also small capitalization stocks, which makes tests of the SMB strategy possible.

1.2. Portfolio Construction

In order to capture all three empirical anomalies in tandem, the HML, SMB, and WML portfolios are constructed as follows. For a given country and at each point in time, we use only stocks for which we have the market capitalization (MV), at least twelve monthly observations so as to be able to calculate the momentum, and a positive book-to-market ratio (B/M). We consider only the twelve months momentum strategy and we implement it by calculating the average of past year's returns, excluding the most recent month (ave12).^{iv}

To construct the portfolios, we sort all stocks that pass the above requirements by B/M and create tritile portfolios. We then take the portfolio of stocks with the highest B/M's and re-sort all stocks by MV, thereby creating three MV portfolios within the high B/M group. We repeat the same procedure for the medium B/M and low B/M groups. After sorting for B/M and MV, we have nine portfolios. We then sort the securities in each of these nine portfolios according to ave12 and create tritile portfolios within the nine portfolios. We obtain in this manner twenty-seven portfolios.

Figure 1 depicts the portfolio construction procedure. "Losers" are the bottom third of the total stocks with the lowest last year's average returns, excluding the most recent month. "Winners" are the top third of the total stocks with the highest last year's average returns, excluding the most recent month and "Medium" contain the remaining third of the stocks.

Figure 1: Portfolio Construction Procedure

Book-to-Market	Market Capitalization	Past Year's Returns	Portfolio
High B/M	Small MV	Losers AVE12	P1
		Medium AVE12	P2
		Winners AVE12	P3
	Medium MV	Losers AVE12	P4
		Medium AVE12	P5
		Winners AVE12	P6
	Big MV	Losers AVE12	P7
		Medium AVE12	P8
		Winners AVE12	P9
Medium B/M	Small MV	Losers AVE12	P10
		Medium AVE12	P11
		Winners AVE12	P12
	Medium MV	Losers AVE12	P13
		Medium AVE12	P14
		Winners AVE12	P15
	Big MV	Losers AVE12	P16
		Medium AVE12	P17
		Winners AVE12	P18
Low B/M	Small MV	Losers AVE12	P19
		Medium AVE12	P20
		Winners AVE12	P21
	Medium MV	Losers AVE12	P22
		Medium AVE12	P23
		Winners AVE12	P24
	Big MV	Losers AVE12	P25
		Medium AVE12	P26
		Winners AVE12	P27

The three trading strategies are performed as follows:

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

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

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

where portfolios P1 to P27 are defined in Figure 1.

HML represents the return to a portfolio that is long on high B/M stocks and short on low B/M stocks, controlling for the size and momentum effects. In other words, HML is a zero investment strategy that is both size and momentum neutral. Similar interpretations can be given for SMB and WML.

The twenty-seven portfolios are value-weighted at construction. Given that our database includes also small capitalization securities, constructing value-weighted rather than equally weighted portfolios results in more realistic returns for the trading strategies.

The returns for the portfolio strategies are calculated for quarterly, semi-annual, and annual re-balancing frequencies. Independently of the rebalancing frequency, we use six-month prior B/M values to make sure that the information was available to the public before the portfolios are formed. Annually rebalanced portfolios use December-end B/M values, June-end market capitalization, and past twelve months of returns subsequent to July. We rebalance semi-annual portfolios at June-end and December-end. Finally, the quarterly sorted portfolios are rebalanced at the end of March, June, September, and December. If a stock does not have returns for any month through the duration of the holding period, we invest that portion of the portfolio into the corresponding country's risk-free asset.

Our portfolio construction procedure differs from the one used in Fama and French (1993). Fama and French use two independent sorts to create the HML and SMB portfolios while we use three sequential sorts to create the three portfolio strategies. The disadvantage of our approach is that our results may be specific to the sorting order used. The Fama and French approach is free of such criticism. However, it could not be used in this study due to the small number of securities we have in some countries. As a remedy, we reversed the sorting order and repeated all of our tests to ensure that our results are not specific to the sorting order chosen. We found that the main results of the paper remain largely unchanged. Therefore, in order to avoid repetition, we do not report them here.

2. Characteristics and Performance of the HML, SMB, and WML Strategies Internationally

Before we test for the potential link between the returns of the trading strategies and macroeconomic growth, it is useful to examine the performance of these strategies in the markets and time period covered by our data. Table 2 reports the returns of the three strategies for annual, semi-annual, and quarterly holding periods.

Our results confirm those of Fama and French (1998) that the value premium is pervasive. We find that, in general, the returns of HML are higher when the portfolios are rebalanced more frequently. For quarterly re-balancing, nine out of ten countries have statistically positive returns.

We also find that the momentum strategy examined provides significantly positive returns. This is consistent with Rouwenhorst's (1998) findings.^v It appears that momentum is very sensitive to the re-balancing period. Returns to WML decrease rapidly as the re-balancing interval increases. Note that the momentum strategy is not profitable in Italy and Japan.

Finally, we verify the existence of a size premium in our larger countries. SMB produces statistically significant returns in Canada, France, Japan, the United States and marginally significant returns in the United Kingdom. It does not appear to be profitable, however, in countries whose markets are typically smaller, less liquid and dominated by a few large capitalization stocks.

3. The Relation between the Returns on the Trading Strategies and the Macroeconomy

This section examines the potential relation between the return on HML, SMB, and WML strategies and future economic growth. Our analysis makes use of additional data, which are discussed below.

3.1. Country Variables

Apart from individual security returns, we use in each country, the return on the market portfolio (MKT), the dividend yield (DY), the short-term interest rate (TB), the term spread (TERM), the growth in the Gross Domestic Product (GDP) and the Industrial Production (IDP).

For a given country, DY represents the dividend yield index created from our database. The dividend index is the ratio of dividends from a market-capitalization-weighted portfolio for the past year to the value of the portfolio at quarter-end. The short-term interest rates and the long-term bond yields are from the International Monetary Fund, and they are reported on an annual basis. For Australia, Canada, Switzerland, the United States, and the United Kingdom we use the three-month Treasury Bill (TB). For the remaining countries we use the Call Money Rate. Both the Treasury bill yield and the money rate are the average of daily rates from the last month of the quarter. We create the variable TERM as the difference between the long-term government bond yield and the TB for each country. TERM measures the slope of the country yield curve. The GDP and IDP series are obtained from the OECD Main Indicators and the National Government Series. We compute continuously compounded

quarterly growth rates of each country's GDP and IDP, and report the annualized mean and standard deviation.^{vi}

3.2. Returns on the Trading Strategies at Different States of the Macroeconomy

We examine the returns on the HML, SMB, and WML strategies at different states of future economic growth. In particular, we associate next year's growth in GDP with past year's annual return, and we subsequently sort by growth in GDP every quarter. We call "Good States" of the economy those states that exhibit the highest 25% of future GDP growth, and "Bad States" those with the lowest 25% of future GDP growth.

The results are presented in Table 3. They show that the returns on HML and SMB are positively related to future growth in the macroeconomy. High portfolio returns precede periods of high GDP growth. Similarly, low portfolio returns are associated with low future GDP growth. This is true for the HML strategy in eight out of the ten countries, whereas it holds for nine out of ten countries for SMB, and six out of ten countries for WML.^{vii}

3.3. The Relation between the Return on the Trading Strategies and the Macroeconomy using Regression Analysis

3.3.1. Univariate Regressions

The above results, regarding the relation of the three strategies and economic growth, are confirmed in this section using regression analysis. Table 4 reports results from univariate regressions of future growth in GDP on past holding period's returns in HML,

SMB, and WML. The first panel reports results from regressions that use quarterly holding period returns while the middle and last panels report results from regressions that use semi-annual and annual holding period returns respectively. All regressions use quarterly data and they are of the form:

$$\text{GDPgrowth}_{(t,t+4)} = a + b * \text{FactorRet}_{(t-n,t)} + e_{(t,t+4)}$$

- n : 1 quarter, 2 quarters, and 4 quarters;
- GDPgrowth : Seasonally adjusted continuously compounded growth rates for country GDP;
- FactorRet : MKT, HML, SMB, and WML month returns compounded to 1 quarter, 2 quarters or 4 quarters; and
- $e_{(t,t+4)}$: The residual term of the regression.

GDP growth rates are observed at quarterly frequencies, and therefore, consecutive semi-annual and annual growth rates have one and three overlapping quarters, respectively. This induces serial correlation in the residuals of our regressions. To correct for this, we use the Newey and West (1987) estimator and set the parameter q equal to one for the semi-annual holding period regressions and three for the annual holding period regressions.^{viii}

In most countries, the returns of the three strategies have greater predictive power over future GDP growth as the holding period increases from one quarter to four quarters.

We would expect the slope coefficients to be positive if high returns of these strategies are associated with future good states of the economy. That would mean that high B/M and small capitalization stocks are better able to prosper when periods of high economic growth are expected, and they face a higher risk of financial distress if economic growth slows down. Indeed, the annual holding period regressions produce positive coefficients in eight of the ten countries for HML, nine for SMB and six for WML. In addition, three coefficients are also statistically significant in the case of HML,

seven in the case of SMB and only one in the case of WML. In general, the returns of the WML strategy appear to contain little, if any, information about future economic growth.

It is known that the market factor is a leading indicator of future economic growth. Furthermore, we know that there exists a positive relation between the returns on the market portfolio and future growth in the economy. Our results show that a similar relation exists between the performance of the HML and SMB trading strategies and future economic growth.

We confirm the stylized facts about the predictive ability of the market factor over future growth in the macroeconomy. For the annual holding period regressions, the slope coefficient is positive in all ten countries which means that periods of high market returns are followed by periods of high economic growth. Furthermore, the coefficients are of similar order of magnitude as those of the HML and SMB portfolios.

It is interesting to note that the information contained in the returns of HML and SMB about future economic growth is largely independent of the information contained in the market factor. The betas reported in Table 5 from regressions of HML, SMB, and WML on the market factor vary between -0.331 and 0.240 . Therefore, the positive relation between HML, SMB and future economic growth is unlikely to be induced by the known positive relation between the market factor and future economic growth. This is further confirmed by the results of the following section.

3.3.2. Multiple Regressions that include the Market Factor

In this section we explicitly compare the informational content of HML and SMB with that of MKT. Since GDP growth changes little from one quarter to another, we concentrate on annual holding period regressions, which are more informative.

The bivariate regressions we estimate include the market factor and the return on a trading strategy:

$$\text{GDPgrowth}_{(t,t+4)} = a + b * \text{MKT}_{(t-4,t)} + c * \text{FactorRet}_{(t-4,t)} + k_{(t,t+4)}$$

MKT : Annualized monthly excess market return over the risk-free rate.

FactorRet : Annualized monthly returns on HML, SMB, and WML.

$k_{(t,t+4)}$: the residuals of the regression.

Table 4 reports the results. Even in the presence of the market factor, the coefficients of HML and SMB remain positive and statistically significant. Furthermore, their magnitude is largely unchanged. HML has a positive and statistically significant coefficient in Australia, France, Italy, United Kingdom, and USA. The coefficient of SMB is positive and significant in Australia, Canada, France, Germany, Italy, the Netherlands, and the United Kingdom. As expected, the adjusted R-squares are now larger than those from the univariate regressions of Section 3.3.1 that included only the market factor. Therefore, the returns of HML and SMB contain information about the future state of the macroeconomy, over and above the information contained in the market factor. Once again, WML appears to have virtually no ability to explain future economic growth.

We now run a “horse-race” between HML and SMB by estimating the following regression model:

$$\text{GDPgrowth}_{(t,t+4)} = a + b * \text{MKT}_{(t-4,t)} + c * \text{HML}_{(t-4,t)} + d * \text{SMB}_{(t-4,t)} + u_{(t,t+4)}$$

Where $u_{(t,t+4)}$ denotes the residuals of the regression.

Table 7 reports the results. For seven out of the ten countries, either HML or SMB remains statistically significant. A comparison of the coefficients in Table 4 and Table 5 reveals that the sign and the magnitude of the coefficients remain relatively stable in the presence of both factors. In France HML subsumes the effects of SMB. The opposite occurs in Australia and United Kingdom where SMB subsumes the effects of HML. It seems that the informational content of HML and SMB regarding the future state of the macroeconomy is to some extent country specific. This is a plausible result, given that the countries included in our analysis differ in terms of the size of their markets, the average market capitalization, and their accounting standards.

3.3.3. Regressions That Include Business Cycle Variables and the Market Factor

Given the results of the previous sections, it is instructive to examine how much of the information contained in the returns of the trading strategies regarding future economic growth is also present in popular business cycle variables. The multiple regressions estimated are of the form:

$$\text{GDPgrowth}_{(t,t+4)} = a + b*\text{MKT}_{(t-4,t)} + c*\text{FactorRet}_{(t-4,t)} + d*\text{TB}_{(t)} + f*\text{DY}_{(t)} + g*\text{TERM}_{(t)} + h*\text{IDPgrowth}_{(t-4,t)} + q_{(t,t+4)}$$

- $\text{TB}_{(t)}$: Annual Treasury bill yield or Call Money Rate;
- $\text{DY}_{(t)}$: Dividend yield on country market capitalization index;
- $\text{TERM}_{(t)}$: 10 year government yield minus $\text{TB}_{(t)}$; and
- $\text{IDPgrowth}_{(t-4,t)}$: Past one-year growth in country industrial production.
- $q_{(t,t+4)}$: the residuals of the regression.

Table 8A presents the results. It appears that even in the presence of business cycle variables in addition to the market factor, HML still maintains a positive and

statistically significant relation with future economic growth in France, Italy, and the United Kingdom (see first panel). Furthermore, the predictive ability of SMB remains significant in France, Germany, Italy, the Netherlands, and the United States whereas it is subsumed by the presence of business cycle variables in Australia, Canada, Germany, and the United Kingdom (see second panel). Finally, WML has a positive and significant coefficient in the US and the UK.

We also perform regressions that include both the HML and SMB variables in addition to the business cycle state variables. The results are reported in Table 8B. HML has now a positive and significant coefficient only in France and the UK, whereas SMB has a positive and significant coefficient in France, Germany, Netherlands and the US. There is obviously some overlap in the information content of the returns of HML, SMB, and the business cycle variables. Our aim in this section has not been to propose a new model for predicting future economic growth. Instead, we aimed to evaluate the level and nature of information contained in the returns of the trading strategies regarding future economic growth. Our results show that at least HML and SMB contain significant information regarding future growth in the macroeconomy. Furthermore, some of this information is similar in nature to that contained in popular business cycle variables. Our findings support the Fama and French (1992, 1993, 1995, 1996, 1998) hypothesis. They imply that it is reasonable to consider HML and SMB as state variables that predict future changes in the investment opportunity set, in the context of Merton's intertemporal capital asset pricing model.

4. Turnover in the HML, SMB, and WML Portfolios

Is the market aware of the B/M, size, and momentum characteristics of securities? If these characteristics are persistent over time, then the answer is likely to be yes. In that case, risk averse investors may require a risk premium to hold stocks with persistently high B/M, small capitalization, and poor past performance.

Table 9 reports the turnover of the portfolios over the life of the trading strategies. In general, more than 50% of the securities in the HML and SMB portfolios remain the same over a period of three years, and more than 30% of the stocks never exit the portfolios over the life of the trading strategies. This is not the case for the WML portfolios, which exhibit much higher turnover in all countries. These results provide further support to a risk-based explanation for the performance of the HML and SMB trading strategies.

5. Conclusions

The aim of this study was to investigate the extent to which the profitability of the HML, SMB, and WML trading strategies can be linked to future economic growth.

Using a large cross-section of securities from ten developed markets, we found that at least the HML and SMB portfolios contain significant information about future GDP growth. The apparent predictive ability of these strategies appears to be to a large degree independent of any information contained in the market factor, which is known to be a leading indicator of economic growth. Similarly to the case of the market factor, the relation between the returns on HML and SMB and future economic growth is positive and economically significant. Even in the presence of popular business cycle

variables, HML and SMB retain their ability to predict future economic growth in some of the countries examined.

The results of this study suggest that a risk-based explanation for the returns of HML and SMB strategies is plausible and likely. Fama and French (1993, 1995, 1996, 1998) argue that HML and SMB are state variables that predict future changes in the investment opportunity in the context of Merton's (1973) intertemporal asset pricing model. Our findings support this hypothesis. Finally, our analysis reveals little evidence to support a similar explanation for the returns of WML.

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Table 1: Number of Securities Included in the July Portfolios of the Annual Portfolio Sorts

Year(July)	Australia	Canada	France	Germany	Italy	Japan	Netherlands	Switzerland	U.K.	U.S.
1978		140							1,079	1,546
1979		145					28		1,129	1,593
1980		150					36		1,142	1,637
1981		157				67	40		1,176	1,661
1982		170				85	42		1,186	1,734
1983		213				85	44		1,168	1,788
1984		224	100			656	41		1,173	1,811
1985	71	240	105			757	42		1,147	1,854
1986	88	248	111			798	42		1,099	1,844
1987	99	261	125	38	35	814	48	53	1,041	1,877
1988	102	296	129	134	48	823	48	67	1,029	1,911
1989	157	293	155	139	85	994	50	109	979	1,839
1990	160	317	281	224	89	1,049	53	128	918	1,763
1991	169	329	284	342	97	1,066	49	133	893	1,699
1992	175	356	292	379	103	1,072	52	132	849	1,654
1993	169	373	301	401	109	1,070	56	133	822	1,696
1994	182	425	292	409	111	1,074	92	142	809	1,810
1995	175	414	287	416	120	1,077	99	135	832	1,792
1996	175	382	280	441	122	1,086	100	131	817	1,670
avg.	144	270	211	292	92	786	53	116	1,015	1,746

For inclusion in a portfolio, a security must have positive December-end price-to-book values, June-end market capitalization, and twelve months of returns prior to July. Portfolios are held for one year and are rebalanced at the end of June. The data are from Datastream.

Table 2
Summary of Long-Short Portfolios Annual Returns
Portfolio Construction Over Different Horizons

Country	Quarterly Rebalancing			Semi-Annual Rebalancing			Annual Rebalancing		
	mean	std.	t-stat.	mean	std.	t-stat.	mean	std.	t-stat.
Australia									
HML	9.30%	14.53%	2.26**	9.14%	14.06%	2.29**	7.02%	13.14%	1.85*
SMB	6.21%	15.88%	1.38	2.79%	16.06%	0.61	8.82%	19.90%	1.53
WML	9.60%	14.98%	2.26**	12.56%	15.35%	2.88**	4.18%	15.74%	0.92
Canada									
HML	7.44%	11.06%	2.98**	8.56%	10.69%	3.53**	4.00%	10.71%	1.63
SMB	4.85%	10.71%	2.01**	6.02%	10.79%	2.46**	6.64%	10.43%	2.77**
WML	14.50%	14.80%	4.34**	10.52%	14.22%	3.26**	1.69%	13.22%	0.56
France									
HML	12.51%	9.09%	5.13**	12.05%	9.26%	4.85**	7.00%	8.74%	2.88**
SMB	5.22%	11.70%	1.66*	5.46%	11.42%	1.79*	5.57%	10.33%	1.94*
WML	10.17%	9.49%	4.00**	8.57%	9.14%	3.50**	7.64%	9.15%	3.00**
Germany									
HML	5.55%	6.42%	2.75**	3.14%	5.96%	1.66*	2.74%	7.59%	1.14
SMB	2.07%	9.69%	0.68	0.82%	9.63%	0.27	1.39%	9.55%	0.46
WML	9.60%	9.62%	3.18**	10.08%	9.62%	3.30**	7.70%	9.83%	2.47**
Italy									
HML	7.29%	9.77%	2.38**	7.47%	9.24%	2.55**	5.18%	10.27%	1.59
SMB	2.19%	10.50%	0.67	2.92%	10.32%	0.89	0.68%	10.93%	0.20
WML	5.17%	12.56%	1.31	3.24%	11.89%	0.86	-2.77%	12.18%	-0.72
Japan									
HML	8.75%	10.12%	3.53**	6.85%	9.77%	2.84**	8.21%	9.06%	3.61**
SMB	6.78%	15.27%	1.81*	6.92%	15.37%	1.82*	6.93%	14.08%	1.96*
WML	-1.67%	11.77%	-0.58	-1.42%	11.30%	-0.51	-3.09%	10.38%	-1.19
Netherlands									
HML	0.75%	11.50%	0.28	0.96%	11.60%	0.36	-1.22%	12.08%	-0.43
SMB	2.00%	12.98%	0.67	1.82%	12.73%	0.62	-1.75%	11.59%	-0.64
WML	14.00%	12.26%	4.97**	9.61%	12.85%	3.25**	11.03%	11.92%	3.92**
Switzerland									
HML	8.66%	10.34%	2.77**	7.62%	10.57%	2.38**	5.85%	9.90%	1.86*
SMB	-4.13%	10.81%	-1.26	-3.39%	11.01%	-1.02	-3.60%	9.19%	-1.23
WML	9.01%	9.83%	3.03**	7.54%	10.04%	2.48**	8.04%	8.97%	2.82**
United Kingdom									
HML	7.83%	6.05%	5.74**	6.92%	5.84%	5.22**	4.85%	5.86%	3.60**
SMB	4.35%	11.12%	1.74*	4.09%	11.02%	1.63	4.38%	10.94%	1.74*
WML	14.56%	7.20%	8.97**	13.23%	6.70%	8.69**	9.08%	6.24%	6.33**
United States									
HML	8.62%	9.20%	3.19**	6.82%	9.00%	3.34**	5.08%	8.74%	2.53**
SMB	8.86%	11.25%	3.49**	8.64%	11.44%	3.33**	6.84%	10.74%	2.77**
WML	11.30%	9.75%	5.14**	9.78%	9.34%	4.61**	4.39%	8.99%	2.12**

* Significant at the 10% Level.

** Significant at the 5% Level.

HML is the return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks, holding the 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 large capitalization stocks, holding the book-to-market and momentum characteristics of the portfolio constant. WML is the return on a portfolio that is long on the best performing stocks of the past year (“winners”) and short on the worst performing stocks of the past year (“losers”), holding the book-to-market and size effects of the portfolio constant. Returns and standard deviations are reported annualized.

Table 3: The Performance of the HML, SMB, and WML Strategies at Good and Bad States of the Economy

Past Year Return on Factor Sorted by Future GDP Growth						
Country	HML		SMB		WML	
	Good States	Bad States	Good States	Bad States	Good States	Bad States
Australia	23.88%	8.77%	22.93%	-1.87%	5.75%	5.15%
Canada	8.19%	15.57%	9.15%	-0.41%	21.53%	11.56%
France	30.11%	3.01%	16.29%	-0.94%	6.74%	9.43%
Germany	9.39%	2.80%	13.47%	-2.44%	17.50%	8.53%
Italy	19.75%	-0.92%	5.71%	-6.98%	6.10%	6.35%
Japan	13.02%	10.07%	12.98%	2.35%	1.79%	-5.06%
Netherlands	10.68%	-2.46%	9.61%	-8.09%	6.69%	18.90%
Switzerland	5.91%	7.85%	1.83%	3.91%	13.52%	7.51%
United Kingdom	17.85%	3.38%	13.59%	-7.10%	17.22%	17.23%
United States	8.49%	2.81%	12.98%	10.03%	13.82%	10.71%

HML is the return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks, holding the 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 large capitalization stocks, holding the book-to-market and momentum characteristics of the portfolio constant. WML is the return on a portfolio that is long on the best performing stocks of the past year (“winners”) and short on the worst performing stocks of the past year (“losers”), holding the book-to-market and size effects of the portfolio constant. GDP growth is calculated as the continuously compounded growth rate in a country’s Gross Domestic Product, which is seasonally adjusted. For Japan we use the seasonally adjusted Gross National Product. We characterize as “Good States” of the economy, those states that exhibit the highest 25% of future GDP growth, and “Bad States” those with the lowest 25% of future GDP growth.

Table 4: Univariate Regressions of GDP growth rates Conditional on Past One-Quarter, Two-Quarters, and Four-Quarters of Factor Returns
 $GDPgrowth(t,t+4) = a + b*FactorRet(t-n,t) + e(t,t+n)$ where $n=1,2,$ or 4 .

Country	Time Period	Slope Coefficient				t-statistics				Coefficient of Determinations			
		MKT	HML	SMB	WML	MKT	HML	SMB	WML	MKT	HML	SMB	WML
		Past One Quarter: $GDPgrowth(t,t+4) = a + b *FactorRet (t-1,t) + e(t,t+4)$											
Australia	1984Q4-1996Q2	0.047	0.019	0.051	0.021	1.28	0.48	2.04**	0.66	3.9%	-1.7%	4.8%	-1.7%
Canada	1977Q4-1996Q2	0.133	-0.017	0.048	0.009	3.03**	-0.34	1.55	0.18	15.7%	-1.2%	0.0%	-1.3%
France	1983Q2-1996Q2	0.016	0.098	0.110	-0.010	0.73	4.60**	4.05**	-0.28	-0.7%	11.1%	12.8%	-1.8%
Germany	1987Q1-1996Q3	-0.011	-0.239	0.189	0.095	-0.17	-1.24	3.08**	0.78	-2.6%	2.9%	6.3%	-0.7%
Italy	1987Q2-1996Q3	0.031	0.103	0.124	-0.022	1.19	2.72**	3.10**	-0.80	2.0%	10.4%	13.5%	-1.5%
Japan	1980Q3-1996Q3	0.018	0.018	0.048	0.030	0.72	0.52	1.52	1.03	-0.6%	-1.3%	2.3%	-0.7%
Netherlands	1978Q2-1996Q3	0.059	-0.006	0.015	-0.048	2.17**	-0.14	0.58	-1.44	5.3%	-1.3%	-1.1%	1.4%
Switzerland	1986Q2-1995Q4	0.010	-0.029	-0.053	-0.010	0.30	-1.00	-1.05	-0.49	-2.3%	-1.3%	2.1%	-2.5%
UK	1977Q4-1996Q3	0.070	0.161	0.137	-0.043	1.95*	2.39**	3.27**	-0.69	4.5%	7.0%	12.5%	-0.9%
USA	1977Q4-1996Q3	0.084	0.001	0.069	0.105	2.01**	0.02	1.66*	1.52	7.2%	-1.4%	2.8%	3.0%
		Past Two Quarters: $GDPgrowth(t,t+4) = a + b *FactorRet (t-2,t) + e(t,t-4)$											
Australia	1985Q1-1996Q2	0.048	0.022	0.054	0.022	1.47	0.75	2.16**	0.86	9.8%	-0.7%	11.5%	-1.0%
Canada	1978Q1-1996Q2	0.098	-0.027	0.048	0.017	3.28**	-0.66	2.00**	0.47	23.0%	-0.4%	2.0%	-0.7%
France	1983Q3-1996Q2	0.014	0.096	0.090	-0.008	0.82	5.84**	5.33**	-0.29	0.3%	28.3%	20.6%	-1.7%
Germany	1987Q2-1996Q3	0.002	-0.089	0.174	0.114	0.03	-0.55	3.66**	1.03	-2.8%	-1.5%	14.7%	3.3%
Italy	1987Q3-1996Q3	0.031	0.087	0.096	-0.013	1.44	2.97**	3.61**	-0.59	7.8%	19.4%	21.1%	-2.1%
Japan	1980Q4-1996Q3	0.024	0.000	0.040	0.041	1.16	0.02	1.72*	1.74*	2.1%	-1.6%	4.1%	1.3%
Netherlands	1978Q3-1996Q3	0.046	0.006	0.055	-0.057	2.41**	0.25	2.15**	-2.41**	8.1%	-1.3%	5.0%	6.6%
Switzerland	1986Q3-1995Q4	0.014	-0.040	-0.053	-0.019	0.47	-1.56	0.60	-0.79	-1.2%	1.0%	8.4%	-2.0%
UK	1978Q1-1996Q3	0.064	0.111	0.109	-0.036	2.29**	2.61**	4.22**	-0.83	8.6%	11.1%	20.7%	-0.6%
USA	1978Q1-1996Q3	0.069	0.010	0.062	0.073	2.23**	0.27	1.52	1.39	12.7%	-1.2%	4.8%	3.5%
		Past Four Quarters: $GDPgrowth(t,t+4) = a + b *FactorRet (t-4,t) + e(t,t+4)$											
Australia	1985Q3-1996Q2	0.028	0.036	0.053	0.023	1.31	1.60	3.16**	0.97	7.5%	7.3%	31.9%	0.5%
Canada	1978Q3-1996Q2	0.051	-0.033	0.052	0.021	2.93**	-1.21	2.67**	1.05	16.3%	1.9%	8.2%	1.4%
France	1984Q1-1996Q2	0.009	0.072	0.052	0.001	0.77	4.80**	3.09**	0.03	0.1%	41.4%	16.0%	-2.1%
Germany	1987Q4-1996Q3	0.056	0.070	0.125	0.144	1.40	0.73	3.40**	1.31	6.4%	-1.0%	11.9%	14.9%
Italy	1988Q1-1996Q3	0.031	0.067	0.061	-0.007	2.75**	3.30**	3.06**	-0.54	25.4%	33.0%	20.4%	-2.7%
Japan	1981Q2-1996Q3	0.031	0.006	0.022	0.053	2.04**	0.32	1.40	2.65**	12.3%	-1.5%	2.2%	8.8%
Netherlands	1979Q1-1996Q3	0.029	0.016	0.075	-0.039	1.90*	0.89	4.65**	-1.89*	7.6%	0.7%	20.0%	7.9%
Switzerland	1987Q1-1995Q4	0.016	-0.026	-0.056	-0.001	0.86	-1.68*	-1.88*	-0.06	1.4%	0.6%	27.3%	-2.9%
UK	1978Q3-1996Q3	0.069	0.068	0.070	-0.001	3.29**	2.37**	4.04**	-0.04	19.3%	12.2%	21.2%	-1.4%
USA	1978Q3-1996Q3	0.047	0.024	0.036	0.065	2.33**	1.05	1.06	1.42	11.8%	0.6%	3.4%	5.7%

* Significant at the 10% Level.

** Significant at the 5% Level.

T-statistics are corrected for heteroskedasticity and serial correlation (of lags zero (first panel), one (second panel) and three (third panel)) using the Newey West (1987) estimator. In the regression notation, "FactorRet" stands for MKT, HML, SMB, and WML. MKT is the excess return on the local market index. HML is the return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks, holding the 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 large capitalization stocks, holding the book-to-market and momentum characteristics of the portfolio constant. WML is the return on a portfolio that is long on the best performing stocks of the past year ("winners") and short on the worst performing stocks of the past year ("losers"), holding the book-to-market and size effects of the portfolio constant. GDP growth is calculated as the continuously compounded growth rate in a country's Gross Domestic Product, which is seasonally adjusted. For Japan we use the seasonally adjusted Gross National Product. All returns are annualized and continuously compounded.

Table 5: Regression Results of Portfolio Strategy Returns on Excess Market Returns

Country	Time Period	HML			SMB			WML		
		alpha	beta	adj. R2	alpha	beta	adj. R2	alpha	beta	adj. R2
Australia	1984M10-1997M5	0.010	-0.190	6.7%	0.007	-0.230	6.9%	0.006	0.203	6.1%
		3.20**	-3.45**		1.92*	-3.49**		1.74*	3.29**	
Canada	1977M10-1997M5	0.010	-0.170	5.2%	0.007	-0.207	9.9%	0.011	0.141	2.3%
		4.77**	-3.27**		3.58**	-5.19**		4.36**	2.56**	
France	1983M4-1997M5	0.010	0.111	4.1%	0.005	0.020	-0.5%	0.010	0.091	2.8%
		4.59**	2.87**		1.89*	0.45		4.63**	2.42**	
Germany	1987M1-1997M5	0.006	0.006	-0.8%	0.002	-0.331	29.8%	0.008	-0.088	1.9%
		3.03**	0.18		0.78	-8.39**		3.58**	-1.86*	
Italy	1987M4-1997M5	0.008	0.108	5.5%	0.001	-0.033	-0.3%	0.005	-0.138	5.5%
		2.95**	2.84**		0.21	-0.82		1.53	-2.83**	
Japan	1980M7-1997M5	0.011	-0.130	6.0%	0.005	0.008	-0.5%	0.000	0.030	-0.2%
		5.79**	-3.72**		1.65	0.13		0.22	0.71	
Netherlands	1978M4-1997M5	-0.002	0.002	-0.4%	0.000	-0.065	0.2%	0.012	-0.030	-0.3%
		-0.01	0.03		0.17	-1.23		4.74**	-0.55	
Switzerland	1986M4-1997M5	0.004	0.183	7.3%	-0.001	-0.209	9.9%	0.007	0.052	0.0%
		1.65	3.39**		-0.370	-3.95**		2.89**	1.01	
United Kingdom	1977M10-1997M5	0.007	-0.056	1.6%	0.006	-0.324	22.1%	0.013	0.051	1.2%
		5.75**	-2.21**		3.00**	-8.23**		9.94**	1.98**	
United States	1977M10-1997M5	0.010	-0.313	14.3%	0.009	0.055	-0.1%	0.011	0.240	7.9%
		4.77**	-6.33**		3.57**	0.94		4.87**	4.60**	

* Significant at the 10% Level.

** Significant at the 5% Level.

T-values appear below the coefficient estimates and they are adjusted for heteroskedasticity and serial correlation. HML is the return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks, holding the 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 large capitalization stocks, holding the book-to-market and momentum characteristics of the portfolio constant. WML is the return on a portfolio that is long on the best performing stocks of the past year (“winners”) and short on the worst performing stocks of the past year (“losers”), holding the book-to-market and size effects of the portfolio constant. The data are from Datastream.

Table 6: Predicting Annual GDP Growth Rates Conditional on Information about the Return on the Market and HML, SMB, and WML Trading Strategies : Bivariate Regressions

$$\text{GDPgrowth}(t,t+4) = a + b*\text{MKT}(t-4,t) + c*\text{FactorRet}(t-4,t) + e(t,t+4)$$

Country	Time Period	MKT		HML		adj. R2
		slope	t-stat.	slope	t-stat.	
Australia	1985Q3-1996Q2	0.029	1.39	0.037	2.22**	15.84%
Canada	1978Q3-1996Q2	0.049	2.83**	-0.022	-1.03	16.66%
France	1984Q1-1996Q2	-0.008	-1.16	0.077	5.44**	41.47%
Germany	1987Q4-1996Q3	0.054	1.39	0.025	0.25	3.80%
Italy	1988Q1-1996Q3	0.019	1.86*	0.050	2.44**	38.93%
Japan	1981Q2-1996Q3	0.031	2.10**	0.010	0.62	11.31%
Netherlands	1979Q1-1996Q3	0.035	2.69**	0.026	1.43	11.41%
Switzerland	1987Q1-1995Q4	0.025	1.32	-0.042	-2.10**	6.52%
United Kingdom	1978Q3-1996Q3	0.067	4.05**	0.065	2.74**	30.50%
United States	1978Q3-1996Q3	0.065	3.09**	0.058	2.83**	20.24%

Country		MKT		SMB		adj. R2
		slope	t-stat.	slope	t-stat.	
Australia	1985Q3-1996Q2	0.017	1.02	0.049	3.40**	33.49%
Canada	1978Q3-1996Q2	0.051	3.24**	0.052	2.51**	24.73%
France	1984Q1-1996Q2	0.007	0.65	0.051	3.14**	15.54%
Germany	1987Q4-1996Q3	0.082	2.13**	0.164	2.88**	28.00%
Italy	1988Q1-1996Q3	0.026	2.54**	0.047	3.14**	36.43%
Japan	1981Q2-1996Q3	0.029	1.93*	0.017	1.24	13.18%
Netherlands	1979Q1-1996Q3	0.027	2.14**	0.073	4.79**	26.84%
Switzerland	1987Q1-1995Q4	0.005	0.30	-0.054	-1.85*	25.50%
United Kingdom	1978Q3-1996Q3	0.055	2.98**	0.057	3.90**	32.35%
United States	1978Q3-1996Q3	0.043	2.41**	0.017	0.63	11.49%

Country		MKT		WML		adj. R2
		slope	t-stat.	slope	t-stat.	
Australia	1985Q3-1996Q2	0.026	1.29	0.009	0.38	5.57%
Canada	1978Q3-1996Q2	0.049	2.81**	0.014	1.00	16.38%
France	1984Q1-1996Q2	0.012	0.91	-0.009	-0.44	-1.45%
Germany	1987Q4-1996Q3	0.029	0.76	0.122	1.11	14.46%
Italy	1988Q1-1996Q3	0.032	2.85**	0.002	0.17	23.07%
Japan	1981Q2-1996Q3	0.025	1.50	0.037	1.47	15.24%
Netherlands	1979Q1-1996Q3	0.031	2.05**	-0.041	-2.25**	16.67%
Switzerland	1987Q1-1995Q4	0.018	0.88	-0.013	-0.50	-1.00%
United Kingdom	1978Q3-1996Q3	0.072	3.57**	-0.027	-0.65	19.11%
United States	1978Q3-1996Q3	0.041	1.95*	0.022	0.49	11.07%

* Significant at the 10% Level.

* Significant at the 10% level.

** Significant at the 5% level.

T-statistics are adjusted for heteroscedasticity and serial correlation using the Newey West (1987) estimator. The parameter q was set equal to three. MKT is the excess return on the local market index. In the regression notation, "FactorRet" stands for HML, SMB, and WML. HML is the return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks, holding the 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 large capitalization stocks, holding the book-to-market and momentum characteristics of the portfolio constant. WML is the return on a portfolio that is long on the best performing stocks of the past year ("winners") and short on the worst performing stocks of the past year ("losers"), holding the book-to-market and size effects of the portfolio constant. GDP growth is calculated as the continuously compounded growth rate in a country's Gross Domestic Product, which is seasonally adjusted. For Japan we use the seasonally adjusted Gross National Product. All returns are annualized and continuously compounded.

Table 7: Predicting Annual GDP Growth Rates Conditional on Information about the Return on the Market and HML, SMB, and WML Trading Strategies :
Multivariate Regressions

$$\text{GDPgrowth}(t,t+4) = a + b*\text{MKT}(t-4,t) + c*\text{HML}(t-4,t) + d*\text{SMB}(t-4,t) + e(t,t+4)$$

Country	Time Period	MKT		HML		SMB		adj. R2
		slope	t-stat.	slope	t-stat.	slope	t-stat.	
Australia	1985Q3-1996Q2	0.015	0.94	-0.008	-0.41	0.054	2.43**	32.10%
Canada	1978Q3-1996Q2	0.048	3.18**	-0.028	-1.30	0.054	2.49**	26.11%
France	1984Q1-1996Q2	-0.007	-0.93	0.070	4.49**	0.015	1.01	41.40%
Germany	1987Q4-1996Q3	0.081	1.88*	0.008	0.10	0.016	2.77**	25.78%
Italy	1988Q1-1996Q3	0.020	1.82*	0.035	1.33	0.023	1.30	38.76%
Japan	1981Q2-1996Q3	0.030	2.01**	0.014	0.86	0.019	1.40	12.73%
Netherlands	1979Q1-1996Q3	0.030	2.90**	0.010	0.55	0.068	4.06**	26.39%
Switzerland	1987Q1-1995Q4	0.006	0.32	-0.002	-0.09	-0.054	-1.62	23.23%
United Kingdom	1978Q3-1996Q3	0.057	3.42**	0.045	1.67*	0.043	2.21**	36.53%
United States	1978Q3-1996Q3	0.059	3.20**	0.062	2.85**	0.026	0.99	21.30%

* Significant at the 10% Level.

** Significant at the 5% Level.

T-statistics are adjusted for heteroscedasticity and serial correlation using the Newey West (1987) estimator. The parameter q was set equal to three. MKT is the excess return on the local market index. HML is the return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks, holding the 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 large capitalization stocks, holding the book-to-market and momentum characteristics of the portfolio constant. WML is the return on a portfolio that is long on the best performing stocks of the past year ("winners") and short on the worst performing stocks of the past year ("losers"), holding the book-to-market and size effects of the portfolio constant. GDP growth is calculated as the continuously compounded growth rate in a country's Gross Domestic Product, which is seasonally adjusted. For Japan we use the seasonally adjusted Gross National Product. All returns are annualized and continuously compounded.

Table 8A: The Ability of Stock Market Factors to Predict Annual GDP Growth in the Presence of Business Cycle Variables

$$\text{GDPgrowth}(t,t+4) = a + b*\text{MKT}(t-4,t) + c*\text{FactorRet}(t-4,t) + d*\text{TB}(t) + f*\text{DY}(t) + g*\text{TERM}(t) + h*\text{IDPgrowth}(t-4,t) + e(t,t+4)$$

Country	Time Period	MKT		HML		TB		DY		TERM		IDP growth		adj. R2
		slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	
Australia	1985Q3-1995Q2	-0.048	-5.73**	-0.001	-0.12	-0.247	1.55	-3.168	-8.41**	-0.590	-2.39**	-0.105	-2.14**	72.5%
Canada	1978Q3-1996Q2	0.046	3.91**	-0.035	-2.01**	-0.042	-0.24	0.530	0.86	0.826	3.70**	0.043	0.70	51.8%
France	1984Q1-1996Q2	-0.008	-1.02	0.076	8.37**	-0.143	-1.02	-0.276	-0.99	0.086	0.40	-0.049	-0.93	46.7%
Germany	1987Q4-1996Q3	0.133	2.30**	0.101	1.21	2.639	2.15**	5.234	1.48	3.444	2.19**	0.108	0.73	37.0%
Italy	1988Q1-1996Q3	0.018	2.93**	0.028	2.14**	-0.428	-2.43**	0.067	0.13	0.043	0.29	-0.021	-0.54	72.3%
Japan	1981Q2-1996Q3	0.022	1.81*	0.019	1.82*	0.197	0.72	-0.950	-0.94	0.205	0.59	0.245	4.21**	48.9%
Netherlands	1979Q1-1996Q3	0.013	0.13	0.017	1.14	-0.805	-3.22**	0.216	0.76	-0.619	-2.16**	0.038	0.94	43.6%
Switzerland	1987Q1-1995Q4	0.001	0.03	-0.035	-1.05	1.007	2.49**	-3.102	-2.42**	0.670	1.17	0.140	1.54	41.0%
UK	1978Q3-1996Q3	0.027	1.47	0.063	3.16**	0.038	0.22	-1.030	-1.47	0.678	3.19**	-0.067	-0.79	59.1%
USA	1978Q3-1996Q3	0.062	2.53**	-0.004	-0.16	-0.002	-0.01	0.689	1.48	0.671	3.50**	0.044	0.70	40.6%

Country	Time Period	MKT		SMB		TB		DY		TERM		IDP growth		adj. R2
		slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	
Australia	1985Q3-1995Q2	-0.047	-6.42**	0.011	0.90	-0.139	-0.84	-3.048	-8.91**	-0.433	-1.64	-0.090	-1.85*	73.0%
Canada	1978Q3-1996Q2	0.053	4.16**	-0.002	-0.11	-0.107	-0.45	0.768	1.21	0.768	3.09**	0.015	0.24	48.4%
France	1984Q1-1996Q2	0.000	0.02	0.056	3.39**	0.044	0.26	-1.061	-2.09**	0.285	1.05	-0.153	-2.34**	29.5%
Germany	1987Q4-1996Q3	0.186	2.64**	0.191	2.82**	2.247	1.89*	5.203	1.50	3.948	2.44**	-0.225	0.17	47.4%
Italy	1988Q1-1996Q3	0.022	2.68**	0.040	2.42**	-0.234	-1.44	-0.626	-1.10	0.120	0.92	-0.079	-1.27	74.0%
Japan	1981Q2-1996Q3	0.023	2.06**	-0.019	-1.34	0.233	0.82	-1.189	-1.07	0.130	0.35	0.254	4.38**	49.2%
Netherlands	1979Q1-1996Q3	0.012	1.45	0.052	4.63**	-0.740	-3.30**	0.200	0.78	-0.550	-2.27**	-0.016	-0.40	50.5%
Switzerland	1987Q1-1995Q4	-0.013	-0.80	-0.027	-0.86	0.975	2.48**	-3.079	-2.45**	0.765	1.49	0.103	1.36	42.5%
UK	1978Q3-1996Q3	0.018	0.84	0.006	0.31	0.278	1.38	-1.756	-1.97**	0.813	2.89**	-0.008	-0.08	51.7%
USA	1978Q3-1996Q3	0.051	2.96**	0.039	1.76*	0.079	0.42	0.513	1.30	0.775	3.91**	0.012	0.19	45.1%

Country	Time Period	MKT		WML		TB		DY		TERM		IDP growth		adj. R2
		slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	
Australia	1985Q3-1995Q2	-0.050	-4.87**	0.003	0.26	-0.227	-1.93*	-3.190	-7.87**	-0.567	-2.71**	-0.1018	-2.05**	72.6%
Canada	1978Q3-1996Q2	0.051	4.36**	0.012	0.96	-0.077	-0.39	0.833	1.33	0.784	3.15**	0.032	0.47	49.2%
France	1984Q1-1996Q2	0.002	0.15	-0.006	-0.38	0.124	0.66	-1.164	-2.57**	0.353	1.30	-0.005	-0.08	15.2%
Germany	1987Q4-1996Q3	0.091	1.69*	0.101	1.53	1.563	1.57	4.306	1.34	1.667	1.32	0.277	1.84*	39.5%
Italy	1988Q1-1996Q3	0.024	1.33	-0.016	-0.53	-0.462	-1.05	0.048	0.07	-0.004	-0.01	0.009	0.24	70.6%
Japan	1981Q2-1996Q3	0.020	1.73*	0.012	0.56	0.163	0.56	-0.796	-0.75	0.117	0.32	0.236	3.97**	47.5%
Netherlands	1979Q1-1996Q3	0.011	1.31	-0.037	-2.82**	-0.824	-4.28**	0.250	0.99	-0.585	-2.29**	0.031	0.72	50.6%
Switzerland	1987Q1-1995Q4	0.001	0.11	-0.028	-1.75*	1.290	4.14**	-2.964	-2.50**	1.147	3.51**	0.096	1.25	41.3%
UK	1978Q3-1996Q3	0.001	0.04	0.057	1.81*	0.455	1.93*	-2.371	-2.52**	1.050	3.73**	0.003	0.04	54.8%
USA	1978Q3-1996Q3	0.036	1.82*	0.086	3.38**	0.108	0.64	0.502	1.29	0.822	4.68**	0.090	1.60	47.4%

* Significant at the 10% Level.

** Significant at the 5% Level.

T-statistics are adjusted for heteroscedasticity and serial correlation using the Newey West (1987) estimator. The parameter q was set equal to three. MKT is the excess return on the local market index. In the regression notation, "FactorRet" stands for HML, SMB, and WML. HML is the return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks, holding the 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 large capitalization stocks, holding the book-to-market and momentum characteristics of the portfolio constant. WML is the return on a portfolio that is long on the best performing stocks of the past year ("winners") and short on the worst performing stocks of the past year ("losers"), holding the book-to-market and size effects of the portfolio constant. TB denotes the annual Treasury Bill yield. DY is the dividend yield on a country's market capitalization weighted index. TERM stands for the premium on a ten-year government bond minus the TB rate. IDP growth is the growth in a country's industrial production. GDP growth is calculated as the continuously compounded growth rate in a country's Gross Domestic Product, which is seasonally adjusted. For Japan we use the seasonally adjusted Gross National Product. All returns are annualized and continuously compounded.

Table 8B: The Ability of Stock Market Factors to Predict Annual GDP Growth in the Presence of Business Cycle Variables

$$\text{GDPgrowth}(t,t+4) = a + b*\text{MKT}(t-4,t) + c*\text{HML}(t-4,t) + d*\text{SMB}(t-4,t) + f*\text{TB}(t) + g*\text{DY}(t) + h*\text{TERM}(t) + i*\text{IDPgrowth}(t-4,t) + e(t,t+4)$$

Country	Time Period	MKT		HML		SMB		TB		DY		TERM		IDP growth		adj. R2
		slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	slope	t-stat.	
Australia	1985Q3-1995Q2	-0.048	-6.22**	-0.006	-0.42	0.013	1.00	-0.165	-0.93	-3.037	-8.91**	-0.481	-1.77*	-0.091	-1.86*	72.1%
Canada	1978Q3-1996Q2	0.047	3.77**	-0.036	-2.00**	0.004	0.18	-0.030	-0.14	0.519	0.82	0.824	3.72**	0.044	0.72	51.0%
France	1984Q1-1996Q2	-0.007	-0.87	0.066	6.32**	0.028	1.77*	-0.141	-1.10	-0.335	-1.15	0.097	0.45	-0.118	-1.97**	48.4%
Germany	1987Q4-1996Q3	0.174	2.58**	0.089	1.10	0.187	2.77**	2.677	2.13**	4.520	1.32	4.430	2.69**	-0.280	-1.94**	47.7%
Italy	1988Q1-1996Q3	0.024	2.85**	-0.006	-0.20	0.045	1.48	-0.196	-0.73	-0.734	-0.80	0.142	0.74	-0.084	-1.15	72.2%
Japan	1981Q2-1996Q3	0.022	2.05**	0.016	1.25	-0.017	-1.13	0.225	0.82	-1.261	-1.16	0.174	0.46	0.258	4.58**	49.5%
Netherlands	1979Q1-1996Q3	0.013	1.54	0.005	0.37	0.049	4.58**	-0.735	-3.22**	0.196	0.75	-0.552	-2.36**	-0.012	-0.31	49.9%
Switzerland	1987Q1-1995Q4	-0.009	-0.46	-0.018	-0.74	-0.022	-0.68	0.914	2.03**	-3.125	-2.50**	0.632	1.02	0.128	1.86*	41.1%
United Kingdom	1978Q3-1996Q3	0.027	1.48	0.064	3.00**	-0.004	-0.22	0.043	0.25	-1.057	-1.46	0.695	3.14**	-0.063	-0.74	58.5%
United States	1978Q3-1996Q3	0.051	2.72**	0.000	0.01	0.039	1.71*	0.079	0.43	0.513	1.30	0.774	4.30**	0.012	0.18	44.3%

* Significant at the 10% Level.

** Significant at the 5% Level.

T-statistics are adjusted for heteroscedasticity and serial correlation using the Newey West (1987) estimator. The parameter q was set equal to three. MKT is the excess return on the local market index. HML is the return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks, holding the 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 large capitalization stocks, holding the book-to-market and momentum characteristics of the portfolio constant. WML is the return on a portfolio that is long on the best performing stocks of the past year ("winners") and short on the worst performing stocks of the past year ("losers"), holding the book-to-market and size effects of the portfolio constant. TB denotes the annual Treasury Bill yield. DY is the dividend yield on a country's market capitalization weighted index. TERM stands for the premium on a ten-year government bond minus the TB rate. IDP growth is the growth in a country's industrial production. GDP growth is calculated as the continuously compounded growth rate in a country's Gross Domestic Product, which is seasonally adjusted. For Japan we use the seasonally adjusted Gross National Product. All returns are annualized and continuously compounded.

Table 9: Turnover in HML, SMB, and WML Portfolios

		Australia	Canada	France	Germany	Italy	Japan	Netherlands	Switzerland	UK	USA
Turnover in Book-to-Market Portfolios											
1 year	High	71%	74%	77%	80%	81%	75%	81%	78%	74%	51%
	Low	73%	75%	73%	70%	79%	78%	79%	78%	74%	68%
3 years	High	50%	59%	58%	67%	61%	59%	66%	60%	54%	34%
	Low	61%	58%	58%	54%	59%	61%	66%	61%	52%	46%
5 years	High	37%	50%	45%	60%	53%	56%	48%	46%	41%	28%
	Low	52%	48%	50%	48%	48%	50%	57%	49%	39%	35%
10 years	High	18%	36%	30%	50%	45%	56%	24%	6%	19%	20%
	Low	45%	29%	40%	23%	33%	38%	46%	22%	22%	23%
Turnover in Size Portfolios											
1 year	Small	71%	78%	76%	72%	82%	83%	77%	74%	76%	65%
	Large	81%	88%	84%	91%	89%	92%	84%	86%	87%	84%
3 years	Small	54%	62%	59%	47%	77%	68%	61%	60%	55%	42%
	Large	78%	82%	81%	92%	85%	92%	78%	83%	75%	71%
5 years	Small	47%	49%	39%	32%	75%	63%	49%	57%	39%	30%
	Large	73%	79%	79%	91%	89%	93%	70%	76%	65%	62%
10 years	Small	47%	35%	17%	25%	64%	44%	37%	35%	17%	14%
	Large	70%	70%	72%	92%	83%	96%	59%	78%	46%	50%
Turnover in Momentum Portfolios											
1 year	Winners	33%	31%	36%	39%	35%	30%	37%	41%	35%	29%
	Losers	33%	32%	36%	37%	35%	32%	34%	37%	34%	28%
3 years	Winners	31%	33%	28%	28%	35%	27%	29%	32%	25%	22%
	Losers	26%	33%	33%	32%	33%	37%	26%	28%	24%	23%
5 years	Winners	25%	26%	28%	29%	31%	30%	25%	29%	22%	18%
	Losers	23%	28%	28%	30%	28%	34%	27%	33%	20%	20%
10 years	Winners	20%	22%	23%	38%	50%	29%	24%	11%	15%	13%
	Losers	18%	21%	25%	25%	50%	30%	21%	18%	15%	15%

This table presents the percentage of securities that remain the same in the HML, SMB, and WML portfolios over different time horizons for the trading strategies. “High” denotes the percentage of securities with high B/M characteristics that remain in the HML portfolios over the years. “Low” denotes the percentage of low B/M securities that remain the same. Similarly, “Small” and “Large” denote respectively the percentage of small and large capitalization stocks that remain the same in the SMB portfolios. Finally, “Winners” and “Losers” denote the percentage of past year’s best performing and worst performing stocks, respectively, that remain the same in the WML portfolios. Note that in cases of Germany, Italy, and Switzerland, the HML, SMB, and WML strategies are performed for a maximum of nine years, instead of ten, due to data availability restrictions.

Endnotes

ⁱ Hawawini and Keim (1995) provide a survey of the size effect in international markets. They report a size effect in Belgium, Japan, Spain, and the United Kingdom, whereas no effect was found in Canada and France. Suggested evidence of an international size effect is also found in Heston, Rouwenhorst, and Wessels (1995).

ⁱⁱ The greater profitability of momentum strategies with shorter re-balancing intervals is consistent with Rouwenhorst's (1998) findings.

ⁱⁱⁱ In the U.S. and the UK the number of dead stocks was over 8,000. We therefore screened the defunct stocks and included only those with at least 60 price observations. The price series of defunct stocks repeat the last price. To mitigate this problem, we deleted any single price that was repeated at least six times.

^{iv} Excluding the most recent month return eliminates problems associated with micro-structure issues such as the bid-ask bounce; see Asness (1995).

^v There exist some discrepancies between our results and those of Rouwenhorst (1998). Note that Rouwenhorst's data cover the period from 1980-1995, while ours run from 1977 to 1997:5, depending on the country. Furthermore, Rouwenhorst's portfolios are equally weighted whereas ours are value weighted.

^{vi} All GDP and IPD series are seasonally adjusted. For Japan we use the GNP since the GDP was not available.

^{vii} Similar results are obtained when the order in portfolio formation is reversed.

^{viii} Our results remain qualitatively the same when the parameter q in the Newey-West estimator takes the alternative values of 4, 5, or 6.