SOURCES OF CROSS SECTIONAL AND TIME SERIES VARIATION IN STOCK RETURNS IN CANADA

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ABSTRACT

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In this study, I will use attribute-sorted portfolios for some of the most popular fundamental and technical factors mentioned in past literature. The study will be the first to address whether or not the joint hypothesis of the Fama and French multi-factor model and the Efficient Market Hypothesis hold for Canadian firms. In addition, I will explore whether or not recent variance of the Fama and French approach have validity in Canada. The results show that although the multi-factor model is significant in explaining returns it does not fully explain the cross section of Canadian returns. Furthermore, when using the multi-factor approach on portfolios sorted by capital investment expenditures the model does poorly. The case for efficient markets is not supported by the Canadian data.

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There is one central theme connecting all of the people above: Freedom. They provided me with the freedom I needed in order to accomplish my goals and dreams. Because of this I value freedom above all other things. It liberates an individual to accomplish anything he desires. I believe that, along with Love, it is probably the strongest positively motivating force out there.

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1. INTRODUCTION

The Capital Asset Pricing Model (CAPM) has been subject to much criticism during the past decade. Foremost amongst the shortcomings cited include: Its alleged inability to fully capture the cross-section of expected returns, and the identification of many anomalies (such as the size effect). The equation for the CAPM is as follows:

$$E(R_i) = R_f + \beta_i [E(R_m) - R_f] \text{ ,}$$

where

$\beta_i = \dfrac{COV(R_i, R_m)}{VAR(R_m)}$ = the beta for stock i.

R_f = the risk-free rate of return.

$E(R_i)$ = the expected return of stock i.

$E(R_m)$ = the expected return of the market.

An alternative approach to asset pricing designed to address the CAPM's limitations is Ross's (1977) Arbitrage Pricing Theory (APT). The APT allows for a number of possible factors that can explain expected returns, not just the single market factor in the CAPM framework. A stock's return at any time t is equal to its expected return plus the return associated with a number of zero-mean factors (such as unexpected inflation, unexpected industrial production, etc.). The equation is as follows:

$$R_i = E(R_i) + \beta_{i1} F_1 + \ldots + \beta_{ik} F_k + \varepsilon_i$$

where

R_i = the random rate of return on asset i.

$E(R_i)$ = the expected rate of return on asset i.

β_{ik} = the sensitivity of asset i's return to the kth factor.

F_k = the mean zero kth factor common to the return of all assets.

ε_i = a random zero mean noise term for the ith asset.

Tests of the APT framework have not shown conclusive evidence that it dominates the CAPM. More recently, Fama and French (1993) introduce an attribute-sorted portfolio approach to capture the cross section of expected returns, which appears to be successful in explaining stock returns in the U.S., and is supportive of the efficient market hypothesis (EMH).

In this study, I will use attribute-sorted portfolios for some of the most popular fundamental and technical factors mentioned in past literature. The study will be the first to address whether or not the joint hypothesis of the Fama and French multi-factor model and the EMH hold for Canadian firms. In addition, I will explore whether or not recent variance of the Fama and French approach have validity in Canada. Section two will discuss the previous literature on the various models used to explain stock returns and their effectiveness. A discussion of the data used in conducting the tests is provided in section three. Section four introduces the methodology used. The results of the tests are provided in section five. The paper concludes with a summary in section six.

2. LITERATURE REVIEW

Although the CAPM remains a standard benchmark for modern portfolio theory and asset pricing, in recent years researchers have sought to improve upon its theoretical and empirical deficiencies, focusing on multi-factor approaches. Connor and Korajczyk (1988) test the APT model by using a derivative of the principal components method in estimating factors called asymptotic principal components. This technique was first suggested by Chamberlain and Rothschild (1983) and then extended by Connor and Korajczyk (1986).

The asymptotic principal components method is a statistical technique that 'extracts' the pervasive factors, and their risk premiums, assumed by the APT. Although the factors are 'identified' statistically we do not know what actual risk factors they represent. That is the weakness with this method. Connor and Korajczyk (1988) identified up to ten such statistically derived factors using the entire sample of NYSE and AMEX stocks for four non-overlapping five-year subperiods, 1964-1968, 1969-1973, 1974-1978, and 1979-1983.

In order to determine the empirical properties of such factors the authors regressed the excess returns of the equal-weighted and value-weighted CRSP (Center for Research in Security Prices) portfolios on the first factor, the first five factors, and the first ten factors.

They discovered that the first factor generally explains 99% of the variance of the equal-weighted portfolio. The remaining factors are statistically significant but obviously explain much less of the variance. The results for the value-weighted portfolio are similar but the first factor explains much less of the variance. The remaining factors are still significant. The authors also test whether the estimated factor premiums are different from zero and generally, they are. The authors also identified a 'January effect' phenomenon when regressing the factors on a constant and a dummy variable that equals one in January and zero otherwise. The dummy coefficient is statistically significant in all four subperiods, which suggests seasonality.

The next step the authors took was to determine if the APT factor model provided a better 'fit' to stock returns than the traditional CAPM model. Two CAPM models were used. The first model used the excess return on the CRSP value-weighted index as the independent variable while the second model used the CRSP equal-weighted portfolio excess return as the independent variable. Two APT models were used. One model regressed the monthly excess returns of ten size-based portfolios on a constant and the factors (five and ten factor models). The other model regressed the excess returns of ten size-based portfolios on a constant, a January dummy variable (where if the month is January the dummy equals one otherwise it equals zero) and the factors (five or ten factors). Modified Likelihood ratio (MLR) tests were conducted to determine mispricing. Mispricing occurs when the constant or the dummy variable is statistically significant. This suggests the model does not fully explain the size portfolio's excess return. It was shown that the constant was more statistically significant, on the aggregate, for the APT model than for both CAPM models. This would suggest the APT performed worse than the CAPM. However, the actual value of the APT mispricing is much smaller than value-weighted CAPM and slightly smaller than the equal-weighted CAPM. Thus, the stronger rejection of the five-factor APT is due to more precision in the estimates of the constant term (R-squared values between 0.78 and 0.98) rather than larger mispricing errors.

Overall, Connor and Korajczyk (1988) show that for mispricing that is not January-specific, the five-factor APT model performed better than the value-weighted CAPM and slightly better than the equal-weighted CAPM. Furthermore, the APT performs much better than both CAPM models when explaining the January-specific mispricing related to size (measured as the market capitalization of a firm). This result is due to the seasonality in the estimated risk premiums of the factors that is not captured by the single-factor CAPM model (even though the market premium in the CAPM also exhibits seasonality).

Although the APT model performed better than the CAPM in many situations, there were still significant alphas (intercepts) in many of the sample sub-periods. In other words, it might be better than the CAPM but it is not a very good model on its own. Generally, empirical implementations of Ross's APT theory have failed to produce much confidence in its explanatory power. This finding does not bode well for the EMH theory.

Then along came the relatively recent work on attribute-sorted portfolios and their explanatory power first introduced by Fama and French (FF) (1993, 1995, and 1996) and taken further by other authors (i.e. Elton, Gruber, and Blake's 1995 four-factor model that incorporates the three FF factors plus a fourth factor, low-grade bond portfolio excess return, that is supposed to incorporate interest rate exposure). Fama and French came up with a three-factor model that is supposed to capture the cross-section of expected stock returns. The three factors are the market premium, a portfolio long in high book-to-market stocks and short on low book-to-market stocks (HML), and a portfolio short on large market capitalization stocks and long on small market capitalization stocks (SMB). These factors are supposed to represent market wide risk factors not captured in past models. These models would be correctly specified if it was found that the intercept term is statistically not different from zero. Their empirical evidence supported this hypothesis and their model has been heralded as a possible 'replacement' of the CAPM. However, it should be noted that there is no fundamental underlying financial theory that the author's used to come up with the model. That is why many researchers wanted to empirically test the FF three-factor model as an asset-pricing model. However, given the findings of Fama and French (1993) the case for efficient markets is backed up.

Ferson and Harvey (1999) test the FF model on conditional expected returns. The authors concentrate on whether the FF model can capture common dynamic patterns in returns, modeled using a set of lagged, economy-wide predictor variables. These variables are: the difference between the one-month lagged returns of a three-month and a one-month T-bill, the dividend yield on the S&P 500, the spread between Moody's Baa and Aaa corporate bond yields (a proxy for default risk), the spread between a ten-year and a one-year T-Bond yield (a term structure variable), and the lagged value of a one-month T-Bill yield (an interest rate variable). They also test whether the four-factor model of Elton, Gruber, and Blake (1995) performs any better.

The monthly returns of US stock portfolios for the period of July 1963 to December 1994 were obtained. Portfolios were formed according to the procedure in Fama and French (1993). Stocks were first sorted into five portfolios according to size. Then, each size-sorted portfolio is further sorted into five portfolios according to book-to-market ratios. This results in 25 size/book-to-market portfolios. The time-series of returns of each portfolio was first regressed on the three FF factors mentioned above. A t-test was conducted for the hypothesis that the intercept is equal to zero. Only four of the 25 intercepts had a p-value less than 0.05, which supports the theory that the FF model explains the unconditional returns of the 25 portfolios.

However, the authors go further and subject the FF model to a more stringent test. They regress the portfolio excess returns on the FF factors and the vector of lagged instruments mentioned above. An F-test was conducted in order to see if the lagged instruments could be excluded from the model. The F-test was significant at the 10% level for all portfolios and at the 5% level for 24 out of 25 portfolios. The FF model fails badly. It seems the FF model cannot explain the conditional expected returns of the 25 portfolios (when the lagged instruments are included).

Furthermore, an even more stringent test was performed in order to incorporate the possibility that the betas of the three FF factors are time varying. The excess returns of the 25 portfolios are regressed onto the FF factors, the lagged instruments, and the products of the lagged instruments and the FF factors. Again, an F-test was conducted in order to determine if the time varying components can be excluded from the model (i.e. if the lagged instruments can be excluded). The F-test was again significant for all portfolios at the 10% level and for 24 out of 25 at the 5% level. These findings suggest a strong rejection of the FF three-factor model even when allowing for time varying betas. It should be noted that tests and conclusions for the Elton, Gruber, and Blake (1995) four-factor model are similar. The lagged instruments reveal information that is not captured by the FF model for the cross-section of expected returns. According to these conclusions, researchers should be careful when using the FF model (or the Elton, Gruber, and Blake model) in an attempt to control for system-wide risk and expected return.

There have been many authors that have approached the asset pricing model framework mentioned above (i.e. factor approach). Ferson and Harvey (1991) and Chen, Roll, and Ross (1986) use prespecified economic factors in order to explain the variation in stock returns. Connor and Korajczyk (1988), mentioned above, use the asymptotic principal components method in order to determine factors. All of these studies focus on short-horizon returns.

Ferson and Korajczyk, in their 1995 paper, attempt to determine the ability of such models to capture the predictability of long-horizon returns. The authors use two sets of risk factors. The first set includes prespecified economic factors similar to Chen, Roll, and Ross (1986). These factors are: The return on the S&P 500 stock index (market factor), the nominal one-month T-Bill rate less the rate of change on the consumer price index (real interest rate factor), the difference between the ex-post monthly percentage change in the consumer price index and a simple time series model for the expected rate of inflation (unexpected inflation factor), the difference between the monthly returns of low-grade corporate bonds and high-grade corporate bonds (corporate default risk factor), and the difference between the return on a long-term US government bond and a one-month T-Bill (term structure risk factor). The second set of risk factors was derived using the asymptotic principal components method described in Connor and Korajczyk (1986).

Furthermore, Ferson and Korajczyk (1995), use the generalized method of moments (GMM) to estimate the fraction of the predictability in returns that is captured by a model, simultaneously with the other model parameters. They came up with a VR ratio that measures the predictable variation in return that is explained by the product of the model's beta coefficients and their corresponding risk premiums, divided by an 'unrestricted' estimate of the predictable variation.

Portfolios of excess returns were formed according to size and then industry classification. These portfolio returns were then regressed on the lagged instruments and the first five factors generated from the asymptotic principal components method. An F-test was conducted in order to determine the incremental explanatory power of the instruments when the five factors are already in the model. Furthermore, a heteroscedasticity-consistent Wald test was conducted. The results are similar for both tests. Overall, for monthly and quarterly return horizons, the F-test rejects the models, suggesting that the five-factor model is not enough in explaining returns. However, for longer periods (annual and 2-year return horizons) the results are more favorable (do not reject). In other words, since these models imply constant betas throughout time, the results reject a constant beta assumption for shorter horizon returns, but cannot reject a constant beta assumption for longer horizon returns.

The results for the GMM system of equations and the VR ratio are encouraging. Although the models with one to five factors and constant beta coefficients do not explain 100% of the return predictability, they do capture a large fraction of it. One-factor models explain about 60% of the predictability in the industry-grouped portfolios and five-factor models capture about 80% (on average). These results are also consistent across all investment horizons. Therefore, these factor models capture a large fraction of the predictability in returns, regardless of investment horizon.

Even though these studies were somewhat encouraging the fact that certain alphas were significant suggests that in some cases markets are not efficient. Fama (1998) shows that many 'anomalies' discovered in the literature seem to disappear when exposed to slight changes in methodology. Such anomalies include the positive abnormal performance of IPOs during the announcement period, the apparent underperformance of IPOs in the long-term future period and the positive abnormal performance of stock splits during both the announcement period and the future long-term period (among others). The disappearance of these anomalies, along with many others, when exposed to different methodologies suggests that the over- or underperformance was due to chance. One anomaly, however, is still apparent even after going through multiple robustness checks: the post-earnings-announcement drift first reported by Ball and Brown (1968). Still, the overall findings suggest market efficiency.

The previous studies all try to determine the effect various factors have on expected returns. Consequently, none of these papers tries to determine what factors best capture the return co-movements of stocks. Chan, Karceski, and Lakonishok (1998) evaluate all major factors suggested in past literature and try to determine which of these factors is important in driving the common variation in stock returns. If the common variation in asset returns can be traced to a small set of underlying pervasive forces, then these factors serve as sources of priced risk.

Chan, Karceski, and Lakonishok (1998) study many factors suggested by past research. These factors are fundamental, technical, macroeconomic, statistical, or market factors. Fundamental factors are accounting based factors such as market-to-book ratios, dividend yield, market capitalization, cash-flow-per-share, etc. Technical factors try to capture momentum (or contrarian) forces in stock returns. These factors include the past month's return, the past six-months' return, and the past five-year return. Macroeconomic factors include the default premium, the growth rate of monthly industrial production, the term premium, the real interest rate, the inflation rate, etc. Statistical factors are the factors derived through the asymptotic principal components method of Connor and Korajczyk

(1988). The market factor is the traditional CAPM return on the market portfolio (both an equal-weighted portfolio and a value-weighted portfolio).

First, mimicking portfolios were constructed similar to Fama and French (1993). The mean returns of these mimicking portfolios were constructed for each factor mentioned above. This was done in order to compare results to past literature. The book-to-market, cash-per-share, all technical factors, and the second statistical factor exhibited the highest mean monthly returns. Does this mean that these factors best capture the return co-movements of stocks?

The authors found that this was not the case. The macroeconomic factors performed poorly. This is surprising because we saw in past literature (mentioned above) that these factors were statistically significant in many APT models. The statistical factors have also fared well in past literature and in this study the authors find that, in a predictive sense, there is no benefit in adding more factors beyond the first two or three principal components. The fundamental factors suggested by Fama and French (1993) perform well. It seems that size and book-to-market factors are the best performers, with the dividend yield a close third. The technical factors also perform very well, producing monthly standard deviations of around 4%. The market factors standard deviations are also quite high, with the equal-weighted market factor slightly higher than the value-weighted factor.

It appears that the fundamental, technical, and market factors perform better than the macroeconomic factors. Although the authors demonstrate the behavior of the different mimicking portfolios, it is difficult to interpret the underlying factors of these portfolios. Even after controlling for industry affiliation and other influences the differences between the best performing factors still persists.

The above studies dealt with analyzing the effect of fundamental, technical, and/or statistical factors on stock returns. Titman, Wei, and Xie (1999) study the effect of a firm's investment expenditures on its stock return. Past empirical evidence (McConnell and Muscarella, 1985) using event studies showed that announcements of increases in capital spending are generally associated with significantly positive excess returns. However, a weakness of this study is that companies tend to announce only the 'positive' investment opportunities to the public and therefore we should not be surprised to see positive returns. Titman, Wei, and Xie (1999) avoid this 'bias in announcements' by studying a comprehensive sample that includes all reported capital expenditures for all NYSE, AMEX, and NASDAQ stocks on the COMPUSTAT database.

Firms with high capital expenditures should outperform firms with low capital expenditures. This is because we expect firms with high capital expenditures to have more positive net present value (NPV) investment opportunities than do low capital expenditure firms. The market should price these positive NPV growth opportunities. Titman, Wei, and Xie (1999) actually find the opposite result. Low capital investment firms actually outperform high capital investment firms.

Two explanations are put forth in explaining the underperformance of high capital investment firms. Firms that invest the most tend to over-invest. This over-investment is allocated to negative NPV projects. Therefore, the market punishes these firms for undertaking such non-profitable actions. Another explanation is that firms that invest the most tend to over-inflate their cash flows so that they may have the funds to invest. Investors subsequently punish these firms when they are not able to sustain this 'higher level' of cash flows. The evidence in Titman, Wei, and Xie (1999) regarding the negative relationship between capital investment and stock returns tends to support the second explanation.

In my thesis I will identify the fundamental and technical factors that affect the cross section of Canadian expected returns, as well as, and to a lesser extent, the sources of systematic return comovements. In identifying these factors I will follow the methodology of Chan, Karceski, and Lakonishok (1998). Identifying these factors is the first step in determining the sources of priced risk in the Canadian market. After identification of these factors, I will determine whether a FF-like model of these factors can explain the returns of firms sorted into portfolios according to capital expenditures (again, for Canadian stocks). For this analysis I will follow the methodology of Titman, Wei, and Xie (1999).

3. DATA

I identified the behavior of underlying factors in the Canadian market by studying the returns of all Canadian stocks in the COMPUSTAT database ($T set). Data was gathered from April 1981 (if available) to April 1994. An out of sample test was performed from May 1994 to April 1997 to see whether the findings hold. It should be mentioned that there is a lot of missing data when studying Canadian stocks. Therefore, for some factors the data go back to 1981, for others they start later. In any case the earliest possible data period is used for each factor.

The data used for determining whether low capital expenditure firms outperform high capital expenditure firms is once again obtained from the COMPUSTAT database for all Canadian firms. The sample period is from April 1991 to April 1997. The sample starts in April 1991 because that is the earliest available month for the data on the market-to-book ratio and the price-to-free-cash-flow ratio.

The fundamental and technical factors used will be the most popular variables that have been used in past academic literature.

Fundamental Factors

In all there are five fundamental factors. First, the market-to-book (MB) ratio was studied. This is the ratio of the monthly market value of equity to the book value of equity of the firm for the most recent quarter. The earliest available data for this ratio is April 1991. Second, the monthly price-earnings (PE) ratio is analyzed. It is the ratio of the monthly price to the trailing twelve months earnings per share of the company in question. Data was available from April 1982. Third, the monthly price-to-free-cash-flow (P/FCF) ratio was studied. It is the monthly price of the stock divided by the free cash flow of the firm during the most recent quarter. Like the MB ratio, the earliest available data for the P/FCF ratio is in April 1991. Fourth, we have the monthly size (SIZE) of the firm measured as the market capitalization at the end of the month. Data for this factor starts in April 1982. And finally, we have the dividend yield (DP), defined as the dividend of the stock divided by the monthly price. Data for this factor starts in April 1982.

Furthermore, A market beta factor (MARKET) was also studied. This factor tests whether high beta stocks outperform low beta stocks. The beta of a stock is determined by regressing the excess return of a stock for that month on the market premium for that month. Two beta factors were used. One factor used the TSE 300 Western database 91-day T-Bill return as the risk free rate in these regressions while the other factor used the Scotia-McLeod series. Both yielded similar results.

Technical Factors

There are three technical factors in all. These factors were studied so that we can get an impression of whether momentum (or contrarian) forces affect the cross section of returns in the short, medium, and long-term time horizons. These factors are based on a stock's past return performance over several non-overlapping periods. R(-1,0) is the return of a stock in the past month. This factor is supposed to capture short-term technical market forces. Data was available for this factor starting in April 1981. R(-7,-1) is the return of the stock starting seven months before the current month and ending one month before the current month. This factor captures the technical behavior of stocks in the mid-term. Data was available for this factor starting in November 1981. R(-60, -12) is the return of the stock starting 60 months before the current month and ending twelve months before the current month. This factor is supposed to capture the long-term past behavior of stocks. Data was available for this factor starting in April 1986.

4. METHODOLOGY

Methodology 1

I formed mimicking portfolios based on each of the above factors following the method first outlined by Fama and French (1993) and employed by Chan, Karceski, and Lakonishok (1998). At each portfolio formation date, I sorted all Canadian stocks into five portfolios based on each stock's ranking for that particular attribute (factor). The lowest 20% of stocks ranked by that attribute go into the first portfolio; the next 20% go into the second portfolio, etc. In the case of the fundamental factors the attribute is directly observable, like firm size or market-to-book ratio. In this case, stocks are sorted based on the average value of that attribute during the past twelve months. The stocks are then assigned into portfolios according to rank. Stocks are sorted in this manner at the end of April of each year. April is chosen because it is assumed that every Canadian public company has finished preparing its financial statements by then, therefore we can be relatively sure that each company has fresh yearly accounting data. In each of the subsequent twelve months (starting in April), I compute the return on each quintile portfolio, assuming that stocks are equally weighted in each portfolio. The mimicking portfolio return for each month is then calculated as the difference between the return on the highest-ranked (fifth) and lowest-ranked (first) portfolio.

Portfolios are formed once a year starting in April. I chose to use the average past twelve-month value of an attribute to rank stocks instead of the value of the attribute at the end of April. This makes my results less sensitive to the choice of month when forming portfolios. Fama and French (1993) argue that the spreads in returns reflect differences in patterns of underlying profitability so, in this sense, the return spread proxies for a common factor related to that attribute. Furthermore, the return spread associated with each of the other attributes isolates the effect of a pervasive factor. Since the quintiles of portfolios are generally large, diversified portfolios, the effects of firm specific returns are reduced. In this case, analyzing the difference in returns between two portfolios isolates the impact of the relevant factor while mitigating the effects of other common factors (like the market). While Fama and French (1993) assume that the level of a stock's attribute is correlated with a stock's loading on a factor, they are silent as to why such a factor is important (maybe because of financial distress or something else). I will also provide the standard deviation of the mimicking portfolio returns in order to determine the sources of systematic return comovements. If we find that a mimicking portfolio exhibits a large return volatility (standard deviation) then this is consistent with the underlying factor contributing a substantial common component to return movements. We will see whether the factors that drive comovements are similar to the factors that exhibit high mean returns.

For the technical factors, each stock's attribute (past return) is also directly observable. The predictive power of past returns varies with the forecast horizon. Thus we reform the portfolios at different intervals based on the technical factor. When the attribute is R(-1,0), portfolios are reformed every month based on the past month's return. When the attribute is R(-7,-1), portfolios are reformed every six months beginning in April of each year based on the average past return of that stock from the past seventh month to the previous month. When the attribute is R(-60,-12), portfolios are formed each April based on the average return of a stock starting in the past 60th month and ending in the past 12th month.

For the market beta factor, the relevant attribute is a stock's loading on that factor. The loading is estimated from a regression using the most recent past 60 months of data prior to the portfolio formation date. Returns in excess of the monthly T-Bill (TSE300 Western 91-day T-Bill and Scotia McLeod series) are regressed on the factor. In this case the factor is the market premium defined as the monthly return of the TSE300 Total return index less the rate of return on T-bills. Stocks are ranked according to the beta coefficient of this regression and then assigned to portfolios. Portfolios are formed every April.

Note that in all cases the factors or factor sensitivities are measured over a pre-formation period. The mimicking portfolio returns are measured over a non-overlapping test period, so we are assessing how the factors perform in a predictive sense. In this sense, I will also see whether the results during this test period (from at least April 1981 to April 1994) hold during an out-of-sample test. This testing period will be from May 1994 to April 1999. In other words, I will determine whether a trading rule can be devised to take advantage of these findings.

Methodology 2

Once I determine what factors best explain the cross section of Canadian stock returns I will use this model to determine whether the abnormal (or excess) returns of firms sorted into portfolios by capital expenditures are significant or not. The recent work by Titman, Wei, and Xie (1999) shows that firms with low capital expenditures outperform firms with high capital expenditures. I will use a similar methodology to determine if the same is true for Canadian data.

Firms with different investment opportunities are likely to exhibit different risks. Firms whose assets are predominantly made up of growth opportunities should be riskier than firms whose assets are more stable in nature. In this case, one would expect the former firms to outperform the safer firms. On the other hand, firms that are safer have the lowest cost of capital; therefore they may be the ones that invest the most. This is because the potential investment opportunities available to them should have a positive net present value (NPV) when compared to firms with a higher cost of capital. In any event, when comparing firms with high and low capital expenditures it is crucial that appropriate benchmarks are chosen.

Titman, Wei, and Xie (1999) use characteristic-based benchmark portfolios in their analysis and so will I. In determining abnormal returns I controlled for characteristics as well as factor sensitivities. Specifically, I formed 25 portfolios that capture two stock characteristics. These characteristics are the market-to-book ratio (MB) and firm size (SIZE) measured as the market capitalization of the firm. When forming these benchmark portfolios I began sorting the entire Canadian sample (starting in April 1991) into five portfolios based on MB. Then, within each MB portfolio, I further sorted each stock into five SIZE based portfolios. This procedure resulted in 25 MB/SIZE portfolios. The equal-weighted returns on these benchmark portfolios were calculated from May of the current year to April of next year. All benchmark portfolios were re-balanced every year at the end of April.

Once these benchmarks were calculated the abnormal returns were easy to calculate. Each month, the abnormal return of a stock is that stock's monthly return less the return of the benchmark portfolio (calculated above) that this stock belongs to (according to its

MB/SIZE designation). These abnormal returns (or excess returns) were then used to calculate the performance of portfolios formed by capital expenditures.

Five capital expenditure (CE) portfolios were formed as follows. On April of each year, all stocks were equally divided into five portfolios based on capital expenditures (in ascending order). Equal-weighted portfolio excess returns were calculated from May of the current year to April of next year. CE portfolios were re-balanced every year. The excess returns of stocks were calculated based on the characteristic-based method mentioned above.

A CE-spread portfolio was also calculated. This is a portfolio that denotes a zero-investment strategy that has one dollar invested in the low CE portfolio and one dollar sold short on the high CE portfolio. A series of time-series regressions were calculated for each CE portfolio (and the CE-spread portfolio) on the classic FF three-factor model and the model developed in the first methodology section to determine if there was a difference.

5. RESULTS

The behavior of mimicking portfolios

I will begin by analyzing the individual behavior of the five fundamental factors, the three technical factors, and the single market factor. By analyzing these factors individually we can get a preliminary result of how such factors affect performance evaluation and attribution. If a portfolio manager solely invests in small stocks, for example, we can see the effect such an attribute will have on the portfolio's return. Such a portfolio will be heavily influenced by the size factor. However, although it is interesting to see how each attribute performs individually we are primarily interested in how these factors perform together. This is because correlations between portfolios can alter our results on the importance of one factor once the other factors are also considered. By considering the factors together we might be able to simplify our model by dropping certain 'redundant' factors. Furthermore, we include the standard deviations of the mimicking portfolios in order to check the systematic comovements of stocks. We will see whether the factors that exhibit the highest mean returns are also the ones that have the highest standard deviations.

Table 1 (all tables are in the Appendix) presents the results of the above query for the month ended April 1994. Note that there are two dividend yield factors (DP). This is because for Canadian firms the majority paid no dividends and thus had a yield of 0%. By grouping the stocks into quintiles the first portfolio (smallest) would contain 0% dividend yield stocks (as would the next three portfolios) while the fifth portfolio would contain a mixture of 0% DP stocks and positive DP stocks. Therefore, constructing a mimicking portfolio return consisting of the fifth portfolio return minus the first portfolio return is not that meaningful. Why not just take the fifth portfolio return minus the second portfolio return (or third, or fourth) since the second portfolio (or third, or fourth) also contains 0% DP stocks? Therefore I include two DP mimicking portfolio returns. The first DP mimicking portfolio return is constructed in the usual manner: Portfolio five return minus portfolio one return and is represented by the DP(P5-P1) symbol. The second DP mimicking portfolio return is slightly more meaningful in that it compares 0% DP stocks with positive DP stocks. This DP mimicking portfolio return is constructed as follows. Each formation date two portfolios are formed. One contains positive DP stocks while the other contains 0% DP stocks. The DP mimicking portfolio return is the return on the positive DP stocks minus the return on the 0% DP stocks.

By looking at the 'all months' column we can see that for the fundamental factors the highest monthly returns are for the MB and SIZE factors. They exhibited mean returns of 2.542% and 2.52% respectively. The negative sign just means that the smallest portfolio has a higher return than the highest portfolio. It is there just by construction. It should not be confused as a negative return. These preliminary results tend to be consistent with the FF three-factor model, where high minus low book-to-market portfolios and small minus big size portfolios are significant factors in explaining the cross section of U.S. returns.

The results, however, are partly consistent with Chan, Karceski, and Lakonishok (1998). Their BM factor had the highest return but it was then followed by the cash-flow-to-market-price (CP) factor, the earnings-to-market-price (EP) factor, and then the size factor. Furthermore, the magnitude of my mean returns was higher than theirs.

The highest mean return for the technical factors is the one-month past return factor. It had a mean return of 2.29%. The negative sign tells us that a contrarian pattern is prevalent in the short-term for Canadian stocks. Stocks that are the worst performers the month before are the best performers the month after. This contrarian pattern is also observed for the long-term technical factor but the mean return is much smaller. The medium-term technical factor exhibits a momentum characteristic, where past winners tend to be future winners. This is somewhat surprising because there has been evidence that suggests momentum effects are witnessed in the short-term while prices tend to mean revert in the long-term. These results are similar to those of Chan, Karceski, and Lakonishok (1998), however, the mean returns are higher for Canadian firms.

Chan, Karceski, and Lakonishok (1998) identified a January effect where the highest mimicking portfolio returns for all of their fundamental and technical factors occurred in January. They also identified a portfolio re-balancing effect where in December portfolio managers tend to get rid of their 'losers' in order to look good at year's end while in January they buy up the depressed stocks of these 'losers' (also the riskiest stocks) in hopes of realizing a big gain. This pattern shows itself when in December we witness the 'big' stocks (the fifth portfolio stocks for that particular factor) outperform the 'little' stocks (first portfolio stocks) and in January we see the pattern reverse itself when the 'little' stocks outperform the 'big' stocks. The January effect and the re-balancing effect are complimentary findings.

The results for the Canadian sample are very different. For the fundamental factors the January effect is non-existent. Not one single fundamental factor's mean return was highest in January. In fact, for both the MB and SIZE factors the highest mean return was in March. The evidence for the re-balancing hypothesis is also very weak. The only factor that exhibited this re-balancing pattern is the DP(P5-P1) factor, which, as mentioned above, is not very meaningful. The technical factors behaved similarly. The only factor that showed the re-balancing pattern was the long-term technical factor. No technical factor's mimicking portfolio return was highest in January.

The market factor showed the smallest mimicking portfolio mean return no matter what T-Bill series was used. High beta stocks very slightly outperform low beta stocks but the difference is not significant. This is the weakest individual factor. However, even though January was not the highest mean return month, the market factor exhibited the rebalancing phenomenon. These results are similar to the results of the Chan, Karceski, and Lakonishok (1998) equal-weighted market factor.

The standard deviations tell a different story than do the mean returns. The highest standard deviation was exhibited by the mid-term technical factor (momentum) followed in descending order by the price-to-free-cash-flow factor (P/FCF), the market-to-book

(MB) factor, the short-term technical factor, and then the size factor (SIZE). For Chan, Karceski, and Lakonishok (1998), the highest standard deviations were exhibited by the size factor, the mid-term and long-term technical factors (very close), and then the book-to-market factor. The individual factors that are most relevant when looking at the comovements of assets are much different than when looking at the mean returns.

The next step is to determine how these factors behave when they are all included in a model to describe the cross section of Canadian expected returns. But before this is done I will see whether a profitable trading rule based on the above findings can be developed out-of-sample.

Trading Rule

Following the results in table 1 we can see that the two factors that exhibited the highest mean returns were size and market-to-book. The results were for the time period ending in April 1994. In this section I will determine whether one can make arbitrage profits using the zero investment strategy of Fama and French (1993) for market-to-book and size sorted portfolios from May 1994 to April 1999. Commissions and other market frictions will be ignored.

The zero investment strategy is similar to the mimicking portfolio returns calculated above. Starting in May 1994 we sort all stocks into five portfolios based on their average market-to-book ratio during the previous twelve months. The first portfolio contains the lowest MB stocks; the second contains the second lowest, and so on. The zero investment strategy involves selling short the highest MB portfolio and buying the lowest MB portfolio. The net investment is zero (not including market frictions). The same procedure is done for size-sorted portfolios and for a combination of the two strategies.

The out-of-sample results are in Table 2. Looking at the MB strategy we see that the average mean return for all months is 1.65% per month. The MB strategy does not exhibit a January effect (the best performing month is June). However, it does exhibit an end-of-year re-balancing effect where the largest MB stocks outperform the lowest MB in December where portfolio managers dump their 'low MB' underperformers in order to look good at the year-end performance appraisal while in January small MB stocks outperform high MB stocks as managers buy back these stocks. The SIZE strategy has an average mean return across all months of 2.26% per month. The SIZE strategy does exhibit a January effect and a re-balancing effect as well. Although this pattern didn't show up during the first sample period it shows itself during this sample period.

How do the factors perform together? [1]

We saw how each factor performed individually in the above section, however, we are interested in seeing how these factors perform together in a model. Can these factors add

[1] An APT model framework was also tested along with two industry dummy variables in order to see whether there were any industry effects. The results showed that the two industry dummys, the market premium, and the market-to-book factor are significant at the 5% level and the size factor is significant at the 10% level. The intercept is also significant at the 10% level.

something more to the FF three-factor model by better explaining the cross section of Canadian returns?

I took the cross section of Canadian excess returns and ran a regular OLS regression against all of the fundamental and technical mimicking portfolio factor returns. The results are in Tables 3 and 3a. Table 3 shows the independent variables as market-to-book, size, market premium, price-to-free-cash-flow, price-earnings, short-term technical factor, and the second dividend factor (i.e. positive dividend yielding stock portfolio less zero yielding portfolio), mid-term technical factor, and long-term technical factor. The results when using the first dividend factor in place of the second dividend factor are similar. From Table 3, we can see from the p-ratio column that the market premium, the PE ratio, the short-term technical, and the mid-term technical factors are significant (at the 5% level) in explaining the cross section of returns. By far, the factor that has the most effect is the market premium, followed by the PE ratio. However, even when including these factors in the model we can see that the intercept is significantly different from zero. This tells us that the model does not capture the full behavior of the excess returns. Overall, the whole model is significant. The F-statistic is significant at the 1% level.

For comparison purposes I include the classic FF model results in Table 3a. The significant factors are the size and the market premium. The market-to-book factor is not significant. The market premium is still the factor that has the most impact. The problem with this model is that the intercept is significantly different from zero (unlike the results of Fama and French, 1993). This tells us that the model does not fully capture the determinants of Canadian excess returns. In other words, there is a positive abnormal return associated with Canadian stocks.

The results from Tables 3 and 3a are somewhat puzzling. The full model suggests that size and market-to-book ratios are not significant variables in explaining the cross section of Canadian returns. In the study of individual factors above we saw a size effect as well as a market-to-book effect. Furthermore, in the FF model (Table 3a) the size factor is significant but the market-to-book factor is not. In both cases, the market factor explains a great majority of the excess returns. I will now determine if the 'full' model is significantly different from the 'restricted' model (the FF model).

An F-test (Wald test) was conducted in order to test whether the expanded model is significantly different from the FF three-factor model. The unrestricted model consists of ten parameters, which include the intercept, the eight fundamental and technical factors, and the market premium. The restricted FF model is the model that includes the intercept, the market-to-book factor, the size factor, and the market premium. The F-statistic when comparing these two models is 6.91. This is above the critical value of 2.10. The full model is significantly different from the FF three-factor model. The results show that the expanded model adds explanatory power to the original FF three-factor model for Canadian returns. However, given the significant alphas the model does not fully capture the cross-section of expected returns. This goes against the EMH. In order for the EMH to hold the intercepts would have to be insignificantly different from zero.

Overall Market Results

I also regressed the market premium onto the eight fundamental and technical factors in order to get an idea of how these factors explain the market's return. The market premium is the monthly return on the TSE 300 Total Return index less the 91-day T-Bill rate. These OLS results are in Table 5. Every factor is significant except the short-term technical factor. The factors with the most impact are the long-term technical factor, followed by the dividend yield, and then the market-to-book factor. The overall model is significant and the R-squared is 0.064. It seems that the underlying risks that are represented by the five fundamental factors, along with the mid and long-term technical factors, are captured by the market premium factor. That is why our full model above showed no significant size or market-to-book effect. These effects were incorporated in the market factor.

Results for CE sorted portfolios

I then studied the effect that a 'real' factor like capital expenditures could have in explaining returns. This analysis was motivated by the Titman, Wei, Xie (1999) article. In that article the authors found that small capital investment firms outperformed large ones. I am attempting to determine if there is another anomaly (like the size effect) that might not be explained by the model. In effect, I am testing for the efficiency of markets given the capital expenditures of a firm.

Table 6 presents the results of the time series regressions. When the individual CE portfolios are regressed onto the factors (as mentioned above) we can see an interesting pattern develop. The lowest CE portfolio has a higher mean return than the highest CE portfolio. This is consistent with Titman, Wei, and Xie (1999). Furthermore, the CE-spread zero investment portfolio has the highest mean return of them all. Again, this finding contradicts the EMH. If markets are efficient, there should be no significantly higher excess returns for the first portfolio as compared to the last portfolio.

The nine-factor model does not do a good job of explaining the CE portfolio's excess returns. The only significant factors were the MB (market-to-book) factor for the second CE portfolio and the SIZE factor for the third CE portfolio (at the 5% level). Every other factor was insignificant. The models do a poor job in explaining excess returns when stocks are sorted into capital investment portfolios. Another puzzling result is that the intercepts are not significantly different from zero (at the 5% level). This would suggest that the models explain the variation in CE portfolios but the above evidence suggests otherwise.

Tables 7 and 8 show the results when the CE-sorted portfolios are regressed onto the FF-three-factor model, as well as the Carhart-4-factor model mentioned in Titman, Wei, and Xie (1999). The results show that the only significant factor is the MB factor for the second CE-portfolio and the SIZE factor in the third CE-portfolio for the FF model. The SIZE factor is significant for the third CE-portfolio in the Carhart model. The intercepts are not significantly different from zero for the first four CE-portfolios for both the FF and Carhart models, which suggests that the models explain the CE-sorted portfolios returns. None of the models are significant. They do a poor job in explaining the returns of firms sorted by capital expenditures.

Summary

The OLS results for the full model as well as the FF model are significant. The most significant factor is the market premium for both. Furthermore, the full model is significantly different from the FF model. This tells us that the extra factors provide useful information in explaining Canadian returns. However, in terms of market efficiency the models suggest that markets are inefficient. This is because the alphas are significant in every model.

When regressing the market premium onto our fundamental and technical factors we see very significant results. The OLS model shows us that every factor, with the exception of the short-term technical factor, is significant. The factor with the most impact is the long-term technical factor followed by the dividend factor. This tells us that the market premium encompasses information that is represented by all our fundamental factors and most of our technical factors.

For the capital expenditures analysis, low CE portfolios have a higher excess mean return than do high CE portfolios. However, the full factor model does a poor job in explaining these returns. The FF and Carhart models don't do a better job either. The results lean towards the existence of another anomaly that goes against the EMH.

6. CONCLUSION

Is market efficiency dead? Are there too many anomalies out there that contradict the notion of efficient markets? These questions were put to the test in this thesis. I analyzed the nine most popular fundamental and technical factors in recent literature in order to determine their effect on Canadian stocks. The goal was to determine whether Canadian markets are efficient when analyzed using the portfolio sorting techniques of Fama and French (1993). This goal was to be accomplished by coming up with a model that can better explain the cross section of Canadian returns. This study has far reaching consequences in many areas of finance. For example, it can help in corporate finance by coming up with a more reliable cost of equity calculation than using the CAPM. Furthermore, it can help in assessing a portfolio manager's actual performance by coming up with an accurate benchmark when trying to determine over or underperformance.

When studying the nine most popular fundamental and technical factors (including a market factor) individually we saw that the factors that had the most impact were the SIZE factor, the short-term technical factor, and the market-to-book factor. This finding is consistent with past literature. I did not find the January-effect anomaly that Chan, Karceski, and Lakonishok (1998) found in their study. However, a January-effect phenomenon was found when conducting an out of sample test. In addition, when looking at the comovements of stocks I find that the most important factors are the mid-term technical factor, the price-to-free-cash-flow factor, and the market-to-book factor.

Although it is interesting to see which factors individually affect performance the most, the real test is to see how these factors perform together in a model and to determine if this model is better than the FF model. A simple OLS regression was first run on the eight fundamental and technical factors and the market premium. An OLS regression was then run on the FF factors. The significant factors for the full model were the market premium, the price-to-earnings factor, the short-term technical factor, and the mid-term technical factor. For the FF model the significant factors were the market factor and the size factor. The market premium had the most impact of all the factors for both models. An F-test showed that these two models were significantly different. This suggests that the full model provides 'extra' explanatory power that the FF model does not. Furthermore, the market premium was regressed onto the eight fundamental and technical factors. The OLS results showed that every factor, excluding the short-term technical factor, was significant. The intercept was also significant. The model shows us that the factor with the most impact on Canadian stocks, given the other factors, is the market premium. The analysis also shows that technical factors also affect Canadian stocks. This latter result seems to contradict the EMH.

When looking at the CE-sorted portfolios we see that low CE portfolios outperform high CE portfolios. The full model, the FF three-factor model, and the Carhart four-factor model do a poor job in capturing the excess returns of these CE-sorted portfolios. A better model is needed in capturing the returns of CE-sorted portfolios. Most of the intercepts are not significant. This is good for market efficiency but the overall insignificance of the factor models suggests otherwise. The finding that low CE portfolios produce higher excess returns than high CE portfolios goes against market efficiency.

Based on these findings we see that the full model is better at explaining the cross section of expected returns than the FF model. However, opponents of the Efficient Market Hypothesis would say that the case for market efficiency is weak. All tests (excluding the CE portfolios) showed significant positive intercepts. Furthermore, the technical factors (and the trading rule) showed significance, which should not be the case if markets are efficient. The evidence on the CE-sorted portfolios further buttresses the lack of market efficiency. Proponents of the EMH would bring up the fact that the time period studied is too brief to draw such a conclusion. They would also point out that the 'January effect' is not present in the original mimicking portfolio test period, therefore its appearance in the out-of-sample (i.e. trading rule) period could be due to chance. Furthermore, the models' failure to capture the cross section of expected returns, as well as the CE-sorted portfolios' excess returns, does not necessarily mean that markets are inefficient. It could just mean that the models chosen were not the 'correct' models for Canadian markets.

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APPENDIX

TABLE 1

The mean monthly returns for each factor are presented in the table below for the period beginning April 1981 (if available) to April 1994 for each factor.
In April of each year factors were formed into quintiles based on the average value of the relevant factor during the past twelve months. The returns of each quintile portfolio (assuming equal-weighting) were taken for each of the subsequent 12 months (from May of the current year to April of the next year).
At the end of the 12 month period (ending in April) portfolios were reformed according to the same procedure. These monthly quintile portfolio returns were used to calculate mimicking portfolio returns for each factor. The monthly mimicking portfolio return is the return of the highest quintile portfolio (portfolio 5) less the return of the lowest quintile portfolio (portfolio 1).The table below presents these mean monthly mimicking portfolio returns for each factor.
The mean monthly returns are given for each month under their respective monthly heading. Furthermore, the mean return for all months combined is given under the 'All months" column. Standard deviations for all factors are included under the 'Stdev' column.
The factors are:

DP(P5-P1): The dividend yield for the period April 1982 to April 1994. The dividend yield is the dividend of that particular stock divided by the monthly price. This mimicking portfolio return is defined as the return of portfolio 5 less the return of portfolio 1.

DP(+)-DP(0): The dividend yield for the period April 1982 to April 1994. Similar to DP(P5-P1) except that the mimicking portfolio return is defined as the return of all dividend paying stocks less the return of non-dividend paying stocks.

MB: The market-to-book ratio from April 1991 to April 1994. The MB ratio for a stock is defined as the monthly market value of equity divided by the book value of equity of that stock for the most recent quarter (MRQ). The mimicking portfolio return for this factor, and all subsequent factors, is the return of portfolio 5 less the return of portfolio 1.

PE: The price-to-earnings ratio from April 1982 to April 1994. The PE ratio for a stock is defined as the monthly price for that stock divided by the trailing twelve months' (TTM) earnings-per-share (EPS) figure.

P/FCF: The price-to-free-cash-flow ratio from April 1991 to April 1994. The P/FCF ratio for a particular stock is defined as the monthly price divided by the free cash flow for that firm during the MRQ. Free cash flow is defined as operating cash flow less capital expenditures.

SIZE: The size of a firm from April 1982 to April 1994. Size is defined as the monthly market capitalization for a particular firm.

(-1,0): The short-term technical factor from April 1981 to April 1994. The short-term technical factor is defined as the return of a stock in the past month. This factor is handled differently than the above factors. Quintile portfolios are formed every month based on the past month's return.

(-7,-1): The mid-term technical factor from November 1981 to April 1994. The mid-term technical factor is the return of a stock starting seven months before the current month and ending one month before the current month. Quintile portfolios are formed every six months based on a stock's return during that six month period

(-60,-12): The long-term technical factor from April 1986 to April 1994. The long-term technical factor is the return of a stock beginning 60 months before the current month and ending 12 months before the current month. Quintile portfolios are formed every year based on the typical procedure.

T91d: The market beta factor, using the TSE 300 91-day T-Bill return as the risk free rate, from April 1986 to April 1994. The market beta of a stock is determined by regressing the monthly excess return of a stock onto the monthly market premium. The past 60 months' data is used for this calculation. Quintile portfolios are then formed based on a stock's beta.

Tbre-SM: The market beta factor, using the Scotia-McLeod series as the risk free rate, from April 1986 to April 1994. Similar procedure as T91d.

FACTORS		MONTH													
Fundamental		January	February	March	April	May	June	July	August	September	October	November	December	All months	Stdev
	DP(P5-P1))	-0.00419	-0.00853	-2.5E-05	-0.01755	-0.0143	0.007935	-0.00801	-0.00621	-0.0054037	-0.00439	0.004813	0.0170893	-0.00323	0.027006
	DP(+)-DP(0)	-0.01857	-0.00255	-0.0312	-0.01926	-0.02931	-0.01326	-0.01962	-0.01449	-0.0020928	-0.01059	-0.00501	-0.004698	-0.01422	0.044205
	MB	-0.0226	-0.0175	-0.14847	-0.05022	0.004428	-0.01104	-0.02178	-0.0072	-0.0429069	0.047091	0.006438	-0.02498	-0.02542	0.067134
	PE	-0.00327	-0.0253	-0.0067	0.01012	0.003758	-0.00792	-0.00993	-0.01608	-0.0023473	0.008662	-0.00206	-0.018209	-0.005772	0.037825
	P/FCF	0.03345	0.019502	-0.00332	0.020706	-0.01895	-0.01836	-0.01945	0.004041	0.1290995	0.031099	0.000174	-0.011263	0.0138946	0.071662
	SIZE	-0.04363	0.012745	-0.06387	-0.04046	-0.04386	-0.02491	-0.03123	-0.02355	-0.0202186	-0.01849	0.000185	-0.005103	-0.0252	0.05698
Technical															
	(-1,0)	-0.02093	-0.02738	-0.04989	-0.02239	-0.00242	-0.01272	-0.01826	-0.02228	-0.0080352	-0.03872	-0.01032	-0.045011	-0.022899	0.065705
	(-7,-1)	0.00666	-0.00868	-0.01349	-0.00129	0.019527	0.031091	0.019447	0.011047	0.0167303	-0.00825	0.042668	0.0549012	0.0141675	0.092035
	(-60,-12)	-0.0153	0.003314	-0.0504	-0.02485	-0.00775	-0.01177	-0.01911	0.015351	-0.0020532	-0.01152	0.025909	0.0049052	-0.007949	0.054335
Market Factor															
	T91d	-0.01315	0.033359	-0.01171	0.016163	-0.00641	-0.01221	0.019185	0.007516	0.0141932	-0.01976	0.010365	0.0049719	0.0035431	0.041497
	Tbre-SM	-0.01301	0.030914	-0.01136	0.016856	-0.0055	-0.01185	0.01894	0.006377	0.0139612	-0.01983	0.010034	0.0037716	0.0032757	0.041551

TABLE 2 - Trading Rule

A zero net investent strategy was devised whereby $1 was invested in the lowest M/B (and SIZE) portfolio and $1 was sold short in the highest M/B (and SIZE) portfolio from May 1994 to April 1999. In April of each year factors were formed into quintiles based on the average value of the relevant factor during the past 12 months. The equal-weighted average return of each factor was taken for each of the twelve subsequent months. The results are presented in the table below. The mean monthly returns for each month are given under that month's heading. The mean monthly returns for all months combined is given under the 'All months' column. The standard deviation for all months in the sample is given under the StDev column. The factors used are:

M/B: The market-to-book ratio from May 1994 to April 1999. The MB ratio for a stock is defined as the monthly market value of equity divided by the book value of equity of that stock for the most recent quarter (MRQ).

SIZE: The size of a firm from May 1994 to April 1999. Size is defined as the monthly market capitalization for a particular firm.

	MONTH													
M/B	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All months	StDev
avg.ret	0.018675	0.033858	0.009322	0.015263	-0.01244	0.079126	0.035636	0.009394	-0.02513	0.020086	0.018867	-0.00434	0.016526	0.059853
SIZE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All months	StDev
avg.ret	0.08632	0.058225	0.022849	0.020847	0.018024	0.003945	0.019308	0.057306	-0.01671	-0.02129	0.025345	-0.00331	0.0225715	0.050729

TABLE 3

A regression of the cross section of Canadian excess returns on all of the fundamental and technical factors as well as the market premium for the period April 1991 to April 1997. The procedure to obtain these factors is explained below:
In April of each year factors were formed into quintiles based on the average value of the relevant factor during the past twelve months. The returns of each quintile portfolio (assuming equal-weighting) were taken for each of the subsequent 12 months (from May of the current year to April of the next year).
At the end of the 12 month period (ending in April) portfolios were reformed according to the same procedure. These monthly quintile portfolio returns were used to calculate mimicking portfolio returns for each factor. The monthly mimicking portfolio return is the return of the highest quintile portfolio (portfolio 5) less the return of the lowest quintile portfolio (portfolio 1). These mimicking portfolio factor returns are the factors used in the regression. The factors are:

MB: The market-to-book ratio from April 1991 to April 1997. The MB ratio for a stock is defined as the monthly market value of equity divided by the book value of equity of that stock for the most recent quarter (MRQ). The mimicking portfolio return for this factor, and all subsequent factors, is the return of portfolio 5 less the return of portfolio 1.
SIZE: The size of a firm from April 1991 to April 1997. Size is defined as the monthly market capitalization for a particular firm.
MARKET: The market premium from April 1991 to April 1997. The market premium is the return of the TSE 300 Total Return Index less the return on the TSE 300 database 91-day T-Bill return. The market premium doesn't follow the mimicking portfolio procedure mentionned above.
P/FCF: The price-to-free-cash-flow ratio from April 1991 to April 1997. The P/FCF ratio for a particular stock is defined as the monthly price divided by the free cash flow for that firm during the MRQ. Free cash flow is defined as operating cash flow less capital expenditures.
PE: The price-to-earnings ratio from April 1991 to April 1997. The PE ratio for a stock is defined as the monthly price for that stock divided by the trailing twelve months' (TTM) earnings-per-share (EPS) figure.
TECH: The short-term technical factor from April 1991 to April 1997. The short-term technical factor is defined as the return of a stock in the past month. This factor is handled differently than the above factors. Quintile portfolios are formed every month based on the past month's return.
DIV2: The dividend yield for the period April 1991 to April 1997. The mimicking portfolio return is defined as the return of all dividend paying stocks less the return of non-dividend paying stocks.
TECH2: The mid-term technical factor from April 1991 to April 1997. The mid-term technical factor is the return of a stock starting seven months before the current month and ending one month before the current month. Quintile portfolios are formed every six months based on a stock's return during that six month period
TECH3: The long-term technical factor from April 1991 to April 1997. The long-term technical factor is the return of a stock beginning 60 months before the current month and ending 12 months before the current month. Quintile portfolios are formed every year based on the typical procedure.

The model is as follows:

$$R_i = \alpha_i + \sum \beta_{ki} F_k + \varepsilon_i$$

where
R_i = The return of stock i
α_i = The constant term for stock i
β_{ki} = The sensitivity of the ith stock return to the kth factor
F_k = The kth factor
ε_i = The error term for the ith stock

Regression statistics are also provided under the REGRESSION STATISTICS table. The R-Squared, Standard error of the estimate, F-Statistic, and the significance of the F-Statistic are shown.

Factor	Beta coeff	Std. Error	T-Stat	P-value
Constant	0.01555	0.002	6.527	0
MB	-0.02895	0.044	-0.665	0.506
SIZE	-0.06696	0.054	-1.235	0.217
MARKET	0.919	0.06	15.318	0
PFCF	-0.007249	0.035	-0.206	0.837
PE	-0.09621	0.042	-2.315	0.021
TECH	0.08445	0.031	2.766	0.006
DIV2	0.005119	0.066	0.078	0.938
TECH2	-0.06877	0.021	-3.292	0.001
TECH3	-0.0355	0.037	-0.968	0.333

REGRESSION STATISTICS			
R-Squared	StError	F-Stat	Signif.
0.00924821	0.324577439	33.7071973	0

TABLE 3a

A regression of monthly Canadian excess returns onto the MB, SIZE, and Market premium factors from April 1991 to April 1997. The procedure to obtain these factors is explained below:
In April of each year factors were formed into quintiles based on the average value of the relevant factor during the past twelve months. The returns of each quintile portfolio (assuming equal-weighting) were taken for each of the subsequent 12 months (from May of the current year to April of the next year).
At the end of the 12 month period (ending in April) portfolios were reformed according to the same procedure. These monthly quintile portfolio returns were used to calculate mimicking portfolio returns for each factor. The monthly mimicking portfolio return is the return of the highest quintile portfolio (portfolio 5) less the return of the lowest quintile portfolio (portfolio 1). These mimicking portfolio factor returns are the factors used in the regression. The factors are:

MB: The market-to-book ratio from April 1991 to April 1997. The MB ratio for a stock is defined as the monthly market value of equity divided by the book value of equity of that stock for the most recent quarter (MRQ). The mimicking portfolio return for this factor, and all subsequent factors, is the return of portfolio 5 less the return of portfolio 1.
SIZE: The size of a firm from April 1991 to April 1997. Size is defined as the monthly market capitalization for a particular firm.
MARKET: The market premium from April 1991 to April 1997. The market premium is the return of the TSE 300 Total Return Index less the return on the TSE 300 database 91-day T-Bill return. The market premium doesn't follow the mimicking portfolio return mentionned above.

The regression model is as follows:

$$R_i = \alpha_i + \sum \beta_{ki} F_k + \varepsilon_i$$

where
R_i = The return of stock i
α_i = The constant term for stock i
β_{ki} = The sensitivity of the ith stock return to the kth factor
F_k = The kth factor
ε_i = The error term for the ith stock

Regression statistics are also provided under the REGRESSION STATISTICS table. The R-Squared, Standard error of the estimate, F-Statistic, and the significance of the F-Statistic are shown.

Factor	Beta coeff	Std. Error	T-Stat	P-value
Constant	0.01199	0.002	5.477	0
MB	-0.00492	0.029	-0.167	0.867
SIZE	-0.08826	0.036	-2.444	0.015
MARKET	0.924	0.058	15.917	0

REGRESSION STATISTICS			
R-Squared	StError	F-Stat	Signif.
0.00813407	0.324759888	87.20381041	0

TABLE 5

A regression of the Market Premium onto the five fundamental and the three technical factors from April 1991 to April 1997. The procedure to obtain these factors is explained below:

In April of each year factors were formed into quintiles based on the average value of the relevant factor during the past twelve months. The returns of each quintile portfolio (assuming equal-weighting) were taken for each of the subsequent 12 months (from May of the current year to April of the next year)

At the end of the 12 month period (ending in April) portfolios were reformed according to the same procedure. These monthly quintile portfolio returns were used to calculate mimicking portfolio returns for each factor. The monthly mimicking portfolio return is the return of the highest quintile portfolio (portfolio 5) less the return of the lowest quintile portfolio (portfolio 1). These mimicking portfolio factor returns are the factors used in the regression. The factors are:

MB: The market-to-book ratio from April 1991 to April 1997. The MB ratio for a stock is defined as the monthly market value of equity divided by the book value of equity of that stock for the most recent quarter (MRQ). The mimicking portfolio return for this factor, and all subsequent factors, is the return of portfolio 5 less the return of portfolio 1.

SIZE: The size of a firm from April 1991 to April 1997. Size is defined as the monthly market capitalization for a particular firm.

P/FCF: The price-to-free-cash-flow ratio from April 1991 to April 1997. The P/FCF ratio for a particular stock is defined as the monthly price divided by the free cash flow for that firm during the MRQ. Free cash flow is defined as operating cash flow less capital expenditures.

PE: The price-to-earnings ratio from April 1991 to April 1997. The PE ratio for a stock is defined as the monthly price for that stock divided by the trailing twelve months' (TTM) earnings-per-share (EPS) figure.

TECH: The short-term technical factor from April 1991 to April 1997. The short-term technical factor is defined as the return of a stock in the past month. This factor is handled differently than the above factors. Quintile portfolios are formed every month based on the past month's return.

DIV2: The dividend yield for the period April 1991 to April 1997. The mimicking portfolio return is defined as the return of all dividend paying stocks less the return of non-dividend paying stocks.

TECH2: The mid-term technical factor from April 1991 to April 1997. The mid-term technical factor is the return of a stock starting seven months before the current month and ending one month before the current month. Quintile portfolios are formed every six months based on a stock's return during that six month period

TECH3: The long-term technical factor from April 1991 to April 1997. The long-term technical factor is the return of a stock beginning 60 months before the current month and ending 12 months before the current month. Quintile portfolios are formed every year based on the typical procedure.

The market premium is the return of the TSE 300 Total Return Index less the return on the TSE 300 database 91-day T-Bill return.

The regression model is as follows:

$$MARK = \alpha + \sum \beta_k F_k + \varepsilon$$

where

$MARK$ = The market premium for that month

α = A constant term

β_k = The sensitivity of the market premium to the kth factor

F_k = The kth factor

ε = The error term

Regression statistics are also provided under the REGRESSION STATISTICS table. The R-Squared, Standard error of the estimate, F-Statistic, and the significance of the F-Statistic are shown.

Factor	Beta coeff	Std. Error	T-Stat	P-value
Constant	0.004755	0	21.406	0
MB	0.08339	0.04	20.543	0
SIZE	-0.07347	0.05	-14.476	0
PFCF	-0.06864	0.03	-20.873	0
PE	-0.01937	0.04	-4.967	0
TECH	-0.00235	0.03	-0.82	0.412
DIV2	0.0972	0.06	15.83	0
TECH2	0.03881	0.02	19.911	0
TECH3	-0.113	0.03	-33.481	0

REGRESSION STATISTICS			
R-Squared	StError	F-Stat	Signif.
0.063600134	0.0304768	268.7315397	0

TABLE 6 - Time series results

This table presents the mean monthly excess returns for all months for each of the five capital expenditure (CE) sorted portfolios and the CE-spread portfolio from April 1991 to April 1997. The CE-spread portfolio is a portfolio where $1 is invested in the low CE-portfolio (portfolio 1) and $1 is sold short in the high CE portfolio (portfolio 5). Portfolio 1 contains the lowest 20% of CE-sorted firms, portfolio 2 contains the next 20%, etc. The mean returns are presented under the Mean return column.

The results of 6 time series regressions are also presented. The excess returns of each portfolio are regressed onto the five fundamental factors, the three technical factors, and the market premium. The beta coefficient for each independent variable is presented under that variable's column heading. The p-value is given underneath the coefficient value. The procedure to obtain these factors is explained below:

In April of each year factors were formed into quintiles based on the average value of the relevant factor during the past twelve months. The returns of each quintile portfolio (assuming equal-weighting) were taken for each of the subsequent 12 months (from May of the current year to April of the next year).

At the end of the 12 month period (ending in April) portfolios were reformed according to the same procedure. These monthly quintile portfolio returns were used to calculate mimicking portfolio returns for each factor. The monthly mimicking portfolio return is the return of the highest quintile portfolio (portfolio 5) less the return of the lowest quintile portfolio (portfolio 1). These mimicking portfolio factor returns are the factors used in the regression. The factors are:

MB: The market-to-book ratio from April 1991 to April 1997. The MB ratio for a stock is defined as the monthly market value of equity divided by the book value of equity of that stock for the most recent quarter (MRQ). The mimicking portfolio return for this factor, and all subsequent factors, is the return of portfolio 5 less the return of portfolio 1.

SIZE: The size of a firm from April 1991 to April 1997. Size is defined as the monthly market capitalization for a particular firm

MARKET: The market premium from April 1991 to April 1997. The market premium is the return of the TSE 300 Total Return Index less the return on the TSE 300 database 91-day T-Bill return. The market premium doesn't follow the mimicking portfolio procedure mentionned above.

P/FCF: The price-to-free-cash-flow ratio from April 1991 to April 1997. The P/FCF ratio for a particular stock is defined as the monthly price divided by the free cash flow for that firm during the MRQ. Free cash flow is defined as operating cash flow less capital expenditures.

PE: The price-to-earnings ratio from April 1991 to April 1997. The PE ratio for a stock is defined as the monthly price for that stock divided by the trailing twelve months' (TTM) earnings-per-share (EPS) figure.

TECH: The short-term technical factor from April 1991 to April 1997. The short-term technical factor is defined as the return of a stock in the past month. This factor is handled differently than the above factors. Quintile portfolios are formed every month based on the past month's return.

DIV2: The dividend yield for the period April 1991 to April 1997. The mimicking portfolio return is defined as the return of all dividend paying stocks less the return of non-dividend paying stocks.

TECH2: The mid-term technical factor from April 1991 to April 1997. The mid-term technical factor is the return of a stock starting seven months before the current month and ending one month before the current month. Quintile portfolios are formed every six months based on a stock's return during that six month period

TECH3: The long-term technical factor from April 1991 to April 1997. The long-term technical factor is the return of a stock beginning 60 months before the current month and ending 12 months before the current month. Quintile portfolios are formed every year based on the typical procedure.

The procedure to obtain CE-sorted portfolios is as follows. In April of each year stocks were formed into quintiles based upon their capital expenditures (in ascending order). Equal-weighted portfolio returns were calculated from May of the current year until April of next year. CE portfolios were re-balanced every year in April. Portfolio excess returns were obtained as follows:

The excess return of a stock is defined as that stock's return for that month less the return of a benchmark. The benchmark is one of 25 MB/SIZE sorted portfolios that the stock belongs to. Every April, benchmark returns were obtained by first sorting firms into quintiles based on MB ratio. Within each MB portfolio firms were further sorted by SIZE. This produced 25 MB/SIZE portfolios. The monthly returns of these portfolios were obtained from May of the current year until April of next year. This procedure was then repeated every April. A stock's excess return for a particular month is its return less the return of the benchmark portfolio that it belongs to according to its MB/SIZE ranking

The regression model is as follows:

$$R_i = \alpha_i + \sum \beta_{ki} F_k + \varepsilon_i$$

where

R_i = The return of portfolio i

α_i = The constant term for portfolio i

β_{ki} = The sensitivity of the ith portfolio return to the kth factor

F_k = The kth factor

ε_i = The error term for the ith portfolio

Regression statistics are also provided under the REGRESSION STATISTICS table. The R-Squared and Standard error of the estimate are provided. None of the models are significant.

TABLE 6 - Time series results

CI PORTFOLIO	Mean return	Intercept	MB	SIZE	MARKET	PFCF	PE	TECH	DIV2	TECH2	TECH3
Portfolio 1	0.014815381	0.009669	-0.00589	-0.098509	0.139458	0.047156	-0.044392	0.034738	0.061128	0.030617	-0.087443
(p-value)		0.1318	0.9595	0.4968	0.3849	0.6166	0.689	0.67	0.7272	0.5832	0.3729
Portfolio 2	-0.001496589	0.00445	0.219145	-0.016499	-0.054987	0.007794	0.030055	0.058516	0.144606	0.045185	[illegible]
(p-value)		0.282	0.0048	0.8602	0.596	0.8982	0.6756	0.2696	0.2052	0.2134	[illegible]
Portfolio 3	-0.001959201	0.00157	-0.041422	0.197843	-0.055113	0.017076	-0.072209	0.026054	[illegible]	-0.008932	0.0164
(p-value)		0.558	0.3979	0.0018	0.4144	0.6665	0.1253	0.4483	[illegible]	0.7035	0.6905
Portfolio 4	0.00330722	0.000553	0.088712	-0.061955	0.186475	0.060417	-0.013932	-0.049459	-0.130752	-0.083975	0.021594
(p-value)		0.9465	0.5564	0.7414	0.3705	0.6209	0.9228	0.64	0.5655	0.2479	0.8649
Portfolio 5	-0.006179605	[illegible]	-0.005628	0.005168	-0.033647	-0.020346	0.078871	-0.015367	-0.031916	-0.020585	0.001359
(p-value)		[illegible]	0.9179	0.9394	0.6549	0.6458	0.1337	0.6884	0.6985	0.4332	0.9764
CE-spread	0.020994986	[illegible]	-0.000262	-0.103677	0.173105	0.067502	-0.123263	0.050104	0.093044	0.051202	-0.088802
(p-value)		[illegible]	0.9986	0.5764	0.3997	0.5759	0.3868	0.6314	0.6786	0.4742	0.4794

REGRESSION STATISTICS		
	R-Squared	St Error
Portfolio 1	0.0751	0.041207
Portfolio 2	0.2299	0.02668
Portfolio 3	0.1999	0.017342
Portfolio 4	0.0618	0.053451
Portfolio 5	0.0833	0.019371
Portfolio CE	0.0748	0.052787

TABLE 7 - FF Model for CI Portfolios

This table presents 6 regressions The excess returns of 6 capital expenditure portfolios are regressed onto the Fama and French (FF) three-factor model for the period April 1991 to April 1997 The factors include the market-to-book (MB) factor, the market size (SIZE) factor, and the market premium (MARKET) Portfolio 1 contains the 20% of firms with the lowest capital expenditures (CE), Portfolio 2 contains the next highest, etc The CE-spread portfolio is a zero net investment portfolio where $1 is invested in the lowest CE portfolio (Portfolio 1) and $1 is sold short in the highest CE portfolio (Portfolio 5)
In the Table, the beta coefficient for each independent variable is presented under that variable's column heading The p-value is given underneath the coefficient value The procedure to obtain the three factors is explained below
In April of each year factors were formed into quintiles based on the average value of the relevant factor during the past twelve months The returns of each quintile portfolio (assuming equal-weighting) were taken for each of the subsequent 12 months (from May of the current year to April of the next year)
At the end of the 12 month period (ending in April) portfolios were reformed according to the same procedure These monthly quintile portfolio returns were used to calculate mimicking portfolio returns for each factor The monthly mimicking portfolio return is the return of the highest quintile portfolio (portfolio 5) less the return of the lowest quintile portfolio (portfolio 1) These mimicking portfolio factor returns are the factors used in the regression The factors are

MB The market-to-book ratio from April 1991 to April 1997 The MB ratio for a stock is defined as the monthly market value of equity divided by the book value of equity of that stock for the most recent quarter (MRQ) The mimicking portfolio return for this factor, and all subsequent factors, is the return of portfolio 5 less the return of portfolio 1
SIZE The size of a firm from April 1991 to April 1997 Size is defined as the monthly market capitalization for a particular firm
MARKET The market premium from April 1991 to April 1997 The market premium is the return of the TSE 300 Total Return Index less the return on the TSE 300 database 91-day T-Bill return The market premium doesn't follow the mimicking portfolio procedure mentionned above

The procedure to obtain CE-sorted portfolios is as follows In April of each year stocks were formed into quintiles based upon their capital expenditures (in ascending order) Equal-weighted portfolio returns were calculated from May of the current year until April of next year CE portfolios were re-balanced every year in April Portfolio excess returns were obtained as follows
The excess return of a stock is defined as that stock's return for that month less the return of a benchmark The benchmark is one of 25 MB/SIZE sorted portfolios that the stock belongs to Every April, benchmark returns were obtained by first sorting firms into quintiles based on MB ratio Within each MB portfolio firms were further sorted by SIZE This produced 25 MB/SIZE portfolios The monthly returns of these portfolios were obtained from May of the current year until April of next year This procedure was then repeated every April A stock's excess return for a particular month is its return less the return of the benchmark portfolio that it belongs to according to its MB/SIZE ranking

The regression model is as follows

$$R_i = \alpha_i + \sum \beta_{ik} F_k + \varepsilon_i$$

where
R_i = The return of portfolio i
α_i = The constant term for portfolio i
β_{ik} = The sensitivity of the ith portfolio return to the kth factor
F_k = The kth factor
ε_i = The error term for the ith portfolio

Regression statistics are also provided under the REGRESSION STATISTICS table. The R-Squared and Standard error of the estimate are provided. None of the models are significant.

CI PORTFOLIOS	Intercept	MB	SIZE	MARKET
Portfolio 1	[illegible]	-0.066435	-0.058533	0.173352
(p value)	[illegible]	0.3843	0.5315	0.2507
Portfolio 2	0.004071	0.114756	0.086393	-0.002253
(p value)	0.2888	0.0283	0.1736	0.9823
Portfolio 3	0.002133	0.014966	0.099985	-0.062785
(p value)	0.3869	0.6511	0.0159	0.3374
Portfolio 4	0.000497	0.113372	-0.135859	0.138627
(p value)	0.946	0.2526	0.2636	0.4768
Portfolio 5	-0.006258	-0.020312	0.004142	-0.044173
(p value)	0.0241	0.5794	0.9265	0.5412
CE-spread	0.016812	-0.048123	-0.062675	0.217525
(p value)	0.0257	0.6392	0.6036	0.2641

REGRESSION STATISTICS	R-Squared	St Error
Portfolio 1	0.0449	0.039984
Portfolio 2	0.1354	0.026995
Portfolio 3	0.1202	0.017366
Portfolio 4	0.0342	0.051783
Portfolio 5	0.0101	0.019221
Portfolio CE	0.0296	0.051621

TABLE 8 - Carhart 4 Factor Model

This table presents 6 regressions The excess returns of 6 capital expenditure portfolios are regressed onto the Carhart four-factor model for the period April 1991 to April 1997 The factors include the market-to-book (MB) factor, the market size (SIZE) factor, the market premium (MARKET), and a short-term technical factor (TECH) Portfolio 1 contains the 20% of firms with the lowest capital expenditures (CE), Portfolio 2 contains the next highest 20%, etc
The CE-spread portfolio is a zero net investment portfolio where $1 is invested in the lowest CE portfolio (Portfolio 1) and $1 is sold short in the highest CE portfolio (Portfolio 5)
In the Table, the beta coefficient for each independent variable is presented under that variable's column heading The p-value is given underneath the coefficient value The procedure to obtain the three factors is explained below
In April of each year factors were formed into quintiles based on the average value of the relevant factor during the past twelve months The returns of each quintile portfolio (assuming equal-weighting) were taken for each of the subsequent 12 months (from May of the current year to April of the next year)
At the end of the 12 month period (ending in April) portfolios were reformed according to the same procedure These monthly quintile portfolio returns were used to calculate mimicking portfolio returns for each factor The monthly mimicking portfolio return is the return of the highest quintile portfolio (portfolio 5) less the return of the lowest quintile portfolio (portfolio 1) These mimicking portfolio factor returns are the factors used in the regression The factors are

MB The market-to-book ratio from April 1991 to April 1997 The MB ratio for a stock is defined as the monthly market value of equity divided by the book value of equity of that stock for the most recent quarter (MRQ) The mimicking portfolio return for this factor, and all subsequent factors, is the return of portfolio 5 less the return of portfolio 1
SIZE The size of a firm from April 1991 to April 1997 Size is defined as the monthly market capitalization for a particular firm
MARKET The market premium from April 1991 to April 1997 The market premium is the return of the TSE 300 Total Return Index less the return on the TSE 300 database 91-day T-Bill return The market premium doesn't follow the mimicking portfolio procedure mentionned above
TECH The short-term technical factor from April 1991 to April 1997 The short-term technical factor is defined as the return of a stock in the past month This factor is handled differently than the above factors Quintile portfolios are formed every month based on the past month's return

The procedure to obtain CE-sorted portfolios is as follows In April of each year stocks were formed into quintiles based upon their capital expenditures (in ascending order) Equal-weighted portfolio returns were calculated from May of the current year until April of next year CE portfolios were re-balanced every year in April Portfolio excess returns were obtained as follows
The excess return of a stock is defined as that stock's return for that month less the return of a benchmark The benchmark is one of 25 MB/SIZE sorted portfolios that the stock belongs to Every April, benchmark returns were obtained by first sorting firms into quintiles based on MB ratio Within each MB portfolio firms were further sorted by SIZE This produced 25 MB/SIZE portfolios The monthly returns of these portfolios were obtained from May of the current year until April of next year This procedure was then repeated every April A stock's excess return for a particular month is its return less the return of the benchmark portfolio that it belongs to according to its MB/SIZE ranking

The regression model is as follows

$$R_i = \alpha_i + \sum \beta_{ik} F_k + \epsilon_i$$

where
R_i = The return of portfolio i
α_i = The constant term for portfolio i
β_{ik} = The sensitivity of the ith portfolio return to the kth factor
F_k = The kth factor
ϵ_i = The error term for the ith portfolio

Regression statistics are also provided under the REGRESSION STATISTICS table The R-Squared and Standard error of the estimate are provided. None of the models are significant

CI PORTFOLIOS	Intercept	MB	SIZE	MARKET	TECH
Portfolio 1	[redacted]	-0 078715	-0 053886	0 170435	0 050959
(p-value)	[redacted]	0 3188	0 5671	0 2609	0 5064
Portfolio 2	0 005361	[redacted]	0 092568	-0 006131	0 067722
(p value)	0 1748	[redacted]	0 1442	0 9515	0 1888
Portfolio 3	0 002749	0 007182	0.10293	-0 064634	0 032302
(p value)	0 2812	0 8329	0 0134	0 3239	0 3313
Portfolio 4	-0 000416	0 124916	-0 140227	0 141369	-0 047903
(p value)	0 9564	0 2234	0 2527	0 4709	0 6299
Portfolio 5	-0 006782	-0 013684	0 001634	-0 042598	-0 027506
(p value)	0.0185	0 7173	0 9711	0 5571	0 4555
CE-spread	0 018107	-0 065031	-0 05552	0 213032	0 078465
(p value)	0.0191	0 522	0 6473	0 2756	0 4278

REGRESSION STATISTICS	R-Squared	St Error
Portfolio 1	0 0513	0 040148
Portfolio 2	0 1575	0 026844
Portfolio 3	0 1326	0 017371
Portfolio 4	0 0376	0 052077
Portfolio 5	0 0184	0 019283
Portfolio CE	0 0387	0 05176

CORRELATION MATRIX

This is a Pearson correlation matrix for all of the factors plus the market premium from April 1991 to April 1997. Factors were obtained using the following procedure:
In April of each year factors were formed into quintiles based on the average value of the relevant factor during the past twelve months. The returns of each quintile portfolio (assuming equal-weighting) were taken for each of the subsequent 12 months (from May of the current year to April of the next year).
At the end of the 12 month period (ending in April) portfolios were reformed according to the same procedure. These monthly quintile portfolio returns were used to calculate mimicking portfolio returns for each factor. The monthly mimicking portfolio return is the return of the highest quintile portfolio (portfolio 5) less the return of the lowest quintile portfolio (portfolio 1). These mimicking portfolio factor returns are the factors used in the regression. The factors are:

MB: The market-to-book ratio from April 1991 to April 1997. The MB ratio for a stock is defined as the monthly market value of equity divided by the book value of equity of that stock for the most recent quarter (MRQ). The mimicking portfolio return for this factor, and all subsequent factors, is the return of portfolio 5 less the return of portfolio 1.
SIZE: The size of a firm from April 1991 to April 1997. Size is defined as the monthly market capitalization for a particular firm.
MARKET: The market premium from April 1991 to April 1997. The market premium is the return of the TSE 300 Total Return Index less the return on the TSE 300 database 91-day T-Bill return. The market premium doesn't follow the mimicking portfolio procedure mentionned above.
P/FCF: The price-to-free-cash-flow ratio from April 1991 to April 1997. The P/FCF ratio for a particular stock is defined as the monthly price divided by the free cash flow for that firm during the MRQ. Free cash flow is defined as operating cash flow less capital expenditures.
PE: The price-to-earnings ratio from April 1991 to April 1997. The PE ratio for a stock is defined as the monthly price for that stock divided by the trailing twelve months' (TTM) earnings-per-share (EPS) figure.
TECH: The short-term technical factor from April 1991 to April 1997. The short-term technical factor is defined as the return of a stock in the past month. This factor is handled differently than the above factors. Quintile portfolios are formed every month based on the past month's return.
DIV2: The dividend yield for the period April 1991 to April 1997. The mimicking portfolio return is defined as the return of all dividend paying stocks less the return of non-dividend paying stocks.
TECH2: The mid-term technical factor from April 1991 to April 1997. The mid-term technical factor is the return of a stock starting seven months before the current month and ending one month before the current month. Quintile portfolios are formed every six months based on a stock's return during that six month period
TECH3: The long-term technical factor from April 1991 to April 1997. The long-term technical factor is the return of a stock beginning 60 months before the current month and ending 12 months before the current month. Quintile portfolios are formed every year based on the typical procedure.
DIV1: The dividend yield for the period April 1991 to April 1997. The mimicking portfolio return is defined as the return of the fifth portfolio less the return of the first portfolio. Note that this dividend yield factor is different than DIV2 above.

The correlations are presented below. Correlations that are **NOT** significant (at the 5% level) are presented in bold italic.
Every other correlation is significant.

	MB	SIZE	MARKET	PFCF	PE	TECH	DIV1	DIV2	TECH2	TECH3
MB	1	0.37	***-0.1***	-0.135	-0.234	0.233	0.042	0.023	-0.034	0.645
SIZE		1	***-0.01***	-0.022	0.088	0.015	0.244	0.532	***0.006***	0.108
MARKET			1	-0.113	-0.045	0.026	0.027	0.014	0.083	-0.145
PFCF				1	0.123	-0.042	0.094	0.103	***-0.006***	-0.063
PE					1	-0.239	-0.304	-0.282	0.173	-0.294
TECH						1	0.061	***-0.001***	-0.044	0.054
DIV1							1	0.521	-0.152	-0.015
DIV2								1	-0.455	0.024
TECH2									1	-0.112
TECH3										1