Title: **Multifactor Model of Growth and Z score for Projecting Stock Return and Evaluating Risk**

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Key words: stock return, risk, multifactor, sales growth, z-score, CAPM

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Abstract

A growing body of literature has examined and noted significant anomalies in the form of empirical regularities in stock return. These phenomena contradict the well-established paradigms of finance and puzzled many financial researchers. To contribute toward this field of study, this paper seeks to investigate two anomalies, namely, Z score and sales growth effects, in the United States equity market. Applying the time-series regressions, the findings of the analysis provide evidences that these two anomaly-variables exist in the US securities market. As implication of this study, the three factors (market, Z score and sales growth) can be used to guide portfolio selection.

I. Introduction

The fundamental paradigms of modern finance have been challenged by many empirical researchers that show that value-trading strategies can be employed to create portfolios that can help manager to earn abnormal profit. Traditionally, variables that theoretically should have no relationship with stock returns are found to reliably explain the cross-section of average returns. These variables includes, size (ME, stock price times number of shares), book-to-market equity (BE/ME, the ratio of the book value of common equity to its market value), earnings/price (E/P) and cash flow/price (C/P) (Banz, 1981, Basu, 1983, Rosenberg, Reid, and Lanstein, 1985, and Lakonishok, Shleifer and Vishny, 1994). Therefore, value-trading strategies call for buying stocks that have low market value, high book-to-market equity, low price-to-earning ration and so on. Such empirical findings suggest a misspecification in the Capital Asset Pricing Model that only includes one market variable in the model (Sharpe, 1964, Lintner, 1965 and Mossin, 1966). It is however inconclusive, whether the anomaly-variables are the missing factors or are they only proxies for other true but unknown-underlying factors correlated with them.

The empirical findings of these anomaly variables would suggest that the stock market is inefficient and the movement of stock prices does not follow random-walk. The reason is because, if the stock market is efficient, no manager can beat the market and earn abnormal profit based on all the available information in the market.

In the recent years, sizes and book-to-market equity have emerged as the more prominent variables in projecting stock returns. Fama and French (1992) in their research paper documented that these two variables together with a market factor (market return minus risk-free rate) combined to explain the cross-section of average returns. Furthermore, consistent with Reinganum (1981) and Lakonishok and Sharpiro (1986), they find that there is only a weak positive relationship between average return and beta.

Ever since this paper was published, it has attracted many researchers to explore further into this subject. Some researchers have cast doubts on the results obtained due to the data used. Specifically, Shanken and Sloan (1995) claim that there are survivorship biases in the data used by Fama and French. Using an alternative source of data, they find that book-to-market equity is at best weakly related to average stock return. Some researchers have also cautioned the interpretation of the findings. Black (1993) commented that "Announcements of the 'death' of beta seem premature." In his opinion, the flat relationship between beta and expected returns implies that an investor could shift his portfolio to one of a similar total risk but higher expected return by emphasizing on low-beta stocks. Lakonishok, Shleifer and Vishny (1994), among others, have attempted to investigate the reasons behind these phenomena. However, with varying views, the economic interpretations remain an unresolved issue.

The main purpose of conducting this study is to test for the presence of Z-score and sales growth effects in the US stock market. It is in fact an extension of the anomalies (patterns in average stock returns that are not explained by the Capital Asset Pricing Model of Sharpe (1964) and Lintner (1965)) tests conducted by many researchers. In addition to looking for the presence of these two anomalies in the US stock market, it also aims to see which factor (Z-score or sales growth rate) have a stronger effect on the US stock market. Moreover, it also tests whether these two anomaly-variables combine to have strong explanatory power in average returns in the US stock market. In return, this study will assist us in better understanding of these anomalies phenomena. Last but not least, this study hopes to gain a better understanding of the stock prices behavior in the US stock market.

The topic for this study and the selected country for the study have been chosen for the following reasons:

(1) Researchers have identified many patterns in average stock returns. For example, DeBondt and Thaler (1985) find a reversal in long-term returns and Fama and French (1992) find that size and book-to-market variable combined to explain the cross-section of average. Therefore it will be meaningful to look into the effects of other variables (anomalies) on average returns.

(2) Ever since Fama and French (1992) find that size and book-to-market equity combined to explain the cross-section of average returns, many researcher have cast doubts on their findings. Specifically, Shanken and Sloan (1995) claim that there are survivorship biases in the data used. Using an alternative source of data, they find that book-to-market equity is at best weakly related to average stock returns. Thus, with these contrary views, their findings remain an unresolved issue.

In addition, market movements will affects every single variable in the three-factor model derived by Fama and French (1993). For example, stock prices are used in the computation of firm size and book-to-market equity. We believe it will be more appropriate to include both market and company specific variables (accounting variables) in the model to compute expected returns.

The reasons of selecting US stock market as compared to other smaller Asian stock markets are justified. The US stock market has the biggest market capitalization as compared to the other stock market. On top of that, the US stock market is the most efficient stock market in the world. Both high capitalization and efficiency will assist our study to produce more accurate and precise results.

Section II covers a literature review on the works done by various researchers related to this topic. Specifically, it captures the theories and empirical evidences concerning stock returns. Section III lays down the methodology and hypothesis for this study. It covers the data and its sources, portfolio formation procedures, statistical test and techniques employed in this study. Section IV presents the analysis of the results obtained from the various tests. It presents the statistical evidence of the significance of the Z-score, sales growth rate and market effect on stock returns as well as the joint explanatory power of these three variables. Section V rounds up the results and findings. It discusses the implications of the empirical finding of the study. In addition, it also states the limitations of the study together with the suggestions for future studies.

II. LITERATURE REVIEW

A. The Capital Asset Pricing Model (CAPM)

The CAPM developed by Sharpe (1964), Lintner (1965) and Mossin (1966) has been the most widely accepted among the many models developed to explain the relationship between expected returns and risk. Many researchers have tried to test CAPM model empirically (Black, Jensen & Scholes 1972; Fama & MacBeth 1973). Their studies generally concludes that the CAPM gives a useful insight into asset pricing. According to the CAPM, the market can only compensates the investors for bearing systematic risk or common risk, which is measured by the asset's beta. The beta measures the contribution of the risky asset to the riskiness of the entire efficient portfolio.

The relationship between the expected return and risk can be expressed in CAPM model:

$$\mathbf{E(R_i) = R_f + \beta_i(E(R_m) - R_f)}$$

Where $E(R_i)$ = the expected return on the ith risky asset

R_f = the expected return on a risk-free asset

$E(R_m)$ = the expected return on the market portfolio

$\boldsymbol{\beta_i}$ = beta coefficient of the ith risky asset

The establishment of the CAPM are based on the following assumptions:

(1) Investors are risk averse. Therefore investors prefer the highest expected return for a given standard deviation and the lowest standard deviation for a given expected return.

(2) The returns from investment are normally distributed. Therefore two parameters, the expected return and the standard deviation, are sufficient to describe the distribution of returns.

(3) All investors have a common single-period time horizon for their investment decision making.

(4) All investors can borrow and lend unlimited amount of money at a given risk-free rate.

(5) All investors have the same estimates of the expected return on each asset, the variance of return for each asset, and also the covariance between returns for each pair of assets.

(6) All assets are traded in the perfect markets; that is, all assets are marketable, there are no transaction costs or taxes, and all investors are price takers.

The CAPM is challenged by the evidences on anomalies in stock returns. The CAPM says that all diversifiable risks will not be compensated and the only relevant risk is the market risk. Therefore, besides the market factor, no other factors should systematically affect the stock returns. The firm specific factors are capture by the error term, which is random. But the findings of the anomalies such as size, book-to-market equity and earning-to-price ratio suggest that investors can earn abnormal returns based on these trading rules. This may imply that the CAPM is mis-specified.

Furthermore, Roll's (1976) articles also criticized the CAPM. He says that there are an infinite number of ex-post mean-variance efficient portfolios. Therefore, an empirical result will satisfy the linearity relation between beta and returns even when the true market portfolio is not mean-variance efficient. These results imply that it is impossible to measure the returns on all the assets in the market portfolio. Therefore, the CAPM cannot be tested unless the exact composition of the true market portfolio is made known and used in the empirical tests.

B. Efficient Market Hypothesis (EMH)

Fama (1970) defines an efficient capital market as one in which stock prices fully reflect available information. A market is efficient with respect to information if there is no way to make unusual or excess profit by using that information. This means that prices adjust instantaneously to new information. Since new information is impossible to predict, by definition, it is impossible to predict stock prices.

The Efficient Market Hypothesis (EMH) has implications for both the investors and the firm:

(1) Because information is reflected in prices immediately, investors should only expect to obtain a normal rate of return.

(2) Firm should only expect to receive the fair value for the securities that they sell.

Three types of Efficient Market Hypothesis have been developed from the notions of what is meant by the term “all available information”:

(1) The weak form efficient market concerns the information set that includes historical stock prices and volume information.

(2) The semi-strong form efficient market is one that prices incorporate all publicly available information, including information such as published accounting statements for the firm as well as historical price information.

(3) The most stringent hypothesis is the strong form efficient market that prices reflect all information, both public and private.

In-order to make the definitional statement of EMH testable, it is assumed that the conditions of market equilibrium can be stated in terms of expected returns and this equilibrium expected returns are form on the basis of information Φ_t. Given that the market adjust instantaneously to available information, the possibility of earning abnormal returns based on the information set Φ_t is being rule out. Hence, the expected excess return of security i must be zero.

Fama express it as follows:

Let $\mathbf{z_{j,\,t+1} = r_{j,\,t+1} - E(r_{j,t+1}/\Phi_t)}$,

Where $z_{j,\,t+1}$ is the difference between the observed return at t+1 and the expected value of the return that was projected at t on the basis of information Φ_t.

Under the EMH, $E(r_{j,t+1}/\Phi_t) = 0$. Therefore, the sequence $\{z_j\}$ is a “fair game” with respect to the information sequence $\{\Phi_t\}$.

The stock prices would be predictable if patterns in stock price movement exist. Therefore, the Efficient Market Hypothesis rule out these patterns in stock price movements. However, several studies have shown that certain patterns in stock price movement (anomalies) exist in the stock market. These anomalies phenomenon will be discussed in the following Section.

C. *Stock Returns Anomalies*

Many empirical studies have been conducted and found significant empirical regularities in stock prices for the US stocks. From the result of these studies, we can see that there is a violation in the joint hypothesis that the CAPM has descriptive validity and the capital market is efficient.

Book-to-Market Equity effect

One of the contradictions to the CAPM is the evidence of the book-to-market equity effect. Rosenberg, Reid and Lanstein (1985) and Stattman (1980) found that there is a positive relationship between stock returns and book-to-market equity. By the means of the time-series regression, the t-statistics obtained clearly show a positive result for their hypothesis.

In study of Lakonishok, Shleifer and Vishny (1994), all the stock in the US market was divided into ten decile portfolios from 1968 to1989 based on the book-to-market equity (BM) ratio. The results show that the average annual returns for decile with the highest BM was 10.5 percent higher than the lowest BM decile. Running the Fama and MacBeth (1973) type regressions, they found that size and BM had significant explanatory power for returns on a stand alone basis, but were not significant when they were specified together in the regression.

Price-earnings Ratio effect

Another anomaly reported by Basu (1983) is the price-earnings (P/E) effect. The result from his study shows that firms with low P/E ratios outperform firms with high P/E ratios. He finds a significant relation between P/E and risk-adjusted returns for the NYSE firms during the period April 1963 to March 1980 using a two parametric Capital Asset Pricing Model. The P/E effect holds up even if returns are adjusted for portfolio betas. Bhandari (1988) documents a positive relation between leverage (the ratio of debt to equity) and average returns even when the tests include beta and size.

Size effect

The size effect is among the most prominent phenomena identified. Banz (1981) documents that there is size effect in the US stock market, using a test period from 1963 to 1975. The result of this study shows that small firms (measured by market value) on the average earn higher risk-adjusted returns than big firms. Reinganum (1981) also demonstrates that common stock of small firms in the NYSE and American Stock Exchange earns a higher average risk-adjusted return than common stock of large firms. The persistent of the "abnormal" returns for at least two years lead him to conclude that the results seems to indicate a misspecification in the CAPM rather than saying that the market is inefficient.

Brown, Kleidon and Marsh (1983) having estimated the cross-sectional pattern of average returns for ten portfolios ranked on size, found that the excess return attributed to the size effect is unstable through time. From January 1969 to December 1973, a normal size effect with negative relation between excess returns and size of firms existed. However, this relation reversed, during January 1974 and June 1979, when the biggest firms portfolio earned higher returns. In addition, Reingnuam (1992) found that size effect is negatively autocorrelated over longer investment horizons. It was found that the autocorrelation between current and past returns become negative and statistically significant at investment horizons of more than five years. In other words, he observed that size effect tends to reverse itself in five-year interval.

Seasonal effect

Another evidence of the existence of the anomalies is the seasonal effect. In certain period of the year, stock returns are found to be higher as compared to the rest on the calendar year. The most common example of the seasonal effect is the January effect where stocks repeatedly earn higher returns in the month of January than the rest of the months in the year. The seasonal effect is also found in countries including Japan, Australia and Canada documented by Officer (1975), Berges (1984) and Jaffe & Westerfield (1985) respectively. Gultekin and Gultekin (1983) also document the seasonal effect for thirteen major industrial countries.

A number of studies have being conducted to explore the interaction between these anomalies. Some research claim that certain anomalies may be subsumed by other anomalies. For example, Reinganum (1981) demonstrate that size effect largely subsumes the earning yield effect. The reason is because, after controlling "abnormal" returns for an earning yield effect, a large and persistent market value effect is still detected. On the contrary, after controlling "abnormal" returns for the size effect, an independent earning yield effect cannot be found. Keim (1983) also finds a significant interaction between the size and January effects and nearly half of the size effect is due to January effect.

Anomalies Studies on Smaller Markets

As mentioned earlier, those anomalies observed for the US stock market also exist for stock markets in other parts of the world. For example, Chan, Hamao & Lakonishok (1991) find that the book-to-market equity and cash flow yield have significant positive impact on the average returns of Japanese stocks. Aggarwal, Hiraki and Rao (1992) also document the price-to-book value (PBV) effect for Tokyo Stock Exchange.

In London, Levi (1985) showed that smallest firm size portfolio outperformed their largest counterpart by about 5 percent per annual. He also illustrated that the average portfolio returns decline quite uniformly as firm size increases.

A few studies have been conducted on the smaller Asian markets. The results from these studies prove the existence of anomalies in these markets. Ho, Leung and Wong (1988) find that the day-of-the-week effect exists in Singapore, Malaysia, Taiwan, Korea, Hongkong, Thailand and Philippines stock markets. The day-of-the-week effect is a tendency to end each week on a strong note to decline sharply on Mondays. Similar to the US stock market, Philippines and Thailand stocks have lowest average returns on Monday and highest average returns on Friday. However, the rest of the stock markets under study lag by one day in experiencing the lowest and highest returns.

Wong and Lye (1990) examined the relationship between firm size and the returns of common stocks on the Stock Exchange of Singapore (SES). They found that the firm size effect existed in the SES, where small firms on the average have higher risk-adjusted returns than larger firms did. However, they also found that medium firms appeared to exhibit the highest rates of return, followed by small and large firms. In addition, Lee (1991) observed that returns are negatively correlated to market values for Singapore stocks.

Lye (1987) was among the first to examine earnings' yields (E/P) effect in Singapore. Using actively traded stocks in portfolios formed in December for the period 1975-1985, Lye found that stocks with high E/P earn higher average risk-adjusted returns compared to low E/P stocks, even after controlling for firm size. Since the firm size effect virtually disappears after controlling for earnings' yield, Lye concluded that the earnings' yield effect dominates the firm size effect in the SES.

Lee (1991) studied the E/P effect and other anomalies over the period January 1975 to March 1989. He found (1) that the E/P effect exists in the SES even when risk and the January effect are considered; (2) the E/P effect is present in non-January months; and (3) the E/P effect largely dominates the firm size effect, since no clear firm size effect remains when the E/P effect was controlled.

In summary, there is strong evidence to show that anomaly phenomena do exist across different securities markets in the world. Therefore, it would be interesting to explore further into other anomalies that might lead us to a better understanding of the capital asset pricing anomalies.

D. Fama and French Findings

Fama and French (1992) claim that size and book-to-market equity do a good job in explaining the cross-section of average return on NYSE, NASDAQ and AMEX stocks for the period 1963-1990.

Their study is based on previous studies that reveal a strong relationship between average returns and fundamental variables such as size, book-to-market equity, price-to-earnings and leverage. Their empirical test also follows studies done by Reinganum (1981) and Lakonishok & Shapiro (1986) who show that the relationship between beta and average returns disappears during 1963-1990 period. This finding of a flat relationship between beta and average returns would therefore imply that the CAPM is invalid.

Since all the variables mentioned above are scaled versions of a firm's stock price, they can be regarded as different ways of extracting information from the stock prices about the cross-section of expected returns. For example, market capitalization, price-to-earnings, leverage and book-to-market equity are computed using a common variable – price per share of the common stock (Keim, 1988).

This leads Fama and French to suspect that some variable might be redundant for explaining stock returns.

Therefore to study the joint roles of beta, size, price-to-earnings, book-to-market equity and leverage, they employed the cross-sectional regression approach of Fama and Macbeth (1973) in their study. Each month the cross-section of returns on stocks is regressed on the variable hypothesized to explain the cross-section of average stock returns. Their findings indicate that beta does not help to explain the cross-section of average returns. They find that used alone, size, book-to-market equity, price-to-earnings and leverage has explanatory power on average returns. In combination, size and book-to-market equity seem to absorb the roles of leverage and price-to-earnings in average stock returns. In addition, book-to-market equity has a consistently stronger role that size in average returns. The reason is because the difference in average monthly returns on the lowest and highest book-to-market equity portfolios is twice as large as the difference on the smallest and largest size portfolios.

The next step following the establishment of the two anomaly-variables as the most significant variables in explaining stock returns is to provide economic foundation for this phenomenon. In their follow-up paper (1995), they looked into whether the behavior of stock prices, in relation to size and book-to-market equity, is consistent with the behavior of earnings. Their work is guided by two hypotheses: If stocks are priced rationally,

(1) The relation of size and book-to-market equity to returns must be explained by the behavior in earnings.

(2) There must be common risk factors in returns associated with size and book-to-market equity.

Consistent with the rational pricing theory, they find that low book-to-market equity signal strong earnings and high book-to-market equity signals persistent poor earnings. They also show that there are size and book-to-market factors in earning like those in returns. In addition, they find that the market and size factors in earning help to explain the market and size factors in returns. However, there is no evidence that returns respond to the book-to-market factor in earnings.

Although there is some agreement among researchers that size and book-to-market factors have strong relationship with stock returns, the issue on the interpretation of why the two variables have explanatory power is however controversial.

One possible explanation of the size and book-to-market equity effects is derived within the framework of rational asset-pricing theory. It is argued that small and large firms have different sensitivities to the risk factors important for pricing assets. Chan, Chen and Hsieh (1985) documented that small firms are more exposed to changes in the risk premium and production risk. In addition, Chan and Chen (1991) find that the size and average return are related in terms of the relative prospects of the firm. Small firms on the NYSE tend to be less efficiently manage and have higher leverage. Therefore, the earning prospects of these distressed firms are more sensitive to economic conditions. This results in a distress factor in returns that is priced in expected returns.

An alternative explanation of the size and book-to-market equity effects is market overreaction. De Bondth and Thaler (1985) show that investor overweight recent information and underweight base rate data such that portfolios of prior “loser” are found to outperform prior “winner”. They (1987) also found that this winner-loser pattern is positively related to book-to-market equity.

Lakonishok and Ritter (1992) claim that the overreaction effect and size effect is not related. Their findings suggest that the overreaction effect is a more powerful and different source of abnormal return than the size effect.

Fama and French (1992) also suggest that the book-to-market effect might be the resultant of market overreaction. However, their results show that prior returns have no power to explain average returns. Fant and Peterson (1995) provide evidence to support the existence of market overreaction effect. However, their findings do not support the deduction that book-to-market equity effect is caused by the overreaction effect. The reason is because strong seasonal relations still exist between returns and prior returns even after accounting for size and book-to-market equity.

Fama and French (1993) extended their research to suggest that that if stocks are priced rationally, size and book-to-market equity must proxy for sensitivity to common risk factors in returns. Their analysis confirm their hypothesis as portfolios constructed to mimic risk factors related to size and book-to-market equity add substantially to the variation in stock returns explained by the market portfolio. Moreover, the three-factor asset pricing model (market, size and book-to-market equity) capture the cross-section of average returns on US stocks.

On the other hand, Lakonishok, Shleifer and Vishny (1994) advocate an irrational pricing theory to explain the size and book-to-market effects. They argues that prior to portfolio formation, the market incorrectly estimate the strong earning growth of low-book-to-market equity stocks and the weak growth of high book-to-market equity stocks. This is inconsistent with Fama and French (1995) findings. Their results indicate that once stocks are allocated to portfolios based on size and book-to-market equity, the market makes unbiased estimates of earnings growth.

Shefrin and Statman (1995) proposed a behavioral approach to stock valuation. They argued that the belief that good stocks are stock of good companies with large size and low book-to-market equity ratio and the indifference to beta underlie both the superior performance of stocks of small firms with high book-to-market equity and the weak relationship between realized returns and beta.

However, Black (1993) warned that the results obtained from these studies might be due to "Data Mining". With enough data mining, all the results that seems significant could be just accidental (Lo, Andrew and Mackinlay, 1990).

The CAPM and EMH are challenged by the empirical findings of anomalies in stock returns. However, the explanation of the existence of these anomalies in the securities markets is still not conclusive. This calls for further research to identify more anomalies that can conclusively verify the existence of regularities in stock prices.

III. DATA AND METHODOLOGY

This section aims to provide a detail description of the data used and the methodology employed in this study. Section III-A described the data source and the sample selection criteria for the firms in the US stock market. Next, the portfolio formation procedure used in the study will be presented in Section III-B. The research design used to examine the relationship between sales growth rate, Z-score and common stock returns is found in Section III-C. In this study, the statistical techniques used will follow closely to Fama and French methodology. Lastly, some econometric issues involved in using time-series regressions will be discusses in Section III-D.

A. Data Source and Sample Inclusion Criteria

The data used for this study are drawn from two main sources:

1) Datastream from the Financial Database.

2) Standard & Poor's Research Insight (maintained by COMPUSTAT).

Quarterly stock prices from beginning of July 1988 to June 1998 are extracted for the computation of quarterly stock returns of firms. These stock prices are taken from Datastream in the Financial Database. U.S. 3-month Treasury bill rates are also extracted from the same source for the same time period.

All the quarterly accounting variables (sales turnover, net working capital, accumulated retained earnings, earning before tax and interest, book value of equity, total assets and total liabilities) are extracted from the Standard & Poor's Research Insight. These accounting variables are needed to compute the fundamental variables hypothesized to explain stock returns.

In this study, quarterly holding periods are employed as compared to Fama and French (1992) who use annual holding period. The accounting data for quarter q are matched with the returns for quarter q+1 to allow for a 3-month gap. The 3-month gap is essential for firms to file in their financial statements with the stock exchange as well as for the market to react to these financial disclosures. The time period for this study start from 1 July 1988 to 31 June 1998, consisting of 40 equally quarters.

One possible problem with the use of a common holding period for all stocks is that some firms have non-December year ends. Fama and French (1992), however, set a precedent. They did a comparative study using only firms with December year ends, and found similar results with that of mixing firms with different year ends.

This study attempted to include all stocks listed in the Standard & Poor 500 Composite Index in 1998. Unfortunately, not all the 500 stocks are included in this study. The reasons are:

1) Failure for some firms to meet the criteria that, for a firm to be included, it must be listed before 1988.
2) Due to the lack of information from the Financial database.

After sorting the data based on the above-mentioned criteria, the number of companies remaining for empirical tests are left with 453 companies.

B. Portfolio Formation

The portfolios in this study are formed based on two criteria: (1) the company sales growth rate and (2) the company Z-score rating. We will first discuss the formation of the nine randomized portfolios in a matrix format based on the two dimensions mentioned above. Next, we will discuss the formation of the final six portfolios that are meant to mimic the underlying risk factors in returns related to sales growth rate and Z-score. These resulting portfolios are used as the explanatory variables in the time-series regression analysis.

Explanatory Variables

The are basically two approaches to randomize the nine portfolios. One of the ways is the method employed in Fama and French research paper (1995). The stock market samples are first sorted by their market equity values in an ascending order for grouping the stocks into different portfolios. The sample stocks are assigned to one of the size-portfolios, that is, firms that belong to the smallest market values quartile are grouped into one portfolio and subsequently firms belonging to middle market values are grouped into other portfolios and the last size-portfolio are those containing those firms with biggest market values. The method of forming the book-to-market portfolio are very much the same as forming the size-portfolio.

After forming the size and book-to-market portfolios, they constructed the final portfolios from the intersections of the two sets of portfolios. The stocks that are common in both dimensions are collected together to form one portfolio. This method of randomization will ensure a clean separation of the effect that one variable may influence the other.

The alternative method with no significant deviations of results would be the one employed by Basu [1983]. After the three size-portfolios are formed, each of them is further divided into three sub-groups on the basis of the ranked book-to-market values of their constituent firms. After forming the nine portfolios, those three portfolios that have the lowest book-to-market values are again grouped into one final portfolio. The same grouping is done on those firms that have middle and highest portfolios. The result of this, is the formation of the final three book-to-market portfolios. The procedure described above also applies to the construction of the final three size-portfolios. This method is particularly useful for research with small sample size.

Since the sample size used in this study is relatively large, the portfolio formation techniques used here would be very similar to that employed by Fama and French. Since different definitions will give rise to different interpretation, it is important for us to first clearly define sales growth rate and Z-score.

Sales growth rate

At the end of every quarter of the fiscal year, the total sales volume for the firms is extracted for the calculation of the firm's quarterly sales growth rate. Generally, the quarterly sales growth rate of stock i will be:

$$\mathbf{SGR_{iq} = S_q - S_{q-1} / S_{q-1}}$$

Where: SGR_{iq} = Sales growth rate of stock i in quarter q

S_q = Total sales volume of stock i in quarter q

S_{q-1} = Total sales volume of stock i in the previous quarter

Sales growth rate is a good indicator in measuring the external performance of a company. The rationale for choosing sales turnover as compared to other accounting variables such as net profit or retained earning is because sales turnover cannot be control or manipulated by firm managers. For example, the firm manager can use accounting policy change of deprecation to affect final net profit figure. Thus, sales growth rate can be a fairly good indicator for measuring the external strength of a firm over time.

Z-score

Edward Altman (1968 and 1993) has developed a solvency model using financial statement ratios and multiple discriminant analyses to predict bankruptcy for firms. Such models are now extensively used in the US and the UK by various groups ranging from bankers and credit managers to auditors and investors. The resultant model is of the form:

$$\mathbf{Z'_q = 6.56X_1 + 3.26X_2 + 1.05X_3 + 6.72X_4}$$

Where: Z'_q = Z-score for stock i in quarter q

X_1 = Net working capital / Total assets in quarter q

X_2 = Accumulated retained earnings / Total assets in quarter q

X_3 = Earnings before interests and tax / Total assets in quarter q

X_4 = Book value of equity / Total liabilities in quarter q

Z-score is chosen as an explanatory variable in this study because of its ability to measure both profitability and balance sheet strength to provide a very powerful index of financial performance for different types of firms. This strength is accumulated from its usage of a wide variety of accounting ratios. In short, the Z-score value provides a very good indicator of the internal financial health of a company.

Formation of nine randomized portfolios

The method of constructing the nine randomized portfolio in this study is quite different from that employed by Fama and French (1995). We are able to separate each variable into three different categories based on certain guiding criteria.

Z-score values are separated into three different categories as suggested by Edward Altman (1993) where:

1) **Z1** = (Z-score $\leq$ 1.23), which indicates a bankruptcy likelihood,

2) **Z2** = (1.23 $<$ Z-score $\leq$ 2.90), which indicates a gray area,

3) **Z3** = (Z-score > 2.90), which indicates financial healthy.

Sales growth rate will also be separated into three different categories where,

1) **SGR1** = negative sales growth rate

2) **SGR2** = 10% ≤ sales growth rate ≤ 20%

3) **SGR3** = sales growth rate > 20%

Since each variable is separated into three different groups, we are now able to form nine randomized portfolios based on these two dimensions in a matrix format. The nine portfolios are Z3SGR3, Z3SGR2, Z3SGR1, Z2SGR3,…, Z1SGR1. At the end of each quarter, individual stock are allocated to one of the nine group based on the two dimensions. For example, if a stock has more than 20% of quarterly sales growth rate and a Z-score value greater than 2.90, then it will be allocated to portfolio Z3SGR3. Since the sales growth rate and Z-score value for each firm is different in each time period, therefore the composition of stocks in each of the nine portfolios will change in every quarter.

Formation of final six portfolios

After the formation of the nine randomized portfolios at the end of each quarter, the lowest Z-score groups relating to the three sales growth rate classes are combined to form a randomized portfolio Z1*. In other words, Z1SGR1, Z1SGR2 and Z1SGR3 are combined together to obtain the portfolio Z1* containing low Z-score firms. In the same way, the other two randomized Z-score-portfolios namely Z2* and Z3* are formed. The procedure described above applies to the construction of the final three sales growth rate-portfolios (SGR1*, SGR2* and SGR3*) which are randomized in terms of Z-score.

Portfolio Z1* and Z3* are used to construct the explanatory variable Z3*Z1* meant to mimic the risk factor in return related to Z-score. It is the difference each quarter, between the average of the returns on the high-Z-score portfolio (Z3*) and the low-Z-score (Z1*) portfolio. Portfolios SGR1* and SGR3* are used to construct the explanatory variable SGR3*SGR1* meant to mimic the risk factor in returns related to sales growth rate. It is the difference, each quarter, between the average of the returns on high-sales growth rate portfolio (SGR3*) and the low-sales growth rate portfolio (SGR1*).

Spearman Rank Correlation Coefficients Test

Spearman Rank Correlation Coefficient Test is used to show that the randomized process is success and that there is no confounding effects that one variable has on the other. The resulting correlation coefficient between the two explanatory variables related to sales growth rate and Z-score will tell whether sales growth rate and Z-score has much influence over one another. The tests mentioned above is chosen because they can be used even when the distribution of the sample are not normal.

Dependent Variables

The dependent variables in the time-series regression are the excess return on the nine portfolios formed based on sales growth rate and Z-score. We use portfolio formed on sales growth rate and Z-score because we seek to determine whether the explanatory variable SGR3*SGR1* and Z3*Z1* capture common factors in stock return related to sales growth rate and Z-score. These nine randomized portfolio are actually obtained when we construct the explanatory variables (Z3SGR3, Z3SGR2, Z3SGR1, Z2SGR3 ,…, Z1SGR1).

Returns on Common Stock

Generally, the return of common stock i in quarter Q will be its capital returns in that quarter of that particular year t. Capital gain is the change in the price of the stock divided by the initial price. It is more accurate and convenient to convert returns in percentage terms than in dollars, because percentage is a common basis for comparison across different stocks.

The quarterly return of stock i in quarter 1 is calculated as follows,

$$\mathbf{R_{iQ1} = (P_{Q+1} - P_Q)/P_Q}$$

Where: R_{iQ1} = return of stock **i** in quarter 1

P_Q = price of stock i at 1st of January

P_{Q+1} = price of stock i at 1st of April

Returns on Portfolio

The quarterly return on a portfolio is calculated as an equally weighted of the average quarterly returns across all the common stocks that are in the portfolio. In another words, it is simply the arithmetic mean of returns of all the stocks included in that portfolio. As the portfolio are formed in every quarter (March, June, September, December of year t), the return on the portfolio are calculated and matched with the portfolio formed one quarter before, based on sales growth rate and Z-score.

The equation for calculating portfolio return is,

$$\mathbf{R_{pQ} = \Sigma R_{iQ} / N}$$

Where: R_{pQ} = Quarterly equally-weighted stock return of a portfolio

R_{iQ} = Quarterly return of common stock **i**

N = Number of stocks in a portfolio

C. Research Design and Hypothesis

Fama and French (1992) use the cross-sectional regression to examine the relations between size, leverage, price-to-earning ratio, book-to-market equity and average returns. However, in their follow-up papers (1993 and 1995), they employed the time-series regression approach of Black, Jensen and Scholes (1972).

The time-series regressions are convenient for studying two important asset-pricing issues: (a) If assets are priced rationally, variables that are related to average return such as sales growth rate and Z-score, must proxy for sensitivity to common risk factors in returns. The time-series regressions give direct evidence on this issue. (b) The time-series regressions use excess returns as dependent variables and either excess returns or returns on zero-investment portfolios as explanatory variables. In such regressions, a well specified asset-pricing model produces intercepts that are indistinguishable from 0 (Merton, 1973). The estimated intercepts provide a simple return metric and a formal test of how well different combination of common factors capture the cross-section of average returns.

Z-score factor in returns

Hypothesis 1: There is a positive relation between returns and Z-score

As an informal test, the average quarterly returns in excess of the risk free rate of the nine portfolios used as the dependent variables are computed together with the mean returns and standard deviations.

The spread between the average excess returns of firms with high Z-score and firms with low Z-score will then give a fairly good indication towards the acceptance or rejection of the hypothesis.

As a formal test, the time-series regression is employed. The time-series approach attempts to explain the cross-section of average returns with premiums for the common risk factors. The explanatory variable is the portfolio Z3*Z1* which is constructed to mimic the risk factor in returns related to Z-score. It is the difference, each quarter, between the average of the returns on the high Z-score portfolio (Z3*) stocks and the low Z-score portfolio (Z1*) stocks. The dependent variable is the excess returns on the nine portfolios.

Therefore, the time-series model relating returns and Z-score factor is:

R(t) – Rf(t) = a + k(Z3*Z1*)(t) + e(t)

Where: R(t) = Quarterly equally-weighted returns on each of the nine portfolios (Z3SGR3, Z3SGR2, Z3SGR1, Z2SGR3,…, Z1SGR1)

Rf(t) = U.S. 3-month Treasury bill rates

Z3*Z1* = The mimicking returns for Z-score factor. It is simply the difference quarter between the average of the returns on the high Z-score portfolio (Z3*) and the low Z-score portfolio (Z1*)

Sales Growth Rate factor in returns

Hypothesis 2: There is a positive relation between returns and sales growth rate.

Similar to the method mentioned above, the average quarterly returns in excess of the risk free rate of the nine portfolios used as the dependent variables are computed together with the mean returns and standard deviations. It therefore serve as a quick check as to whether the firms with high sales growth rate earn higher average quarterly returns than firms with low sales growth rate.

The explanatory variable is the portfolio SGR3*SGR1* which is constructed to mimic the risk factor in returns related to sales growth rate. It is the difference, each quarter, between the average of the returns on the high sales growth rate portfolio (SGR3*) stocks and the low sales growth rate portfolio (SGR1*) stocks. The dependent variable is the excess returns on the nine portfolios.

Therefore, the time-series model relating returns and sales growth rate factor is:

R(t) – Rf(t) = a + j(SGR3*SGR1*)(t) + e(t)

Where: R(t) = Quarterly equally-weighted returns on each of the nine portfolios (Z3SGR3, Z3SGR2, Z3SGR1, Z2SGR3,…, Z1SGR1)

Rf(t) = U.S. 3-month Treasury bill rates

SGR3*SGR1* = The mimicking returns for sales growth rate factor. It is simply the difference quarter between the average of the returns on the high sales growth rate portfolio (SGR3*) and the low sales growth rate portfolio (SGR1*)

Market, Sales Growth Rate and Z-score factors in returns

Hypothesis 3: The market, Z-**score** ***and sales growth rate combine to capture the cross- section of returns***

Fama and French (1995) find that their asset pricing model only becomes well specified when the market factor is included in the regression. Therefore, the regression tests employed in this study are developed in three steps. First, the regression tests use only the excess market return, Rm-Rf. Then the regression tests examine the combine effect of the risk factors related to Z-score and sales growth rate. Finally, the regression extends to include all the three factors.

The time-series models for these three steps are:

1) **R(t) – Rf(t) = a + b[Rm(t) – Rf] + e(t)**
2) **R(t) – Rf(t) = a + k(Z3*Z1*) + j(SGR3*SGR1*) + e(t)**
3) **R(t) – Rf(t) = a + b[Rm(t) – Rf] + k(Z3*Z1*) + j(SGR3*SGR1*) + e(t)**

Where: R(t) = Quarterly equally-weighted returns on each of the nine portfolios (Z3SGR3, Z3SGR2, Z3SGR1, Z2SGR3, …, Z1SGR1)

Rf(t) = U.S. 3-month Treasury bill rates

Rm(t) = Quarterly market return. It is the equally-weighted quarterly returns on all the firm used in constructing the portfolios

Z3*Z1* = The mimicking returns for Z-score factor. It is simply the difference quarter between the average of the returns on the high Z-score portfolio (Z3*) and the low Z-score portfolio (Z1*)

SGR3*SGR1* = The mimicking returns for sales growth rate factor. It is simply the difference quarter between the average of the returns on the high sales growth rate portfolio (SGR3*) and the low sales growth rate portfolio (SGR1*)

The regression slope, the t-statistics and the R^2 values of each set of the above regressions will confirm the hypothesis and the explanatory power of Z-score and sales growth rate factors. The intercepts for the portfolios are then examined to see if they are indistinguishable from zero.

D. Econometric Issues

Testing and Remedial for Multicollinearity

Multicollinearity arises when there is a violation to the assumption that the explanatory variables are independent of one another. Multicollinearity can occurs when either two explanatory variables are correlated with each other or some combination of a few variables is correlated with another variable. When there is multicollinearity in the multiple regression, the coefficients are still unbiased estimators although their standard errors are not accurately estimated. The fact that some or all explanatory variables are correlated among themselves does not, in general, inhibit our ability to obtain a good fit nor does it tend to affect inferences about mean responses or predictions of new observations, provided these inferences are made within the region of observations. The tests of significance therefore are no longer valid because independence is assumed between the explanatory variables when calculating standard errors for the coefficients.

The detection of the effects of multicollinearity can be difficult. However, certain indications of the presence of serious multicollinearity can be observed. For example, when there are large coefficients of simple correlation between pairs of explanatory variables in the correlation matrix $\mathbf{r}_{xx}$ or when there is an existence of both a high R^2 and low t-statistics.

There are several remedial measures to correct for multicollinearity. We can take out highly correlated variables, adding uncorrelated variables, combine cross-sectional and time-series data and transforming the highly correlated variables. A more recent method, which is going to be applied in this study, is "orthogonalization".

In order to separate the influence of variable X1 from that of X2 (those two variables that are found to be significantly correlated), we would create an "orthogonal" variable, X1* which would be uncorrelated with X2. This new variable is obtained as follows:

X1* = X2 – [Cov(X2,X1)/Var(X2)] * X2

such that Cov(X2,X1) = 0, where X1* is an orthogonal variable. In effect, X1* is equivalent to the residual errors from a linear regression of X1 against X2 with the intercept constraint to zero.

Testing for Autocorrelation

If the error terms, μ_t of the regression equations is correlated, contrary to the assumption that $E(\mu_t, \mu_{t-j}) = 0, j \neq 0$, the estimates of the intercepts and the slopes obtained using the least square procedure are no longer best linear unbiased estimators. On top of that, the values of R^2 as well as the t and F-statistics tend to be exaggerated (Maddala, 1977).

The Durbin-Watson test is employed to detect first order autocorrelation for each set of the regressions. Once it is confirmed that the error terms are correlated, the Prais-Winsten autoregression method will be used to correct for this factor.

IV. EMPIRICAL FINDINGS AND ANALYSIS

A. Descriptive Statistics

We will look at some of the descriptive statistics on the excess quarterly returns (above risk-free rate) for the nine randomized portfolios that are used as the dependent variables and the quarterly returns for the independent variable (Z3*Z1*, SGR3*SGR1* and Rm-Rf).

For comparison, these descriptive statistics are summarized in Table I. From the descriptive statistics, we can observe that the average quarterly excess returns on the Z-score portfolios suggest that there is a positive relationship between Z-score and average returns. For every sales growth rate group, the average quarterly excess returns increase from the lowest Z-score portfolio to the highest Z-score portfolio.

The same result can also be observed for the sales growth rate portfolios. From the descriptive statistics, the average quarterly excess returns on the sales growth rate portfolios suggest that there is a positive relationship between sales growth rate and average returns. For every Z-score group, the average quarterly excess returns increase from the lowest sales growth rate portfolio to the highest sales growth rate portfolio.

Table I: Summary statistic for the quarterly dependent (Panel A) and explanatory returns (Panel B) in the various regressions: July 1988 to June 1998.

Panel A

	Z-score group					
	High 3	Mid 2	Low 1	High 3	Mid 2	Low 1
Sales Growth	Mean			Standard Deviation		
High 3	2.2416	-0.6739	-2.2945	5.9129	5.6502	7.6739
Mid 2	0.8877	-1.3775	-2.9576	6.2397	7.1381	6.7597
Low 1	0.1003	-2.0182	-4.2436	6.3627	4.4956	6.1665

Panel B

	Mean	Standard Deviation
Z3*Z1*	2.5521	4.9329
SGR3*SGR1*	1.1194	2.7472
Rm-Rf	0.1632	4.4096

Note: The 9 portfolios are formed as follows: In every ending of a quarter from 1988 to 1998, stocks from the Standard & Poor 500 composite index are sorted based on their Z-score and sales growth rate. This will result in the formation of the nine randomized portfolios. Equally weighted quarterly returns are calculated from the beginning of quarter Q to the end of quarter Q. Z3*Z1*, the return on the mimicking portfolio for the common Z-score factor in returns, is the difference each quarter between the simple average of the returns on the randomized high Z-score portfolio (Z3*) and the simple average of returns on the randomized low Z-score portfolio. SGR3*SGR1*, the return on the mimicking portfolio for the common sales growth rate factor in returns, is the difference each quarter between the simple average of the returns on the randomized high sales growth rate portfolio (SGR3*) and the simple average of returns on the randomized low sales growth rate portfolio. Rm-Rf is the difference between the equally-weighted quarterly return on all stocks used in constructing the portfolios and the T-bill rate of the quarter.

In addition, Z-score factor has a consistently stronger role than sales growth rate in average returns. The difference in average quarterly returns on the highest and lowest Z-score portfolios is more than twice as large as compared to the difference on the highest and lowest sales growth rate portfolios.

Spearman Rank Correlation Tests

The three independent variables employed in this study are (1) the mimicking returns for the Z-score factor (Z3*Z1*), (2) the mimicking returns for the sales growth rate factor (SGR3*SGR1*) and (3) the excess market portfolio returns (Rm-Rf). The Spearman Rank Correlation Coefficient Test is used to show that there are no confounding effects that one variable has on the other.

Table II: Spearman Rank Correlation Coefficients between variables

	Z3*Z1*	SGR3*SGR1*	Rm-Rf
Z3*Z1*	1	0.237035	0.191591
SGR3*SGR1*		1	0.304973
Rm-Rf			1

Note: Z3*Z1*, the return on the mimicking portfolio for the common Z-score factor in returns, is the difference each quarter between the simple average of the returns on the randomized high Z-score portfolio (Z3*) and the simple average of returns on the randomized low Z-score portfolio. SGR3*SGR1*, the return on the mimicking portfolio for the common sales growth rate factor in returns, is the difference each quarter between the simple average of the returns on the randomized high sales growth rate portfolio (SGR3*) and the simple average of returns on the randomized low sales growth rate portfolio. Rm-Rf is the difference between the equally weighted quarterly return on all stocks used in constructing the portfolios and the T-bill rate of the quarter.

The Spearman coefficients show that the Z-score and the market factors are almost uncorrelated but the sales growth rate and the market factors are slightly positively correlated. On the other hand, the correlation between Z-score and sales growth rate factors is 0.237035. Since there are significant correlation between pairs of explanatory variables, the regression tests involving the correlated variables are corrected for multicollinearity using the "orthogonalization" method.

B. Results of Time-series Regressions

The time-series regression are performed using three independent variables: they are (1) the return on the mimicking portfolio for the common Z-score factor (Z3*Z1*), (2) the return on the mimicking portfolio for the common sales growth rate factor (SGR3*SGR1*) and (3) the market factor (Rm-Rf). The dependent variables will be the average quarterly return of the nine randomized portfolios formed based on Z-score and sales growth rate.

Z-score factor in stock returns

The regression results have confirmed the informal analysis that there is a positive relationship between Z-score and average stock return. From table III, we can observe that the slopes on Z3*Z1* decrease monotonically from high Z-score portfolios to low Z-score portfolios in all the sales growth rate groups. This indicates that stock return is related to Z-score.

On top of that, except for two portfolios, the slope on Z3*Z1* of all the rest of the seven portfolios are significant at 5% level of significance with a critical $t_{0.25,\infty} = -1.96 \leq t \leq 1.96$. Therefore, we can reject the null hypothesis that there are no relationship between average returns and Z-score.

From the R^2 values, we can infer that some of the variation in stock returns could be explained by the Z-score effect. For example, the Z-score factor explains more than 20% of the variations in the high Z-score portfolios' returns.

Table III: Regressions of excess Z-score portfolio returns on the mimicking returns for the Z-score (Z3*Z1*) factor: July 1988 to June 1998.

R(t) – Rf(t) = a + k(Z3*Z1*)(t) + e(t)

	Z-score group					
	High 3	Mid 2	Low 1	High 3	Mid 2	Low 1
Sales Growth	k			t(s)		
High 3	0.7333	0.5364	0.4574	4.7677*	2.8942*	2.3962*
Mid 2	0.6505	0.6391	0.1168	3.6195*	3.1542*	0.5271
Low 1	0.6591	0.4794	0.2573	3.6647*	1.9858*	1.8962
	R^2			Durbin-Watson Statistics		
High 3	0.3578	0.1862	0.1464	1.5773*	1.7988	2.6762
Mid 2	0.2368	0.2075	0.0073	1.7398	2.0470	1.4965*
Low 1	0.2611	0.0940	0.0864	1.8826	1.6170*	2.6762

Note: * significant at 5% level of significance
The results shown here have been corrected for autocorrelation
The 9 portfolios are formed as follows: In every ending of a quarter from 1988 to 1998, stocks from the Standard & Poor 500 composite index are sorted based on their Z-score and sales growth rate. This will result in the formation of the nine randomized portfolios. Equally weighted quarterly returns are calculated from the beginning of quarter Q to the end of quarter Q. Z3*Z1*, the return on the mimicking portfolio for the common Z-score factor in returns, is the difference each quarter between the simple average of the returns on the randomized high Z-score portfolio (Z3*) and the simple average of returns on the randomized low Z-score portfolio (Z1*).

Sales Growth Rate factor in stock returns

The formal regression tests indicate that the sales growth rate effect is present in returns. From table IV, with the exception of three portfolios, the slope on SGR3*SGR1* of all the rest of the seven portfolios are significant at 5% level of significance with a critical $t_{0.25,\infty} = -1.96 \leq t \leq 1.96$. Therefore, we can reject the null hypothesis that there are no relationship between average returns and sales growth rate at 5% significance level in favor of the alternative hypothesis.

The regression results have confirmed the informal analysis that there is a positive relationship between sales growth rate and average stock return. From table IV, we can observe that the slopes on

SGR3*SGR1* decrease monotonically from high sales growth rate portfolios to low sales growth rate portfolios in all the Z-score groups. This implies that the mimicking returns for the sales growth rate factors are systematically related to sales growth rate.

From the R^2 values, we can infer that some of the variation in stock returns could also be explained by the sales growth rate effect. For example, the sales growth rate factor explains more than 15% of the variations in the high and medium sales growth rate portfolios' returns.

Table IV: Regressions of excess sales growth rate portfolio returns on the mimicking returns for the sales growth rate (SGR3*SGR1*) factor: July 1988 to June 1998.

R(t) – Rf(t) = a + j(SGR3*SGR1*)(t) + e(t)

	Z-score group					
	High 3	Mid 2	Low 1	High 3	Mid 2	Low 1
Sales Growth Rate		j			t(s)	
High 3	1.0783	1.1166	1.0505	3.3253*	3.7605*	2.8021*
Mid 2	0.9155	1.0711	0.5308	2.6792*	2.9338*	1.5004
Low 1	0.7883	0.3457	0.4631	2.2312*	1.3322	1.1814
		R^2			Durbin-Watson Statistics	
High 3	0.2254	0.1847	0.1414	1.9185	2.0078	2.7078
Mid 2	0.1809	0.2712	0.0559	1.9529	1.7375	1.8744
Low 1	0.1158	0.0446	0.0354	1.9664	1.8825	1.5553*

Note: * significant at 5% level of significance
The results shown here have been corrected for autocorrelation.

The nine portfolios are formed as follows: In every ending of a quarter from 1988 to 1998, stocks from the Standard & Poor 500 composite index are sorted based on their Z-score and sales growth rate. This will result in the formation of the nine randomized portfolios. Equally weighted quarterly returns are calculated from the beginning of quarter Q to the end of quarter Q. SGR3*SGR1*, the return on the mimicking portfolio for the common sales growth rate factor in returns, is the difference each quarter between the simple average of the returns on the randomized high sales growth rate portfolio (SGR3*) and the simple average of returns on the randomized low sales growth rate portfolio (SGR1*).

Market factor in stock returns

Fama and French (1993) find that the market leaves much variation in stock returns that might be explained by other factors. For their portfolios under study, the R^2 values are on the average less than 0.7. The results shown in table V are quite consistence with their results. From table V, the R^2 on the average is about 0.65. This indicates that some of the variation in stock returns might be explained by other factors.

From table V, the estimated coefficients for the slope of all the portfolios are close to one. On top of that, they all significant at 5% level of significance and given that the R^2 on the average are less than 0.7. This implies that although the market portfolios capture much of the variation in stock returns, but it actually leaves some variation in stock returns to be explained by other variables.

Table V: Regressions of excess portfolio returns on the excess stock-market returns, Rm-Rf: July 1988 to June 1998.

R(t) – Rf(t) = a + b[Rm(t) – Rf] + e(t)

	Z-score group					
	High 3	Mid 2	Low 1	High 3	Mid 2	Low 1
Sales Growth Rate		b			t(s)	
High 3	1.6047	1.0300	1.2593	5.8200*	8.3842*	6.4936*
Mid 2	1.1056	1.2075	1.0834	7.7618*	6.9389*	6.1854*
Low 1	1.1441	0.7846	1.1120	8.0695*	7.4698*	8.1332*
		R^2			Durbin-Watson Statistics	
High 3	0.7523	0.6491	0.5259	1.7537	2.2815	2.8450
Mid 2	0.6132	0.5589	0.5017	2.3346	1.8846	1.1696*
Low 1	0.6315	0.5948	0.6351	1.8934	1.5449*	2.1159

Note: * significant at 5% level of significance

The results shown here have been corrected for autocorrelation.

The 9 portfolios are formed as follows: In every ending of a quarter from 1988 to 1998, stocks from the Standard & Poor 500 composite index are sorted based on their Z-score and sales growth rate. This will result in the formation of the nine randomized portfolios. Equally weighted quarterly returns are calculated from the beginning of quarter Q to the end of quarter Q. Rm-Rf is the difference between the equally-weighted quarterly return on all the stocks used in constructing the portfolios and the riskfree rate of the quarter.

Z-score and Sales Growth Rate factors in stock returns

Table VI shows that Z-score and sales growth rate capture some for the time-series variation in stock return with the absence of competition from the market portfolio. Five out of nine R^2 values are greater than 0.28 and the R^2 values tend to be largest for the highest Z-score and sales growth rate portfolios. For example, the portfolio with the highest Z-score and sales growth rate is 0.4285, which is the highest R^2 value among all the nine portfolios. This is another indication of the presence of the Z-score and sales growth rate factors in stock returns.

The R^2 attained from table VI is not large enough may be due to two reasons, (1) the combination of Z-score and sales growth rate factors only capture some of the time-series variation in stock returns and (2) the size of the portfolios are not large enough because the idiosyncratic variances tend to be higher for smaller portfolios than larger portfolios, thus causing the R^2 values to be smaller.

The R^2 values show that the two factors combined explain some of the variations in returns of the stock market. However, much of the variations in returns are left to be picked up by the market factor.

Table VI: Regressions of excess portfolio returns on the mimicking returns for the Z-score (Z3*Z1*) and sales growth rate (SGR3*SGR1*) factors : July 1988 to June 1998.

R(t) – Rf(t) = a + k(Z3*Z1*) + j(SGR3*SGR1*) + e(t)

	Z-score group					
	High 3	Mid 2	Low 1	High 3	Mid 2	Low 1
Sales Growth		k			t(s)	
High 3	0.6335	0.2935	0.1527	4.0034*	1.8882	0.9044
Mid 2	0.5072	0.4942	0.0336	2.7985*	2.3881*	0.1432
Low 1	0.5767	0.2844	0.2421	3.0452*	1.5097	1.3746
		j			t(s)	
High 3	0.7792	0.9786	0.8729	2.4573*	3.2272*	2.9679*
Mid 2	0.5322	0.8096	0.4427	1.9756*	2.6232*	1.2495
Low 1	0.4393	0.1992	0.3588	1.2918	0.7377	0.9658
		R^2			Durbin-Watson Statistics	
High 3	0.4285	0.2869	0.1730	1.6498*	1.7241	2.7357
Mid 2	0.3607	0.2936	0.0359	1.6702*	2.1953	1.5462*
Low 1	0.2930	0.1072	0.1018	1.9145	1.6781*	1.7886

Note: The 9 portfolios are formed as follows: In every ending of a quarter from 1988 to 1998, stocks from the Standard & Poor 500 composite index are sorted based on their Z-score and sales growth rate. This will result in the formation of the nine randomized portfolios. Equally weighted quarterly returns are calculated from the beginning of quarter Q to the end of quarter Q. Z3*Z1*, the return on the mimicking portfolio for the common Z-score factor in returns, is the difference each quarter between the simple average of the returns on the randomized high Z-score portfolio (Z3*) and the simple average of returns on the randomized low Z-score portfolio. SGR3*SGR1*, the return on the mimicking portfolio for the common sales growth rate factor in returns, is the difference each quarter between the simple average of the returns on the randomized high sales growth rate portfolio (SGR3*) and the simple average of returns on the randomized low sales growth rate portfolio.

Market, Z-score and Sales Growth Rate factors in stock returns

Table VII: Regressions of excess portfolio returns on the excess market return (Rm-Rf) and the mimicking returns for the Z-score (Z3*Z1*) and sales growth rate (SGR3*SGR1*) factors: July 1988 to June 1998.

R(t) – Rf(t) = a + b[Rm(t) – Rf] + k(Z3*Z1*) + j(SGR3*SGR1*) + e(t)

	Z-score group					
	High 3	Mid 2	Low 1	High 3	Mid 2	Low 1
Sales Growth Rate		b			t(s)	
High 3	0.9748	0.9933	1.2473	8.3980*	7.4022*	5.3698*
Mid 2	0.9155	1.0383	1.3417	5.6371*	5.0744*	6.8935*
Low 1	1.0260	0.8525	1.2253	6.1468*	6.7788*	7.5354*
		k			t(s)	
High 3	0.3993	-0.2340	-0.2877	3.9523*	-1.6605	-2.6017*
Mid 2	0.2804	0.2513	-0.3263	2.2716*	1.9636*	-3.5072*
Low 1	0.3249	-0.1502	-0.2356	2.5423*	-1.4566	-1.7549
		j			t(s)	
High 3	0.4849	0.4625	0.4357	2.8942*	2.4766*	2.2601*
Mid 2	0.3549	-0.3079	-0.2651	2.3689*	-2.1872*	-1.7611
Low 1	0.2423	-0.6508	-0.2989	1.9728*	-4.0264*	-1.9902*
		R^2			Durbin-Watson Statistics	
High 3	0.8068	0.7173	0.5408	1.7208	1.9624	2.7792
Mid 2	0.6604	0.5881	0.5844	2.1178	2.1688	2.1688
Low 1	0.6551	0.6078	0.6515	1.9993	1.5367*	2.1863

Note: *significant at 5% level of significance
The results shown here have been corrected for autocorrelation.
The 9 portfolios are formed as follows: In every ending of a quarter from 1988 to 1998, stocks from the Standard & Poor 500 composite index are sorted based on their Z-score and sales growth rate. This will result in the formation of the nine randomized portfolios. Equally weighted quarterly returns are calculated from the beginning of quarter Q to the end of quarter Q. Z3*Z1*, the return on the mimicking portfolio for the common Z-score factor in returns, is the difference each quarter between the simple average of the returns on the randomized high Z-score portfolio (Z3*) and the simple average of returns on the randomized low Z-score portfolio. SGR3*SGR1*, the return on the mimicking portfolio for the common sales growth rate factor in returns, is the difference each quarter between the simple average of the returns on the randomized high sales growth rate portfolio (SGR3*) and the simple average of returns on the randomized low sales growth rate portfolio. Rm-Rf is the difference between the equally-weighted quarterly return on all stocks used in constructing the portfolios and the T-bill rate of the quarter.

From table VII we can observe that, when the three stock-market factors are included in the time-series model, they are able to capture the common variation in stock returns. The t-statistics on the Z3*Z1* slopes are all significant at 5% level of significant with the exception of three stock portfolios. This shows that the mimicking return for the Z-score factor captures shared variation in stock returns that is missed out by the market and SGR3*SGR1* factors. In addition to that, the slopes on the Z-score factor (Z3*Z1*) decrease monotonically from the highest to the lowest Z-score portfolios in all the sales growth rate groups. This again confirmed that the slopes are related to Z-score.

Similarly, the slopes of the sales growth rate factor are related sales growth rate. The estimated coefficient on SGR3*SGR1* decrease monotonically from the highest to the lowest sales growth rate portfolios in all the Z-score groups. On top of that, except for one portfolio, the t-statistics on the SGR3*SGR1* slopes are significant at 5% level of significant. This shows that the mimicking return for the sales growth rate factor also captures shared variation in stock returns that is missed out by the market and Z3*Z1* factors.

It is important to note that, even with the presence of the market factor, the slopes of the two factors (Z3*Z1* and SGR3*SGR1*) are also highly significant. These show that the two factors actually exist together with the market factor to explain the variation in stock return.

In addition, we can observe that the combination of the three factors (Rm-Rf, Z3*Z1* and SGR3*SGR1*) resulted in an increase in the R^2 values. Although this increase in R^2 values is not a huge jump from what were obtained earlier (table V) using the market factor alone, it is important to note that in every set of R^2 values in table V, there is an improvement when the two other factors Z3*Z1* and SGR3*SGR1* are included into the time-series regression.

C. The cross-section of average stock returns

Table VIII: Intercepts from excess stock return regressions for the 9 Z-score and sales growth rate portfolios.

	Z-score group					
	High 3	Mid 2	Low 1	High 3	Mid 2	Low 1
	R(t) – Rf(t) = a + k(Z3*Z1*) + j(SGR3*SGR1*) + e(t)					
Sales Growth	a			t(s)		
High 3	0.6628	-1.0065	-2.7272	0.8314	-1.7823	-3.6895*
Mid 2	-0.7516	-2.0709	-2.5054	-0.8448	-2.1589*	-3.2455*
Low 1	-0.2865	-1.6168	-2.0865	-0.3485	-1.9851*	-2.3585*
	R(t) – Rf(t) = a + b[Rm(t) – Rf] + k(Z3*Z1*) + j(SGR3*SGR1*) + e(t)					
	a			t(s)		
High 3	1.1851	-0.5572	-0.9073	2.1753*	-0.8651	-1.9854*
Mid 2	0.5842	-0.5559	-0.5477	0.9362	-0.8875	-0.7652
Low 1	0.2106	-0.3729	-1.2987	0.2933	-0.3569	-2.7154*

* significant at 5% level of significance.

The regression slopes and R^2 values in table V to VII establish that the stock market returns, Rm-Rf, Z3*Z1* and SGR3*SGR1* proxy for risk factors. The three factors capture common variation in stock returns. However, to test how well the average premiums for the three proxy risk factors explain the cross-section of average stock returns, we have to look at the intercepts in the time-series regressions. The dependent variables in the regressions are excess returns. The explanatory variables are the excess returns (Rm-Rf) and returns on zero-investment portfolios (Z3*Z1* and SGR3*SGR1*). Therefore, according to Merton (1973) and Ross (1976), we would examine whether the intercepts in the time-series regressions of excess return on the mimicking portfolio returns are indistinguishable from zero.

The results from table VIII shows that, when the three factors namely the market, the mimicking returns for Z-score and sales growth rate are all included in the time-series regressions, we can observe that the intercepts are not close to zero. Therefore, we can conclude that the three factor combined cannot explain much of the cross-section of average stock returns. The reason is because the high intercept values might represent certain missing variables from the model. In addition, the intercept value is constant, unlike error that occurs in random. But, as compared to the intercepts obtained when we only include the two factor time-series regressions on excess portfolio returns on Z3*Z1* and SGR3*SGR1*, we can see that there is an significant improvement in the result.

In general, we conclude that the three factors (market, the mimicking returns for the Z-score and sales growth rate) combined were not able to explain the cross-section of average returns. But the result is better than that of two factors (mimicking returns for Z-score and sales growth rate).

The results of the time-series regressions on return are positive. We find that the three factors (market, Z-score and sales growth rate) capture much of the variation in stock returns. However, The results from table VIII are not conclusive, when the three factors namely the market, the mimicking returns for Z-score and sales growth rate are all included in the time-series regressions, we can observe that the intercepts are not close to zero. Therefore, we can conclude that in addition to the three fundamental factors there should be some sentimental factors to explain the cross-section of average.

V CONCLUSIONS

A. Major Findings

The topic of this study is motivated by recent papers that documented strong stock price regularities in the US stock market. Using the same research design and procedures, we attempt to investigate two more fundamental anomalies (Z-score and sales growth rate factors) in the US market. Essentially, this paper studies the presence of these two common risk factors in the US stock returns and test whether these shared risks capture the cross-section of average return.

The results obtained from the analysis generally point to the conclusion that there are Z-score and sales growth rate factors in the US stock market. Although they do not have as strong explanatory power in explaining the US stock return as compared to size and book-to-market factor by Fama and French (1992), our analysis do have merits. First our analysis reveals two fundamental factors which have policy implications are related to stock return and risk. Second our study avoids the multicollinearity problem in Fama and French's study due to they use same price information in both dependent and independent variables. Table III and IV indicate clearly that Z-score and sales growth rate factors are presence in the stock returns. The slope on the mimicking returns related to the Z-score factor increase monotonically from the lowest to the highest Z-score portfolios. Similarly, the slope on the mimicking returns to the sales growth rate factor also increase monotonically from the lowest to the highest sales growth rate portfolios.

Fama and French (1992, 1995) document a flat relationship between beta and average returns (when the CAPM says that the beta suffice to describe the average stock returns). The results shown in this study is quite consistent with their findings. From table 4.5, we find that although the market factor capture much of the variation in stock returns but the R^2 values does not indicate that the market factor capture all the variation in stock returns. This might imply that much of the variation in stock returns might be explained by other factors.

There is still room for the Z-score and sales growth rate factors in playing their parts in explaining the cross-section of average returns. In the time-series regressions that combine all the three factors namely the market, Z-score and sales growth rate, the R^2 values obtained are higher than that of using the market factor alone. Furthermore, the intercepts of the time-series regressions involving the three factors are lower than that of the two factors. This shows that the combination of the three factors capture more of the cross-section of average returns than using one or two factors, however, they can not explain return completely.

B. Implications

Many researchers have criticized about the continual use of the one-factor model (CAPM) in assessing portfolio performance and estimating the cost of capital despite the lack of evidence that it is efficient. The finding of the important role of the market factor in explaining its relationship with stock returns in this study however shows that that the CAPM is not a good model to use in such evaluation.

From table VIII in section IV, we know that the three factor (market, Z-score and sales growth rate) combined to explain the cross-section of average returns better than leaving out the market factor. If we can include a sentimental factor, the three factor model (market, Z-score and sales growth rate) may be able to become a more accurate and precise way of evaluating portfolio performance and cost of capital.

In addition, the three factors can be used to guide portfolio selection. The results show that stocks that exhibit high returns either have high Z-score values or high sales growth rate. This implies that investor should invest in stocks that have high Z-score values or high sales growth rate.

Lastly, the finding of the Z-score and sales growth rate effects may imply the formation of a possible trading strategy using the information pertaining to these two factors to earn abnormal returns. However, the costs of implementing strategy design to capture this abnormal return may be restricted due to reasons like transaction costs and liquidity.

C. Limitations of Study

The scope of the study is limited to 10 years (40 quarter) due to the unavailability of data. Therefore, it is not possible to study the Z-score and sales growth rate factors in sub periods which may lend more credence if there were evidence of these two factors in the sub periods.

The size of the stock market under study is not large enough as compared to Fama and French research (1995). Therefore, the portfolios may have some characteristics that may be firm specifics that would possibly make the analysis based on these portfolios to be less precise.

D. Suggestions for future studies

Having established the Z-score and sales growth rate effect on stock returns, we need also to study how this is related to beta. This is important since beta is currently the most widely use measurement for risk. By studying the interactions between these two effects, we would then be able to conclude whether the emphasis on beta should be continued or replaced by our measure.

This study only include three factors (Market, Z-score and Sales growth rate), other risk variables which have been found to be important, such as cash flow per share, size and book-to-market equity may also be included as additional explanatory variables in future study.

Future studies utilizing a longer time period could be carried out when data are available. On top of that, similar study could also be carried out to detect the presence of these two effects in smaller Asian markets.

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