

**THE BEHAVIOUR OF STYLE ANOMALIES ON THE
AUSTRALIAN STOCK EXCHANGE:**

A UNIVARIATE AND MULTIVARIATE ANALYSIS

EMILE JANARI

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van Rensburg and presented to the School of
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Abstract

Recent attempts to empirically verify the Sharpe (1964), Lintner (1965), Mossin (1966), and Black (1972) Capital Asset Pricing Model (CAPM) have identified numerous inconsistencies with the model's predictions. A number of variables have displayed evidence of the ability to explain the cross-sectional variation in share returns beyond that explained by beta. These anomalous effects have become known as "style effects" or "style characteristics".

This thesis sets out to examine the existence and behaviour of these style-characteristics over the period June 1994 to May 2004. A data set of 207 firm-specific attributes is created for all Australian Stock Exchange (ASX) All Ordinaries stocks listed on 1 September 2004. The data are adjusted for both thin trading and look-ahead bias. The study largely follows the tests of van Rensburg and Robertson (2003) who adopt the characteristic-based approach of Fama and Macbeth (1973). Attributes are tested for the ability to explain the cross-sectional variation in ASX share returns beyond that explained by the CAPM and a principal-components-derived APT model. Similar significant characteristics are found when unadjusted and both risk-adjusted returns sets are examined. The set of significant characteristics derived from the unadjusted returns test is then simplified using correlation analysis and an agglomerative hierarchical clustering algorithm, resulting in a list of 27 variables that are not highly correlated with each other. These characteristics are divided into nine interpretation groups or combinations thereof, namely: (1) Liquidity; (2) Momentum; (3) Performance; (4) Size; (5) Value; (6) Change in Liquidity; (7) Change in Performance; (8) Change in Size; and (9) Change in Value. While the existence of the anomalies found in prior Australian literature (size, price-per-share, M/B, cashflow-to-price, and short- to medium-term momentum) is confirmed, the P/E effect is not found to be significant in this study. As these previously documented anomalies only cover five of the final 27 characteristics, this paper identifies 22 new Australian anomalies.

Six style-timing models are evaluated for the ability to forecast the monthly payoffs to the 27 characteristics. A twelve-lag autoregressive model convincingly displays the best performance against moving average and historic mean models. Parametric and nonparametric tests find inconclusive evidence of seasonality in the monthly payoffs to the attributes.

The 27 significant style characteristics are then used to construct a multifactor style-characteristics model which comprises a set of factors that are significant when simultaneously cross-sectionally regressed on share returns. The employed construction method yields a five-factor style model for the ASX and comprises: (1) prior twelve-month momentum; (2) book-to-market value; (3) two-year percentage change in dividends paid; (4) cashflow-to-price; and (5) two-year percentage change in market-to-book value.

Finally, a stepwise procedure is performed using six style-timing models. Five dynamic multifactor expected return models are created and contrast with a static multifactor expected return model similar to that used in van Rensburg and Robertson (2003). The derived expected return models have between three and thirteen factors. While all six models display good forecasting ability, the dynamic (trailing moving average) models all perform better than the static (historic mean) model. This is convincing evidence that the asset pricing relationship follows a dynamic model.

Declaration

I, Emile Janari, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other University. I empower the University to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

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Introduction

"The key to successful style analysis rests on whether a set of factors can be identified to reliably represent the active-return-generating process. Such a framework usually comes, at least in part, from market anomaly studies. A large body of academic and professional evidence demonstrates the existence of stock factors that are statistically significantly related to ex post return, after risk adjustment, in many equity markets and time periods. Such results appear to contradict the efficient market hypothesis and often form the basis of an active stock selection framework"

- Michaud (1999)

1.1. Introduction

The mid-1960s saw the birth of what was to become known as "Modern Finance" with the establishment of the Capital Asset Pricing Model (CAPM) by Sharpe (1964), Lintner (1965), and Mossin (1966). The model built on the mean-variance efficiency work of Markowitz (1952; 1959) and promised the ability to describe the relationship between risk and return in efficient markets. The CAPM postulated that one and only one factor was required to explain the variation in share returns of any asset – the proportional covariance ("beta") of that asset's expected return with the return of the market portfolio.

The subsequent work of Roll (1976) approached asset pricing from a different angle – arbitrage. Roll's (1976) theory states that a particular securities return may have statistically significant sensitivities to a number of factors. Exposure to most factors can be eliminated through the process of diversification. The factors that cannot be (costlessly) diversified away result in investors requiring a risk premium in the form of higher expected returns. Arbitrage ensures that two portfolios with the same sensitivity to each systematic risk factor are very close substitutes and offer the same expected return. The model, known as the Arbitrage Pricing Theory (APT), does not

however specify the number or nature of the systematic factors and has thus made empirical testing a rather difficult task.

Attempts to empirically verify the CAPM have identified numerous inconsistencies with the model's predictions. While the risk factor beta has often been found to be unrelated to return, other variables have displayed evidence of the ability to predict security returns beyond that explained by beta. Tests of asset pricing models are, however, inseparably linked to evaluations of market efficiency, thus it is not possible to know for certain what the empirical tests imply about the validity of asset pricing models. Further, evidence against one model does not necessarily validate the alternative models.

Nevertheless, investigations into the relationships between returns and other variables such as firm-specific attributes continue to shed new light on how pricing occurs in the financial markets. King (1966) finds that investment portfolios consisting of securities with similar attributes show a clustering of performance. Haugen (1995) suggests that the theories of Modern Finance may in fact be outdated and that a "New Finance" in which firm-specific variables are used to explain asset returns is more appropriate. These anomalous effects have become known as "style effects" or "style characteristics". Robertson (2002) describes the link between the CAPM anomalies and style effects as "an individual security displays a particular attribute, while a portfolio of such securities displays a particular style".

This paper follows the Johannesburg Stock Exchange tests of van Rensburg and Robertson (2003) who adopt the characteristic-based approach supported by Daniel and Titman (1997) and first used by Fama and Macbeth (1973). The aim is to uncover the identity of the firm-specific attributes that demonstrate the ability to explain the cross-sectional variation in Australian Stock Exchange (ASX) share returns beyond that explained by the CAPM and the APT. Share returns are cross-sectionally regressed over a particular period on various firm-specific attributes as observed at the beginning of the period. As put by van Rensburg and Robertson (2003), "The time-series of the slope coefficients estimated in this manner represent the 'rewards' accruing to each characteristic concerned." All data are sourced from DataStream

International. As DataStream International only update information once it is publicly known, the study is free from look-ahead bias. However, the study is subject to survivorship bias.

The study also focuses on testing whether the monthly payoffs to the significant firm-specific characteristics can be predicted, and gives insight as to whether these payoffs demonstrate seasonal fluctuations. A multifactor style-characteristics model is created in an attempt to identify a set factors that are uncorrelated with each other and are univariately and multivariately significant when cross-sectionally regressed on share returns. Finally, the methodology of Haugen and Baker (1996) is applied in a stepwise framework with the aim of creating an expected return model which predicts share returns.

The remainder of this chapter is set out as follows: Section 1.2 reviews the motivation for this research and the research objectives, Section 1.3 discusses the contribution, and Section 1.4 outlines the structure of this thesis together with a brief overview of each chapter.

1.2. Motivation for this research

Firm-specific attributes, many of which are financial ratios, provide useful information to investors. They enable investors to assess firms on the basis of their profitability, operating efficiency, liquidity, ability to meet long-term financial obligations, and how frequently they are traded in financial markets. A large body of research has been focused on attempting to find relationships between these firm-specific attributes and stock returns, most of which has been conducted on the US market. Not many firm-specific characteristics tests have been performed on the Australian market and none to the author's knowledge have included a wide range of these characteristics in one study.

The structure of the Australian market has been quite different from that of the US market. Faff (2001b) states, "[Australia's industrial setting] is characterised by the

substantial influence that the mining and resource sector has on the domestic economy and stock market. At the same time, Australia has an equally strong industrial sector.” In reference to other Australian studies, Faff notes the relative underperformance of the mining and resource sector as compared to the industrial sector (see Ball and Brown, 1980; Ball, 1986; Dolan, 1997; and Ord, 1998). He comments that in the context of the Dual-Beta CAPM, “this differential performance can mean that the resources and the industrial sector stocks respond differently to changes in market conditions.” In this study, a principal components analytic approach is thus undertaken with the aim of identifying whether such a resources-industrials dichotomy does indeed exist. Such a dichotomy would enable the use of a multifactor model to risk adjust share returns and test whether the firm-specific characteristics are still significantly related to share returns after this adjustment.

The first objective of this research is to determine whether a factor analysis orientated Multi-index model performs better than the longstanding Single-index model. The second objective is to investigate the cross-sectional relationships between an extensive set of firm-specific attributes and stock returns on the ASX both before and after conducting CAPM- and APT-based risk adjustments.

Evidence of these relationships in the Australian market, a market not as commonly tested as that of the US, decreases data-snooping bias, and thus strengthens the findings of such attributes in other markets. However, Becker and Ochman (2004) argue that a style-characteristics model developed for one country cannot simply be applied to another market due to “differences between the two markets in capital structure, accounting systems, reporting policies and homogeneity of the universe.” Thus a market-specific study is required to identify the firm attributes relevant to the Australian market.

Anderson, Lynch, and Mathiou (1990) note that Australia’s shares are much smaller than those of the US, which means that the definition of a “large” share is considerably different. Australian research thus provides greater insight into the existence and behaviour of style characteristics in these relatively smaller firms.

Prior research has shown that the payoffs to the firm-specific attributes do not always remain consistent in direction or magnitude. Thus the third objective is to assess the behaviour of the payoffs to the significant characteristics and examine whether the payoffs can be predicted.

There has been a lot of evidence of a “seasonal effect” in Australian share returns. These seasonal effects have been found to be related to the firm-specific attributes’ payoffs in many US studies while the Australian evidence is fairly silent on these relations. The fourth objective is to explore these relations and thus provide additional insight into the behaviour of the style-based effects.

The fifth objective is the derivation of a multi-attribute cross-sectional model for the ASX, and an examination of whether the controlled payoffs of the constituent characteristics can be predicted. The final objective is the creation of a multifactor style-characteristics expected return model that is able to forecast share return.

1.3. Contribution

Fama (1991) classifies the tests of market efficiency into three categories: (1) tests for return predictability (which include forecasting returns with firm-specific variables, tests of asset-pricing models and the anomalies, and seasonality in returns); (2) event studies which test the adjustment of prices to public announcements; and (3) tests for private information which investigate whether specific investors have relevant information not yet reflected in market prices.

This thesis adds to the work relating to the first category of market efficiency tests as firm-specific variables are tested both for forecasting ability as well as for explanatory value after returns have been adjusted for risk by the CAPM and APT asset-pricing models. If the variables demonstrate significant explanatory value, the evidence either points towards misspecification of the asset-pricing model, or inefficient markets, or both.

The list of characteristics tested represents the most comprehensive set of attributes yet assembled for an Australian asset-pricing study and enhances the literature by documenting previously unexamined relationships. In order to conduct the APT risk adjustment, an APT model is derived using the methodology employed by van Rensburg and Slaney (1997) that gives rise to observable factor proxies. This methodology has not yet been used on the Australian market, and the APT has hardly been used to risk adjust returns in the Australian anomalies studies. This thesis also provides evidence on the areas of style seasonality and style timing for which little Australian evidence exists.

The testing of an extensive set of characteristics may be subject to criticism on the basis of data-snooping bias as sample-specific significant characteristics are bound to be found if enough variables are tested (Lo and MacKinlay, 1990). Kennedy (2003) suggests that if economic theory cannot defend the use of a variable as an explanatory variable, it should not be included in the set of potential independent variables: "Such theorizing should take place before any empirical testing of the appropriateness of potential independent variables". Grinold and Kahn (1995) agree and state that factors should be selected intuitively without reference to the data. While this may be preferable, it suggests that interpretation of the anomalous factors found in prior research is known. This is however not the case, and there are a number of differing explanations as to their meaning. On discussing the size anomaly, Banz (1981) concludes: "To summarise, the size effect exists but it is not at all clear why it exists." Sometimes the underlying explanations contradict each other in terms of predicting the direction of the payoff to the anomalous factor. Further, while there are theories explaining why an anomalous factor should payoff in a particular direction, some of these anomalies have in fact reversed in direction for extended periods of time.

Ou and Penman (1989) examine an exhaustive set of financial statement items to predict the direction in one-year-ahead earnings changes and do not attempt to identify a priori conceptual arguments for studying any of their explanatory variables. Merely testing anomalous factors that have been found to be significant in prior research only adds to evidence on those factors and thus does not consider the possibility of other attributes also having explanatory value.

It is for these reasons that an extensive set of firm-specific attributes is examined in this thesis. A collection of technical, momentum, market related, and fundamental attributes are assembled. While the list of explanatory variables can be endless, the fundamental variables selected are limited to those thought of to possibly contain financial information analysed by market participants. Some variables are similar to others, but are included for completeness as they may display greater value than the other variables. The remedy for data-snooping issues lies in the ongoing observation of the characteristics' relationships with share returns.

The finding of significant persistent style characteristics has value beyond the mere disproof of the CAPM. Fama and French (1992; 1993; 1995; 1996a; 1996b) argue that the anomalous effects of firm size and M/B ratio are in fact proxies for a form of (as yet) unobservable risk that is not captured by the CAPM. If the characteristics are viewed as proxies for these risk factors, then following Fama and French (1993), Carhart (1997) and Grinblatt and Titman (1988; 1989; 1994), they are to be included in asset-pricing models. Fama and French (1993) note that: "In principle, our results can be used in any application that requires estimates of expected stock returns. The list includes (a) selecting portfolios, (b) evaluating portfolio performance, (c) measuring abnormal returns in event studies, and (d) estimating the cost of capital....The applications...do not require that we have identified the true factors."

Finally, if a suitable multifactor style-characteristics expected return model is derived, the model can be used to forecast share return and thus be a useful tool for active portfolio management.

1.4. Thesis organisation

Chapter Two provides an overview of the investment theory that is relevant to the research conducted in this thesis. The concepts of informational efficiency and the Efficient Market Hypothesis are introduced, and then the theories of mean-variance efficiency, the CAPM and the APT are discussed. The chapter also briefly presents

some theoretical explanations for evidence inconsistent with the asset-pricing models and clarifies the meaning of “style” in an asset-pricing context.

Chapter Three opens with a brief review of prior anomaly focussed research performed on the US market and also presents evidence of the relation between the January seasonal effect with the anomalous predictor variables. The chapter then reviews the literature that has attempted to explain the documented anomalies and seasonality effects. The review of Australian literature begins with the past performance of the CAPM model and looks at whether the market displays evidence of a multifactorial structure. Finally, the chapter turns its attention to Australian anomalies studies, seasonality, and the relationship between the anomalies and the seasonal effect in Australia.

Chapter Four introduces the stock returns and attribute data sets that are analysed in Chapters Five, Six, and Nine, and from which the data sets used in Chapters Seven and Eight are derived. The procedures used for sorting and manipulating the data are discussed, and some descriptive statistics are presented.

Chapter Five conducts cluster and principal components analyses as part of an exploratory analysis of the structure of the Australian market. The methodology of van Rensburg and Slaney (1997) is applied to construct an APT model with observable factor proxies. The chapter then compares the ability of the Single-index model to explain the time-series variation in share returns to that of a Multi-index model which uses the derived APT factor proxies as explanatory variables.

Chapter Six employs the cross-sectional technique of Fama and Macbeth (1973) to identify which firm-specific attributes are significantly able to predict monthly stock returns on the ASX. The attributes are tested for significance both before and after adjustments are made to the share returns for CAPM- and APT-based risk. A correlation matrix of the monthly payoffs is assessed to reduce the list of significant factors by excluding the less significant characteristic in every highly correlated pair. An examination on the consistency of the direction of the monthly payoffs of the significant characteristics is also conducted.

Chapter Seven investigates whether the monthly payoffs to the simplified list of significant characteristics can be predicted using autoregression and trailing mean style-timing models. The models are tested and compared for forecasting ability using three measures that include Theil's (1958) Inequality Coefficient.

Chapter Eight uses a methodology based on that of Michaud (1999) to examine whether the simplified list of significant attributes maintain their significance when the seasonal effect is considered. The Kruskal-Wallis (1952) and Analysis of Variance (ANOVA) methodologies are then employed to assess the monthly payoffs to the characteristics for seasonality, and the Scheffé (1953) test is used to identify the months responsible for the seasonality in payoffs.

Chapter Nine undertakes to construct a multifactor style-characteristics model in which all the factors remain significant in the multivariate framework. The chapter also examines the ability of an autoregressive model to predict the controlled monthly payoffs to the multifactor model's explanatory variables. The Haugen and Baker (1996) methodology is then applied to the multifactor model to test its ability to forecast share returns. Finally, the Haugen and Baker (1996) methodology is applied in a stepwise framework with the aim of creating an expected return model that has the ability to forecast share returns.

Chapter Ten provides a summary of the results from Chapters Five to Nine. The final section concludes the thesis and suggests several areas for further research on the ASX.

Theoretical Overview

“...market efficiency per se is not testable. It must be tested jointly with some model of equilibrium, an asset-pricing model”.

- Fama (1991)

2.1. Introduction

The valuation of securities and the predictability of returns on those securities have been the main areas of focus for both practitioners and academics in the field of investment finance. A great deal of research has been aimed at developing and testing models that attempt to value securities as well as assess the performance of these shares. Related to this is the idea of market efficiency – whether asset prices fully reflect all available and relevant information and are thus correctly valued (Fama, 1970).

As the Fama (1991) quotation above indicates, examinations of market efficiency cannot in fact be separated from the tests of asset-pricing models – if there is evidence of incorrect valuation, the conclusion is merely a joint one: either the market is inefficient or the asset-pricing model is misspecified.

This chapter provides an overview of informational efficiency and asset pricing theory to contextualise the empirical investigations of later chapters. The remainder of the chapter is set out as follows: Section 2.2 discusses informational efficiency and the Efficient Market Hypothesis, Section 2.3 introduces the theory of asset pricing and the CAPM, and Section 2.4 presents some theoretical explanations for evidence inconsistent with the asset-pricing models. Section 2.5 examines the APT, Section 2.6 clarifies the meaning of “style” in an asset-pricing context, and finally Section 2.7 summarises and concludes.

2.2. Informational efficiency and the EMH

An efficient capital market is one in which security prices adjust rapidly to the arrival of new information and as such reflect all information relating to the security (Reilly and Brown, 2000). While Bachelier (1900) proposed that “past, present and even discounted future events are reflected in market prices”, the concept of the market being “informationally efficient” was largely formalised by Fama (1970)¹. An important underlying assumption is that new information regarding securities comes to the market in a random fashion. This assumption along with the theory of informationally efficient markets implies that asset returns are serially independent. Samuelson (1965) states that asset prices in an efficient market should fluctuate randomly through time in response to the unanticipated component of news.

Fama (1970) presents the efficient market theory in terms of a “fair game” model. First it should be noted that equilibrium models formulate prices in terms of rates of return that are dependent on some definition of risk, and can be described as:

$$E(\bar{P}_{j,t+1} | \Omega_t) = [1 + E(\bar{r}_{j,t+1} | \Omega_t)] P_{j,t} \quad (2.1)$$

where:

E = expected value operator

$P_{j,t}$ = price of security j at time t

$P_{j,t+1}$ = price of security j at time $t+1$

$r_{j,t+1}$ = the one period percentage rate of return for security j during period $t+1$

Ω_t = the set of information that is assumed to be “fully reflected” in the security price at time t

¹ English translation of Bachelier’s (1900) work can be found in Cootner (1964).

The equation indicates that the expected price of security j (given the full set of information available at time t) is determined from the current price and the expected return (given the set of available information at time t) on that security.

Now let $x_{j,t+1}$ equal the difference between the actual and expected price at time $t+1$ such that:

$$x_{j,t+1} = P_{j,t+1} - E(P_{j,t+1} | \Omega_t) \quad (2.2)$$

This represents the excess market value for security j . Fama's (1970) fair game model then postulates that markets reflect a "fair game" with respect to the information set Ω_t , so that in an efficient market, the expected excess market value for security j (given the information set at time t) is zero:

$$E(\bar{x}_{j,t+1} | \Omega_t) = 0 \quad (2.3)$$

This implies that current prices fully reflect all available information and are consistent with the risk involved. The economic rationale is based on the assumptions that there are a large number of competing profit-maximising investors that independently analyse and value securities, and these investors attempt to adjust security prices rapidly to reflect the effect of new information belonging to the shared information set Ω_t .

Fama (1970) divides his fair game model, also known as the Efficient Market Hypothesis (EMH), into three forms: (1) weak-form; (2) semi-strong-form; and (3) strong-form. The weak-form EMH assumes that current stock prices fully reflect all security-market information such as historical sequences of price, rates of return, trading volume data, and other market-generated information. This implies that past rates of return and other market data should have no relationship with future rates of return. The semi-strong-form EMH states that security prices adjust rapidly to the release of all public information, which includes non-market information such as price-to-earnings ratios, earnings and dividend announcements, and other accounting-

based information and ratios. The strong-form EMH argues that stock prices fully reflect all information from public and private sources, thus no group of investors should be able to consistently derive above-average profits. Fama (1991) revises the names of tests for these three forms of efficiency and calls them “tests for return predictability”, “event studies”, and “tests for private information” respectively. In generalising the weak-form category by referring to it as “return predictability”, his revision implies that future rates of return should also not be predictable from firm-specific variables and historical seasonal fluctuations in return.

Grossman and Stiglitz (1980) note that as information is not costless, investors are only prepared to collect information until the marginal cost of acquiring it equals the marginal benefit. This means that asset prices would not reflect all available information, but instead reflect all information up to the point where no gains can be made from the acquisition of additional information.

2.3. Asset pricing and the CAPM

The positive relationship between risk and return forms the basis of asset pricing. While returns are observable and taken as the sum of capital appreciation and dividend yield, risk has been difficult to quantify as well as define. There was no real specific measure for risk until the introduction of the basic portfolio model, developed by Markowitz (1952; 1959). The model assumes that investors (1) consider each investment alternative as being represented by a probability distribution of expected returns over some holding period; (2) maximise one-period expected utility and experience diminishing marginal utility of wealth; (3) estimate the risk of the portfolio on the basis of the variability of expected returns; (4) base decisions solely on expected return and risk; and (5) prefer higher returns to lower returns for a given level of risk (and prefer less risk to more risk for a given level of expected return). Risk, as measured by the variance of expected returns, represents the dispersion of returns around the expected mean – thus the greater the variance, the greater the risk of not earning the expected return. The standard deviation of the expected return is the square root of this variance and is as such also a measure of this risk. Under these

assumptions, the Markowitz (1952; 1959) basic portfolio model states that a single asset or portfolio of assets is mean-variance efficient if it offers the highest expected return given its level of risk.

Markowitz (1959) shows that it is possible to earn higher return for the same level of risk by creating portfolios of non-perfectly correlated assets. This diversification leads to the creation of Markowitz' "efficient frontier", which represents that set of portfolios that has the maximum rate of return for every given level of risk. Any rational investor would thus choose to invest in one of the portfolios on the efficient frontier – exactly where on the frontier depends on the investor's appetite for risk.

The introduction of a risk-free asset into the theory lead to the development of the CAPM which is generally attributed to Sharpe (1964) although similar theories were developed independently around the same time by Lintner (1965) and Mossin (1966). The model is thus often referred to as the Sharpe-Lintner-Mossin (SLM) CAPM. Black's (1972) model was similar to the SLM CAPM, but does not make use of a risk-free rate.

As the CAPM stems from the work of Markowitz (1952), it requires the same assumptions and further assumes that investors (1) are "Markowitz" efficient investors who want to target points on the efficient frontier; (2) can borrow and lend any amount of money at the nominal risk-free rate of return; (3) have homogenous expectations; (4) have the same one-period time horizon; and (5) are not subject to taxes or transaction costs relating to buying or selling assets. Also, it is assumed that all investments are infinitely divisible, there is no inflation or change in interest rates (or inflation is fully anticipated), and that capital markets are in equilibrium.

On a graph with expected return on the y -axis and expected standard deviation in returns on the x -axis, a straight line drawn from the risk-free intercept to a point "P" on Markowitz's frontier of efficient portfolios represents the combination of portfolio P and the risk-free asset in various ratios. Given this line, known as the Capital Market Line (CML), all rational investors would maximise utility by combining the risk-free asset with that portfolio "M" that lies on the efficient frontier at the point of

tangency with the CML. Therefore, as everyone will want to invest part of their money in portfolio in M (the rest being in the risk-free asset), this portfolio must include all risky assets - exclusion of a risky asset would imply that it is not desired and thus has no value. Further, all assets are included in this portfolio in proportion to their market value.

As this portfolio contains all risky assets, it is also known as a completely diversified portfolio where all firm-specific (“unsystematic”) risk has been eliminated. The relevant risk measure of an asset is no longer its standard deviation, which still contains the asset’s unsystematic risk, but rather that asset’s covariance with the market portfolio – a measure of its systematic risk.

As all rational investors are expected to diversify, they are only “rewarded” for bearing systematic risk. The CAPM calculates what the expected return on a portfolio should be for a certain level of systematic risk given the expected return and variation of return on the market portfolio and the expected risk-free rate. This linear relationship is represented by the Security Market Line (SML):

$$E(r_i) = r_{f,t} + \beta_i(r_{m,t} - r_{f,t}) \quad (2.4)$$

Here $E(r_i)$ is the asset’s expected return, $r_{f,t}$ is the risk-free rate, $r_{m,t}$ is the market return, and β_i represents the asset’s covariance with the market standardised by the expected variance of the market portfolio’s returns:

$$\beta_i = \frac{Cov_{i,m}}{\sigma_m^2} \quad (2.5)$$

The covariance between the asset and the market is the product of the correlation between the returns on the asset and the returns on the market, and the standard deviations of the asset and market’s returns:

$$Cov_{i,m} = \rho_{i,m}\sigma_i\sigma_m \quad (2.6)$$

In equilibrium, all assets and all portfolios should fall on the SML. Fama and French (1996b) state, "...the main implication of the CAPM is that in a market equilibrium, the value weighted market portfolio, M, is mean-variance efficient. The mean variance efficiency of M, in turn, says that:

- (i) β , the slope in the regression of security's return on the market return, is the only risk needed to explain return;
- (ii) There is a positive expected premium for β risk.

Our main point is that evidence of (ii)...is only support for the CAPM if (i) also holds."

This states a most important implication of the CAPM: the only relevant thing that should be taken into account when pricing an asset (given the expected market return, return variance, and risk-free rate) is that asset's covariance with the market.

The CAPM model is ultimately a statement about ex ante (expected) returns. In practice, however, only ex post (realised) returns are directly observable. When moving from expected to realised returns, the Single-index model is therefore employed:

$$(r_i - r_{f,t}) = \alpha_i + \beta_i(r_{m,t} - r_{f,t}) + \varepsilon_i \quad (2.7)$$

The ε_i term represents the standard error of the equation. The CAPM states that the expected value of α_i is zero for all securities, while the Single-index model holds that the realised value of α_i should average out to zero for a sample of historical observed returns. Further, the sample α_i values should be independent from one sample period to the next.

While some of the assumptions of the CAPM have been challenged, relaxation of the assumptions has lead to minor adaptations of the model.² Further, Friedman (1953) argues that theories should be judged on the validity of their predictions and not on

² See Reilly and Brown (2000).

the basis of their assumptions. Of course, if a model fails to produce satisfactory results, a re-examination of the assumptions may well be in order.

2.4. Efficient markets, the joint-hypothesis problem, and rationality

As noted earlier, an efficient market is defined as a market in which the expected returns implicit in the current price of the security should reflect its risk (Reilly and Brown, 2000). In order to examine efficiency, an asset-pricing model is needed to specify the return-generating process. The CAPM is one such model and uses the asset's covariance with the market as a risk measure from which the expected return is calculated.

This situation results in what is termed the "joint-hypothesis" problem – if there is evidence of securities being incorrectly priced given their risk, the evidence either indicates the market is inefficient or the asset-pricing model is misspecified (or both). Explanations of finding significant explanatory variables other than those specified by the pricing model are also subject to the joint-hypothesis problem. Reinganum (1981b) however suggests that if abnormal returns are persistent, it is the model that is misspecified, and these explanatory variables are at least proxies for risk factors omitted from the model.

The existence of monthly seasonal effects is also inconsistent with the predictions of both efficient markets and the conventional asset-pricing models as it provides investors with the ability to predict the movement of share prices to some extent. Its relationship with the anomalous explanatory variables, however, is an interesting situation as neither are supposed to exist in efficient markets using the CAPM as the risk-return model.

Another problem with results interpretation arises at the stage of empirical testing of asset-pricing models: the models such as the CAPM require the use of proxies for the independent variables. Evidence against efficiency and the CAPM may merely be caused by the use of a poor and unrepresentative proxy, as noted by Basu (1983) and

Roll (1977).³ Lastly, it may well be that the assumption of rationality (that underpins much of economics and modern finance) may not be as steadfast as initially believed, highlighted by the growing field of behavioural finance.

2.5. The APT

The APT, developed by Ross in the early 1970s and initially published in 1976, is a less restrictive asset-pricing model as it requires fewer assumptions, namely: (1) capital markets are perfectly competitive; (2) investors always prefer more wealth to less wealth with certainty; and (3) the stochastic process generating asset returns can be represented as a linear K -factor model of the form:

$$r_i = E(r_i) + b_{i,1}\delta_1 + b_{i,2}\delta_2 + \dots + b_{i,k}\delta_k + \varepsilon_i \quad (2.8)$$

where:

r_i = realised return on asset i during a specified time period

$E(r_i)$ = expected return on asset i

$b_{i,k}$ = a coefficient that measures the sensitivity of asset i 's returns to movements in a common factor

δ_k = the k^{th} common risk factor that influences the returns on all assets. All such factors have an expected value of zero

ε_i = the normally distributed unexplained residual error unique to asset i 's return. This has an expected value of zero, and is completely diversifiable in large portfolios.

With this model, all securities are affected by the set of common factors, and the $b_{i,k}$ terms indicate the direction and magnitude of this reaction.

³ In fact, Roll (1977) states that the CAPM is not testable unless the exact composition of the true market portfolio is known and used in the tests, which by definition requires the inclusion of *all* individual assets in the sample.

Here systematic risk is represented by the assets' sensitivity to and the variation of the common factors. Similar to the CAPM, the APT assumes the return on a zero-investment portfolio with zero systematic risk is zero in equilibrium, as the firm-specific effects are diversified away. This assumption allows the model to be restated as:

$$E(r_i) = \lambda_0 + \lambda_1 b_{i,1} + \lambda_2 b_{i,2} + \dots + \lambda_k b_{i,k} \quad (2.9)$$

where:

λ_0 = the expected return on an asset with zero systematic risk

λ_k = the risk premium related to each of the common factors

$b_{i,k}$ = a coefficient that measures the sensitivity of asset i 's returns to movements in a common factor

It is of course possible for some assets to be completely unaffected by some common factors in which case the sensitivity coefficients of the asset would be zero for that factor.

The APT itself does not however give any indication as to the number or identity of the common factors. Further, it does not require the number and nature of the set of factors to remain the same over time and across markets.

Faff (1988) breaks the areas of APT empirical investigation into three major sections. The first deals with finding evidence of the existence and dimension of an underlying factor structure in security return data. The second involves an examination of how well the basic APT model deals with asset pricing compared to alternative models as well as the determination of the number of priced factors. The final section attempts to find the identity of the priced factors.

The factors are often determined through methods such as factor analysis and principal components analysis that derive factors that are statistical constructs

extracted from the covariance or correlation matrix of asset returns. McElroy and Burmeister (1988) argue that the major weakness of factor analysis is that it gives rise to unknown random factors that have no straightforward economic interpretations. However, van Rensburg and Slaney (1997) use a factor analytic procedure on a sample of South African shares and subindexes to give rise to an APT model with economically interpretable and observable factors. They include subindexes in the varimax rotation and then use subindexes with high loadings on the factors as proxies for those factors.

The other method used to determine the factors is the pre-specified variable approach where factors are pre-specified on the basis of underlying economic theory. Empirical work thus usually makes use of macroeconomic variables as factors or at least as proxies for the factors⁴. Robertson (2002) notes that as the theory does not specify the relevant factor structure of the APT there will always be uncertainty over the general empirical validity of the model. Fama (1991) states that “since multifactor models offer at best vague predictions about the variables that are important in returns and expected returns, there is the danger that measured relations between returns and economic factors are spurious, the result of special features of a particular sample (factor dredging).”

Similar to the CAPM, the APT model is a statement about ex ante (expected) returns. When moving from expected to realised returns, the Multi-index model is therefore employed:

$$(r_{i,t} - r_{f,t}) = \alpha_i + \beta_{factor1,i}(r_{factor1,t} - r_{f,t}) + \beta_{factor2,i}(r_{factor2,t} - r_{f,t}) + \dots + \beta_{factorK,i}(r_{factorK,t} - r_{f,t}) + \varepsilon_{i,t} \quad (2.10)$$

While the APT states that the expected value of α_i is zero for all securities, the Multi-index model holds that the realised value of α_i should average out to zero for a

⁴ The first such test was conducted by Chen, Roll, and Ross (1986) who propose a five-factor model with maturity premium, expected inflation, unexpected inflation, industrial production growth and default premium as the factors.

sample of historical observed returns. Again, the sample α_t values should be independent from one sample period to the next.

Robertson (2002), on discussing the anomalous explanatory variables found in tests of the CAPM, notes that “[for the APT], anomalies do not generally exist in the CAPM sense. If an anomaly is detectable under the APT, an additional factor could simply be added, or any unexplained variation can be rolled up in the residual of the model. Consequently, the majority of empirical studies of the APT have been directed towards the search for factors and the evaluation of the pricing accuracy of the resulting model.”

2.6. Style

As discussed in Chapter Three, numerous variables have been found to be related to returns after adjusting for CAPM risk. These empirical contradictions of the CAPM are termed “anomalies” or “anomalous variables”. Robertson (2002) notes that the CAPM anomalies represent the first empirical evidence that securities with certain attributes move together in a way that suggests the attribute has predictive power. King (1966) finds that investment portfolios consisting of securities with similar attributes show a clustering of performance. The attributes have become known as “style effects” and the term “style” has subsequently been used to describe the positioning of an equity portfolio towards stocks with similar attributes.

Robertson (2002) describes the link between the CAPM anomalies and style effects as “an individual security displays a particular attribute, while a portfolio of such securities displays a particular style”.

Using the framework of style, portfolios can be classified as large or small (based on market capitalisation of the constituent stocks), or can be classified as value or growth (based on a proportional measure of market valuation relative to some accounting value). Growth stocks are also termed “glamour” stocks while value stocks don the

title “out-of-favour” stocks, although these terms more specifically describe the past performance of stocks where glamour indicates stocks that have performed well and out-of-favour represents stocks that have not.

For the remainder of the thesis, the terms “anomalies”, “style characteristics” and “firm-specific attributes” are used interchangeably to describe these firm-specific variables that may explain variation in stock returns.

2.7. Summary and conclusion

This chapter lays down the theoretical framework within which the empirical tests of this thesis fall. An efficient capital market is defined as one in which security prices adjust rapidly to the arrival of new information and as such reflect all information relating to the security (Reilly and Brown, 2000). However, as capital market efficiency can only be assessed with the use of an asset-pricing model which links the information set with predictions of asset prices, evidence in contrast to efficiency may merely be an indication that there are problems with the underlying asset-pricing model. This lack of interpretability is known as the “joint-hypothesis” problem because any test of efficiency is in fact a joint test of efficiency and the explanatory ability of the underlying asset-pricing model. The underlying asset-pricing model may be misspecified, or the assumptions may be invalid thus resulting in model inadequacy.

Two asset-pricing models are discussed – the CAPM, and the more recent APT model. It is noted that the problem with the APT is the fact that the theory does not specify the number or nature of the explanatory factors. This means that empirical statistical techniques have to be used to supplement the lack of theoretical specification.

Some firm-specific attributes have been found to be able to explain the variation of share returns over and above that explained by the CAPM, which is in direct contradiction with either the CAPM or market efficiency. The predictive ability of

these anomalous characteristics has earned them the title “style effects” when applied to portfolio selection. This thesis aims to identify the anomalous style effects on the Australian market as well as attempt to provide insight as to their behaviour over time and assess whether they can be used in a multifactor framework to forecast share returns. These tests are conducted in the empirical Chapters Six to Nine.

Literature Review

3.1. Introduction and a brief review of US findings

The theoretical asset-pricing model CAPM discussed in the previous section has been used to test market efficiency in various studies, and a number of early US studies document anomalous effects in the context of the CAPM and efficient markets. Banz (1981) and Reinganum (1981a; 1981b) find a small size effect; Basu (1977) finds an earnings-to-price (P/E) effect and he later (Basu, 1983) also finds a size effect; and Stattman (1980) and Rosenberg, Reid, and Lanstein (1985) document a market-to-book (M/B) effect. Litzenberger and Ramaswamy (1979), Blume (1980), and Keim (1985) find a dividend yield effect, and Bhandari (1988) finds a debt-to-equity effect.

The renowned Fama and French (1992) study confirms the existence of size, P/E, leverage, and M/B effects, and infamously finds market betas unable to explain the cross-sectional variation in equity returns. Subsequent studies have revealed other anomalies such as a one-year momentum effect (Jegadeesh and Titman, 1993) and a trading volume effect (Campbell, Grossman, and Wang, 1993). As noted earlier, these anomalies are also known as “style characteristics”.

An area of application of the style characteristics is that of mutual fund asset allocation. Managers choose which shares to invest in based on the “style” of their portfolio – “value” shares typically have relatively low M/B ratios, low P/E ratios and high dividend yields when compared to “growth” shares (Reilly and Brown, 2000). The behaviours of the style factors have not however been consistent. Brown, Kleidon, and Marsh (1983) find the small firm effect to be unstable over time, while Gompers and Metrick (1998), Dimson and Marsh (1999), and Gustafson and Miller (1999) find a reversal in the direction of the size effect in recent years. Chan, Karceski, and Lakonishok (2000) also find a reversal in the value effect’s direction

over the period 1990 to 1998. Lucas, van Dijk, and Kloek (2001) find that the relationships between future returns and firm-specific attributes can depart from the documented patterns for extended periods. Thus the question of whether to “rotate” the style strategy or follow a consistent strategy is raised.

Hall (2000) notes that there are two “deadly sins of style risk” that somewhat oppose each other. The first deadly sin of style risk is that due to a changed market environment not suitable to an investor’s investment process, the investor changes his style and embarks on a new investment process in which he has little expertise or experience. The new style may involve a valuation process with which the investor has less experience, or may require the use of investment instruments of which the investor has little knowledge. Hall (2000) notes that the investor is usually “very late to the party” thus gets to the arena of the new style when the market environment changes again. Or, the investor is not very good or experienced with the new investment process. The second deadly sin is if the investor fails to adapt his investment process in the midst of a changing market environment. While the market environment may return to a state in line with the investor’s investment process, this may take years to occur.

Kahn (1996) reports that most funds do not systematically follow a value or growth style, but rather tend to shift between one and the other (or adopt a combination). Levis and Liodakis (1999) note that style consistency is not necessarily an optimal strategy, and there may be a need for style-rotation strategies. Kahn (1996) also finds some funds move across portfolios of small and large stocks. Surprisingly Indro, Jiang, Hu, and Lee (1998) observe that funds that change both their value/growth and small/large capitalisation allocation strategies are the worst performing group of actively managed funds.

In making the rotation decision, the real question is whether or not the style can be “timed” such that additional profits can be made. Indeed the idea of market timing has been around for a while, but has mainly focused on the asset allocation decision.⁵

⁵ Sharpe (1975) was the first to examine asset-allocation timing.

While Macedo (1995) reports that recent style performance is a poor predictor of future style performance, Wang (2003) finds that style-momentum and style-rotation strategies generate abnormally high returns. His style momentum strategy ranks the style portfolios in each month according to their returns over the previous month and then buys the winner style and short-sells the loser style. Barberis and Shleifer (2003) predict that style returns exhibit a rich pattern of own- and cross-autocorrelations. Lucas, van Dijk, and Kloek (2001) find the forecasting power of firm's attributes to be partially predictable even after risk adjustment. They compare the forecasting ability of purely statistical time-series models (such as pooling, averaging, and autoregression) to models that use macroeconomic factors, and report that the statistical models are less robust. In fact, the statistical techniques are not found to be useful in predicting the future sign and magnitude of style payoffs.

Coggin (1998) concludes that style indexes cannot be predicted using only the time series of returns as information variables but rather requires outside information such as business cycles and interest rates. The forecasting ability of these macroeconomic variables has been investigated in numerous papers.⁶

Some authors such as Haugen and Baker (1996) take the anomalies research a step further by using firm-specific attributes to create expected return models which forecast share return. The payoffs to the style characteristics are predicted using a timing model, and the predicted payoffs are then combined with the attribute values to produce a share return forecast. This area of research falls under active portfolio management, and Haugen and Baker (1996) find that such strategies are indeed beneficial.

The concept of style timing is relatively new and as such there appears to be no published articles on this topic for the Australian market.

Another US anomaly associated with the CAPM is known as the "January effect," and is reported by both Rozeff and Kinney (1976) and Keim (1983). What is of particular

⁶ See Bauman and Miller (1995); Jensen, Johnson, and Mercer (1998); Kao and Shumaker (1999); and Chordia and Shivakumar (2002).

interest is that this anomaly has been strongly associated with the style-based effects.⁷ The relationship between the size anomaly and the January effect was highlighted by Keim (1983), who reports that “the relation between abnormal returns and [firm] size is always negative and more pronounced in January than in any other months - even in years when, on average, large firms earn larger risk-adjusted returns than small firms.” He finds that on average, 50% of the size effect is attributable to the abnormal January returns, and more than 26% of this “January premium” is due large abnormal returns during the first week of January thus leading Keim (1983) to suspect the size effect may be unstable between months. He finds that while the relation between size and abnormal returns is steep and negative in January, all the other months display only a slight negative slope, with percentage abnormal return clustered around zero across the market-value-sorted deciles.

Keim (1985) examines the empirical relation between stock returns and long-run dividend yields. While he finds a nonlinear relation, Keim (1985) notes that the effect occurs predominantly in January, and the yield-return relation ceases to be significant when January observations are excluded. He further finds the January-dividend-yield relation still persists after controlling for firm size.

In the Rosenberg, Reid, and Lanstein (1985) study of the M/B effect, they find that both the mean and the standard deviation of the book/price return are much higher in January than in any other month over the period 1973 to 1984, with a downward trend in the monthly mean over the course of the year.

These relations bring a new dimension to the assessment and interpretation of the style-based effects. Some of the earliest influential studies reporting monthly seasonal anomalies were in fact focused on the Australian market (Officer, 1975; Brown, Keim, Kleidon, and Marsh, 1983). However, little evidence has been found linking the style-based effects with the monthly seasonal effects in that market.

The remainder of this chapter is organised as follows: Section 3.2 outlines the various explanations that have developed to explain the anomalous style effects, and Section

⁷ See Hawawini and Keim (2000) for a full discussion and review of recent evidence.

3.3 provides explanations for the January-seasonal effect. Section 3.4 examines the performance of the CAPM in past studies, and also looks at whether evidence has been found to suggest that the variation of share returns on the Australian market should in fact be explained by a multifactor model. Section 3.5 documents the prior research on style anomalies in Australia, Section 3.6 reviews literature on seasonality of Australian returns and its relationship with the style anomalies, and Section 3.7 summarises and concludes. The chapter does not contain Australian literature on style timing as no prior research could be found.

3.2. Explanations for the CAPM style-based anomalies

Van Rensburg (2001) classifies the arguments that have developed in attempting to explain the anomalies into three groups, namely: (1) investor irrationality; (2) investor rationality; and (3) methodological bias.

3.2.1. Arguments for investor irrationality

Michaud (1999) separates the investor irrationality arguments into two sub-groups: (1) ephemeral inefficiencies; and (2) irrational behavioural hypothesis. In discussing ephemeral inefficiencies, he states that anomalous factors in a market may simply indicate capital markets are episodically informationally inefficient, an interpretation favoured by some early researchers. While this theory suggests that once such a factor is identified its related payoff should be eroded away during the return to efficiency, there is evidence of anomalous factor persistence over relatively long periods (Reinganum, 1981b).

Studies in the relatively new area of behavioural finance discuss and examine investor psychology and find evidence of irrational behaviour. This is of course in direct conflict with the rationality assumption made by modern finance and the CAPM.

Basu (1977) discusses the “price-ratio” hypothesis to explain the P/E effect. Basically, investors become excessively pessimistic after a series of bad earnings

announcements and other bad news resulting in the under-valuation of these companies (and hence low P/E ratios). But once future earnings turn out to be better than the overly gloomy forecasts, the price adjusts. Similarly, companies experiencing a string of good news and thus having high P/E ratios are considered overvalued until the price predictably falls to correct the mispricing. De Bondt and Thaler (1985) take this argument in a slightly different direction and state that if stock prices systematically overshoot, their reversal should be predictable from past return data alone (with no use of any accounting data such as earnings). They find portfolios of companies that performed poorly over the previous three-to-five-year period (“losers”) significantly outperform the prior “winners” in the next three to five years, evidence consistent with their overreaction hypothesis. De Bondt and Thaler (1987) further find that this overreaction effect is not due to firm size.

Lakonishock, Schleifer, and Vishny (1994) examine a contrarian model in which overpriced “glamour” stocks are those that have performed well in the past and are expected to perform well in the future. Similarly, the underpriced “out-of-favour” or “value” stocks are those that have performed poorly in the past and are expected to continue to perform poorly. The model asserts that value strategies that bet against investors who extrapolate past performance too far into the future produce superior returns. Lakonishock, Schleifer, and Vishny (1994) use information on past growth in sales, earnings, and cash flow to measure past performance and find that investors buying out-of-favour value stocks have outperformed glamour strategies. They conclude, “Market participants appear to have consistently overestimated future growth rates of glamour stocks relative to value stocks”. Haugen (1995) contends that investors’ projections of future earnings growth underestimates the influence of future competition in the underlying goods and services markets.

Lakonishock, Schleifer, and Vishny (1994) argue that their results stem from the preference of both individual and institutional investors for glamour stocks over value stocks and offer several reasons for this preference. First, individuals tend to place excessive weight on recent past history and may as such extrapolate past growth rates of glamour stocks when such growth rates are unlikely to persist in the future. Or, individuals might confuse a “good firm” with a “good investment”, and may as a

result end up buying overpriced shares of “good firms”. Shefrin and Statman (1995) in fact find that Fortune magazine survey respondents rank stocks as if they believe good stocks are stocks of good companies. Further, they find respondents tend to rank large companies with low book-to-market ratios (the inverse of the M/B ratio, and thus labelled B/M for the remainder of the thesis) as good companies. The two sets of evidence show that the respondents favour stocks of large companies with low B/M ratios while the anomalies studies in fact show that the stocks that tend to outperform are those of small companies with high B/M ratios.

Shefrin and Statman (1995) divide the investor base into two groups: (1) “information traders” who know the relationship between characteristics of companies and the return distributions of the stocks of these companies and thus do not suffer from the cognitive error; and (2) “noise traders” who make the mistake of believing that good companies are good stocks. The noise traders are the ones who make systematic errors in assessing the relationship between characteristics of companies and the return distributions of their stocks and are as a result not mean-variance efficient. Shefrin and Statman (1995) note that while no risk-free arbitrage is possible to take advantage of this situation, information traders appear to be in the minority thus preventing sufficient arbitrage eliminating the pervasive abnormal returns. And if the information traders act as brokers to the noise traders hence increasing the size of the investments made under their direction, they would in fact choose to invest in the stocks that appear to be “safe” in the eyes of their clients (noise traders). They do this to protect themselves against the situation that arises if the stock does badly – if the clients believed the stock to be risky, they would blame the broker – but if they believed it to be “safe”, they would simply write the loss off as an “Act of God”. Thus the irrationality of the noise traders allows the abnormal returns of small firms and firms with high B/M ratios to persist.

Lakonishock, Schleifer, and Vishny (1994) echo this and state that institutional investors might prefer glamour stocks because they are easier to justify to sponsors. They also note that most investors have shorter time horizons than are required for value strategies to consistently pay off. Further, as institutional investors cannot afford to underperform the index or their peers for even short periods of time (as

sponsors will then withdraw their investments), they often have even shorter time horizons than individuals.

3.2.2. Arguments for investor rationality

Two sets of rationality arguments offer explanations of the anomalies. Fama and French (1992; 1993; 1995; 1996a; 1996b) claim their findings are consistent with efficient markets and rational investors. They argue that the return-generating model is merely misspecified and that the size and M/B effects are just proxies for unobserved risk factors. This implies the anomalies reflect systematic risks not captured by the CAPM. Their argument echoes that of Ball (1978) who observes that empirical contradictions of the CAPM such as the existence of the style anomalies are more likely to be caused by inadequately specified asset-pricing models than by market inefficiency. The persistence of the higher returns associated with these anomalies further supports the rationality assertion by discounting arguments of temporary inefficiencies.

The Fama and French (1992; 1993; 1995; 1996a; 1996b) argument implies that using the CAPM as a benchmark model will lead to bias in favour of small firms and firms with low M/B ratios. Fama and French (1993) thus construct a three-factor model that uses market return, size, and the M/B ratio as factors. Carhart (1997) expands this model to include a one-year momentum factor. Grinblatt and Titman (1988) develop and use (Grinblatt and Titman, 1989; 1994) an eight-portfolio benchmark arguing that the firm characteristics are factor proxies. The benchmark comprises four size-based portfolios, three dividend-yield based portfolios, and one past-returns-based portfolio.

Daniel and Titman (1997) attempt to test whether the effects can be explained as risk premia. After first classifying firms according to size and M/B ratio, they further subdivide portfolios based on the sensitivity (represented by betas) of each stock to size and M/B factors. They find that the betas on these factors do not explain additional variation in share returns once size and M/B ratio are held constant and thus conclude that the characteristics themselves influence returns and not the betas on those characteristics. This evidence, while being inconsistent with the Fama and

French (1992; 1993; 1995; 1996a; 1996b) argument, does not necessarily imply irrational markets. These characteristics may themselves measure a form of systematic risk.

A problem with the Fama and French (1992; 1993; 1995; 1996a; 1996b) line of argument is pointed out by Lakonishock, Schleifer, and Vishny (1994), who state, “one can never reject the ‘metaphysical’ version of the story, in which securities that earn higher returns must by definition be fundamentally riskier”.

The second rationality argument was developed in an attempt to explain the size effect and consists of the liquidity and neglected-firm effects. Amihud and Mendelson (1986; 1991) argue that investors will demand a return premium to invest in less liquid shares that entail higher trading costs. They show that the least liquid shares have a strong tendency to earn abnormally high risk-adjusted return. Roll (1981) suggests the stocks of small firms are traded less frequently than the stocks of larger firms, but however concludes that the bias in risk estimates due to nonsynchronous trading cannot explain the magnitude of the risk average returns found by Reinganum (1981b). The liquidity effect may therefore be at least partially responsible for the abnormal returns to small firms.

Banz (1981) suggests the small firm effect is due to the relatively limited information available about smaller firms. Arbel and Strebel (1982; 1983) note that the cause of the limited information is the small firms being neglected by large institutional traders.

Klein and Bawa (1977) show that a risk-averse investor will limit his portfolio to investment in the high information securities because with insufficient information, the estimation risk of a portfolio containing the low information securities will be arbitrarily large and the portfolio’s predictive variance will be infinite. Arbel (1985) measures the information deficiency of firms using the coefficient of variation of analysts’ forecasts of earnings and finds the correlation between the coefficient of variation and total return to be quite high and statistically significant. As a share with limited information is seen as a riskier investment, it follows that smaller firms are

such riskier investments requiring higher returns. However, Reinganum and Smith (1983) point out that if the effects of limited information on security risk characteristics are diversifiable, researchers should not expect to observe any effects of limited information on average security returns. However, Barry and Brown (1984) use period of listing as a crude measure of differential information and find it to be associated with the firm size anomaly. Their results do not fully account for the size effect, and they suggest a more satisfactory measure of information is required.

These rationality arguments only explain the size effect. However, they can be understood in the Fama and French (1992; 1993; 1995; 1996a; 1996b) context where the size effect proxies for the previously unobserved information risk effect, and the risk factor that is proxied by the M/B effect has yet to be identified.

3.2.3. Arguments for methodological bias

The third type of argument is based on biases in the data and methodologies used in the anomalies studies. Banz and Breen (1986) discuss and examine look-ahead bias. The construction of explanatory variables such as the P/E ratio involves matching a market-based figure (price) to an accounting figure (earnings) on a particular date. The period-end accounts data are only released a while after the end of the period. Matching the period-end earnings of year t with price at the end of period t thus assumes investors knew the earnings figure before it was released. Or, as put by Banz and Breen (1986), it implies that investors have the ability “to forecast future reported earnings without error.” Apart from the construction error, the bias also occurs when using accounting figures such as the current ratio to explain the variation of returns even when that accounting information was not available to the public at the time of the returns. This dating problem is known as look-ahead bias.

Kothari, Shanken, and Sloan (1995) raise the issue of survivorship bias, which arises when the data set examined excludes shares that have been delisted before the end of the examined period. They attempt to mitigate this by using a more complete data set to that used by Fama and French (1992). While they find the M/B effect much weaker

than that found by Fama and French (1992), its persistence is nevertheless still evidence against the CAPM.

Davis (1994) collects and tests a new set of data free of both look-ahead and survivorship bias on returns of large firms over the previously unexamined 1940-to-1963 period. He finds significant cross-sectional B/M, P/E, and cash-flow to price ratio effects while both the CAPM beta and firm size were unable to explain the portfolio returns. Davis (1994) concludes that his results offer support to the findings of Fama and French (1992).

Chan, Jegadeesh, and Lakonishok (1995) find the primary reasons for delisting from the COMPUSTAT database used by Fama and French (1992) are surprisingly entirely unrelated to financial distress. Rather, delisting occurs due to mergers, nonstandard accounting information, listed closed end investment funds, and other such proceedings.

While van Rensburg (2001) argues that the Davis (1994) and Chan, Jegadeesh, and Lakonishok (1995) evidence suggests survivorship bias is unlikely to have a major distorting influence on studies examining large non-thinly traded firms, the Australian market is dominated by small firms, a large proportion of which are thinly traded. Further, many of the large firms are small relative to those in the US.

Data-snooping (Lo and MacKinlay, 1990; Black, 1993; MacKinlay, 1995), also known as “data-mining”, describes the problem that arises with intensive study of a database. Spurious (sample-specific) relationships between returns and “factors” are likely to be found. Further, if these alleged factors are used to construct an asset-pricing model that is tested on the same database, the results will be biased in favour of the model.

The finding of similar significant style factors in a wide range of foreign markets indicates that many of these factors are not sample-specific (Chan, Hamao, and Lakonishok, 1991; Fama and French, 1998; Hawawini and Keim, 2000; van Rensburg, 2001; see also Chapter Three Section 3.5 for Australian evidence).

However, significant style factors may differ between markets for reasons other than data-snooping bias, such as differences in capital structure, accounting systems, reporting policies, and homogeneity of the universe (Becker and Ochman, 2004).

Many empirical studies use the returns of attribute-sorted portfolios to assess asset-pricing models and identify risk factors despite Litzenberger and Ramaswamy (1979) commenting that the sorting procedure results in a loss of information. Michaud (1999) states that a long-short portfolio framework tends to magnify portfolio returns without changing underlying factor-return relationships⁸: “For example, factor returns may be associated with a long equal-weighted portfolio of top-decile stocks and from some stock universe ranked according to some stock attribute. This long-short equity strategy framework leverages index-relative returns and generally substantially increases residual risk....In the case of numerous market anomaly long-short framework studies, portfolio residual risk levels are often substantially greater than what would be acceptable for most institutional investors.”⁹

In Berk’s (1995) critique of size-related anomalies he shows that even if a firm’s operational size is unrelated to expected return, its market capitalisation is likely to have a negative relationship with average return in cross-sectional regressions. The underlying intuition is illustrated with a thought experiment where Berk (1995) considers a one-period economy in which all investors evaluate assets on the basis of risk and return. Assuming that all the firms in the economy have the exact same operational size and all firms have the same end-of-period cashflow, the riskier firms will have lower market values and so by construction have higher expected returns. Berk (1995) concludes that if market value is used as the measure of size, it will predict return. Van Rensburg and Robertson (2003) note that while this can also be extended to financial ratios that use market prices in their construction, the problem can be avoided if the financial ratios are lagged with respect to share returns. Of the

⁸ See also Michaud (1993).

⁹ Berk (2000) further shows that when asset pricing tests are run within groups (as opposed to between groups), the empirical procedure biases the results in favour of rejecting the asset pricing model even if the model is economically correct. He also demonstrates that by simply sorting the shares into enough portfolios, it is possible to reduce the explanatory power of all asset-pricing models (even if economically correct) to zero. While this may not be directly related to anomalies, it may explain why some studies have found beta to be insignificantly related to the variation of share returns.

24 variables tested on the South African market, van Rensburg and Robertson (2003) find that when the lagging is used, five variables (including the logarithm of market capitalisation) are significant both before and after CAPM-risk adjustment, and a sixth is only significant before CAPM-risk adjustment.¹⁰

Finally, Basu (1983) suggests there may be deficiencies in the empirical implementation of the model such as the use of an “incomplete version of the market portfolio”. The error thus enters at the stage of practical execution of the model. Roll (1977) criticises previous tests of the CAPM and states that the theory is not testable unless the exact composition of the true market portfolio is known and used in the tests – this requires the inclusion of *all* individual assets in the sample. Finding the market proxy to be inefficient implies nothing about the true market portfolio’s efficiency. In fact, Roll (1977) also states that if the market proxy is found to be mean-variance efficient, the true market portfolio may not and does not have to be efficient.¹¹ Results may thus be tainted from the use of an unsuitable market proxy, and the CAPM model may very well correctly describe the risk-return relationship.

3.3. Explanations for the January seasonal effect

As previously mentioned, numerous US studies have found that shares have abnormally high returns in January. This is known as the “January effect”. However, Miller (1990) calls this the “turn-of-the-year effect” because it coincides with the change in the US tax year.

Several hypotheses have been developed in an attempt to explain the January seasonal effect (see Miller (1990) for a full discussion), the most prominent being the tax-loss selling hypothesis and the information hypothesis. Wachtel (1942) and Branch (1977) hypothesise that many people sell stocks that have declined in price during the previous months (“losers”) to realise their capital losses before the end of the tax year.

¹⁰ Interestingly, apart from the momentum variables tested, the six significant variables were the only variables that use the share price in their construction.

¹¹ See also Roll and Ross (1994) and Kandel and Stambaugh (1995).

These investors do not reinvest the resulting proceeds until the start of the next year at which point the unusually large demand for shares pushes the prices of the shares upwards. This argument is supported by evidence in Ritter (1988) who finds the ratio of stock purchases to sales of individual investors peaks in January and reaches an annual low at the end of December. As firms' size is usually represented by their market capitalisation¹², a portfolio of the smallest firms is biased towards the inclusion of shares that have experienced large declines in price and are therefore more likely to be sold for tax-loss purposes. Reinganum (1983) finds that within size class, firms that decline in price more drastically had larger January returns.

Reinganum (1983) however concludes that tax-loss selling cannot explain the entire January seasonal effect as he finds small firms least likely to be sold for tax purposes (those that increased in price) also displayed large January returns.

The January effect has been by no means confined to the US. Gultekin and Gultekin (1983) find the January effect in many different countries. They report a significant January effect in sixteen countries and an April effect in the UK, all of which coincide with the country's tax-year end (except in the case of Australia). While this may have strengthened the tax-loss selling hypothesis, Agrawal and Tandon (1994) find the January effect in fourteen out of nineteen countries, many of which do not share the same tax-year end or similar tax regimes.

Further, Jones, Pearce, and Wilson (1987) find that the January effect existed in the US long before income taxes were introduced. Miller (1990) suggests that the strongest argument against the year-end effect caused by tax-loss selling is provided by the actions of investors over the 1986/1987 turn of the year. The US tax laws over this period in fact advocated the retention of "loser" shares and the sale of "winners". Miller (1990) refers to evidence in Miller, Hill, Lajaunie, and Sundar (1991) that indicates that there was no reversal of the usual pattern of shares that hit new lows at year-end having abnormally high returns in January of the new year. Miller (1990) thus states that the evidence suggests the abnormal turn-of-the-year effect is not primarily a tax effect.

¹² Other measures include operating size as suggested by Berk (1995).

The second major argument is the information hypothesis applied in general to the January effect by Rozeff and Kinney (1976) and more specifically to the January-size effect by Keim (1983). Rozeff and Kinney (1976) note that “January marks the beginning and ending of several potentially important financial and informational events...January is the start of the tax year for investors, the beginning of the tax and accounting years for most firms and the period during which preliminary (and in many cases final) announcements of the previous calendar (fiscal) year’s accounting earnings are made. It is possible that seasonality is in some way associated with these accounting events”. Keim (1983) explains that for at least those firms with year-end fiscal closings, the month of January marks a period of increased uncertainty due to the impending release of relevant information. Keim (1983) then suggests that the gradual diffusion of this information may have a greater impact on the prices of smaller firms for which the process of gathering and processing information is more costly. He does however note that the annual recurrence of the effect is inconsistent with a rational-expectations equilibrium in the market.

The two arguments presented above were developed to explain the turn-of-the-year effect while other arguments have been developed to explain the January effect not necessarily associated with the turn of the year. The arguments are controversial and further do not explain why there may be similar seasonal effects in months other than those of January and the first month of the tax year. These calendar effects thus remain an anomaly.

3.4. The CAPM, the APT, and the Australian market

Tests have revealed the CAPM to be controversial in an Australian context. Ball, Brown, and Officer (1976) examine the industrial equity market over the period 1958 to 1970. They find a positive linear relationship between the expected values of rates of return on shares and their covariances with the rate of return on a portfolio that consists of all the shares in the sample and thus conclude: “The model appears to describe the data quite well...”

Stokie (1982) examines three different market indexes using monthly data over the period 1958 to 1973 for leading Australian securities and tests for mean-variance efficiency using the methodologies suggested by Roll (1979). While he finds mixed results for mean-variance efficiency (the balance of which is against index efficiency), he cautions that his results may be affected by imperfections in the tests, inadequate data, and sampling errors in the betas.

Faff (1991) conducts a likelihood ratio test of the Zero-Beta CAPM of Black (1972) using a multivariate approach over the period 1958 to 1987. The model is strongly rejected when an equally weighted market index is used as the market portfolio. However, when a value weighted market index is used, the tests reveal moderate support for the CAPM. Faff and Lau (1997) conduct a generalised method of moments test of mean variance efficiency and report mixed results.

Faff, Brooks, and Tan (1999) test the standard market model against a dynamic market model that augments the standard market model with a lagged dependent variable as discussed in Cartwright and Lee (1987). They use a multivariate approach on industry portfolio returns over the period 1974 to 1995. While they find strong evidence in favour of both versions of the model, their results support the dynamic CAPM over the static model.

In one of the first tests of the APT using Australian data, Faff (1988) uses principal components analysis on the sample period 1974 to 1985 and finds evidence indicating a three-factor model. Several limitations of that study are however pointed out by Faff (1992) and include issues of nonstationarity, errors-in-variables, and an excessive testing period of twelve years relative to the standard five-year analysis for such tests. Further, the cross-sectional testing framework used suffers from an inability to incorporate the monthly seasonality in Australian equity returns as documented by Brown, Keim, Kleidon, and Marsh (1983) and others (see Chapter Three Section 3.6.1).

Faff (1992) tests a five-factor and ten-factor APT model against the CAPM. He concludes that “While the APT [five-factor] appears to perform better than the CAPM, neither model can adequately explain [monthly] seasonal mispricing in Australian equities.”

Brooks, Faff, and Josev (2001) compare the market model, the quadratic market model, and a two-factor APT model (which uses the quadratic market model framework) using daily, weekly, and monthly return intervals over the period January 1988 to October 1996. They conclude that while the correlation coefficients are very high across all models and return intervals, the APT model describes the return generating process the best. These findings are robust to the return intervals used.

Faff’s (2001b) paper indicates the Australian market is characterised by the substantial influence of the resource sector while still having an equally strong industrial sector. He comments on studies indicating the relative underperformance of the mining and resource sector in comparison to the industrial sector (Ball and Brown, 1980; Ball, 1986; Dolan, 1997; and Ord, 1998), stating that in the context of the Dual-Beta CAPM, “this differential performance can mean that the resources and the industrial sector stocks respond differently to changes in market conditions.” This implies that a multifactor asset-pricing model is more appropriate for this market.

Faff and Mittoo (1999) define global industries as “those sectors that are largely influenced by global (common) factors which include oil, mining, and financial firms,” and local and regional industries as “those industries that are largely influenced by local and regional factors such as firms in consumer and service industries.” Using Merton’s (1987) model which predicts that expected returns decrease with the relative size of the investor base, they argue that differential pricing for global and regional industry shares exists as a result of differences in the degree of information asymmetry between foreigners and locals: “...firms in global industries would have more information publicly available and therefore have a larger investor base relative to their counterparts in regional or local industries.” This also implies a two-factor asset-pricing approach. Wood (1991) refers to evidence in Wood (1990) and suggests “foreign investors may be the dominant investors in high capitalisation

resource sector stocks while domestic investors are dominant in the other sectors of the market”.

Wood (1991) investigates the mean-variance efficiency of the Centre for Research in Finance's (CRIF) value weighted index using a multivariate cross-sectional regression approach over the sample period January 1974 to December 1988. Both the Sharpe-Lintner-Mossin (SLM) and Black (1972) versions of the CAPM are used. In the test of the simple CAPM he finds that resource sector shares had mean returns lower than expected, while industrial sector assets displayed returns higher than that expected. He is also unable to reject the null hypothesis that the CRIF value weighted index is mean-variance efficient when the Black (1972) CAPM model is used and the pricing portfolios are formed on the basis of industry classification. Wood (1991) concludes that the dominant investor in resource and industrial sector shares are indeed different. Faff and Mittoo's (1999) study tests the different-dominant-investor theory across Australia, Canada, and the US over the period 1983 to 1992. They find evidence in support of the theory, concluding: "...regional industry stocks are priced in segmented markets in both subperiods while global industry stocks are priced largely in integrated capital markets.”

Using the CAPM model, Faff, Brooks, and Tan (1999) find resources industries more risky than industrials, with the average resources share beta being 1.1876 and the average industrials share beta being 0.7666. Faff (2001a) states “An area of concern when applying the CAPM and asset-pricing models generally in an Australian setting is the apparent overpricing of mining and resources stocks.”

In an attempt to modify the CAPM by introducing an additional variable, Chan and Faff (1998) investigate the possibility of a gold price factor that explains returns beyond that of market returns over the period 1975 to 1994. They find industry equity returns are indeed sensitive to a gold price factor - positively for resource and mining sectors and negatively for the industrials sector. Given that the gold price is usually quoted in US\$ and thus a gold price factor would be coupled with an exchange rate factor, separation of the effects reveals the gold price itself is the dominant effect. While their paper shows that a modification of the CAPM model is beneficial, the

evidence also points towards another multifactor structure involving the resources and industrials sectors. While gold is often thought of as a hedge against market risk, the large resources sector disallows such an unqualified statement in the Australian context.

With respect to the Fama and French (1993) three-factor model, Faff (2004) conducts a visual inspection of the results of unrestricted regressions for various subsectors. Faff (2004) states that “if any pattern exists at all, it appears that there may be a tendency for mining and resources to produce negative ‘risk-adjusted performance’ in terms of the Fama and French alpha, whereas industrials tend towards positive alphas.” Further, Faff (2004) finds the largest positive exposure to both the size and M/B factors comes from the gold-industry portfolio, while the largest negative exposure is recorded by the media-industry portfolio for both factors.

3.5. Australian style anomalies

In one of the first anomalies tests on the Australian market, Brown, Keim, Kleidon, and Marsh (1983) document a size effect, and the monthly premium of 4% of the smallest portfolio over the next smallest portfolio appears to be unaffected by seasonal effects.

Beedles, Dodd, and Officer (1988) examine the period January 1974 to December 1984 and report small shares provide much larger returns than large firms. This size effect persists after adjustment is made for systematic risk for both value weighted and equal weighted common market factors. As there may be a greater propensity for small firms to leave the database as a result of bankruptcy, they note that if the last price is unreliable, the final month negative return may be understated. However, even when a terminal rate of return of -100% is assigned to all firms leaving the database there is still clear evidence of a size effect.

The existence of the size effect is also found to be robust to both changing the assumption of a monthly holdings revision on the basis of size to a yearly revision as

well as adjusting for total risk (given that some investors specialise in shares of a particular size category). However, given their findings of differences in volume of information and liquidity between small and large shares, they note that these may affect investors' risk perceptions and thus be causing the size effect.

Beedles, Dodd, and Officer (1988) refer to Stoll and Whaley (1983) who point out that transaction charges in the US are inversely related to the per-share values of the securities in question. Further, Stoll and Whaley (1983) find that total equity capitalisation and average per-share value are highly collinear, which may indicate that the size effect exists merely as a result of transaction costs. Given the similar transaction costs structure in Australia and the finding that size and per-share price are also collinear in Australia, Beedles, Dodd, and Officer (1988) attempt to separate these effects. They find both a distinct size effect independent of a price-per-share effect and a price-per-share effect independent of the size effect.

Aitken and Ferris (1991) state that the Beedles, Dodd, and Officer (1988) tests of the impact of transaction costs are weak and indirect. They instead adjust the CAPM for actual transaction costs and examine the period January 1965 to December 1985. They find that while the size effect exists when using investment horizons of twelve, six, and four months, it is largely reduced with a horizon of three months and disappears altogether using investment horizons of one and two months. Aitken and Ferris (1991) show that the difference in transaction costs between large and small shares can be severe: the average proportional transaction costs¹³ for a round trip transaction in Australia over the period was 6.02% for large firms and 13.35% for small firms. While transaction costs play an important role in practical application, empirical research is hampered by the lack of sufficiently detailed transaction costs databases.

Anderson, Lynch, and Mathiou (1990) test for M/B, P/E, and size effects on a sample of shares from the Australian Graduate School of Management (AGSM) Annual Report File over the ten-year period January 1975 to December 1984. They also conduct multicollinearity tests between M/B, P/E, and size. They find a strong size

¹³ Transaction costs comprise both brokerage fees and the bid-ask spread.

effect and a weaker and nonpersistent M/B effect. There is also evidence, though inconclusive, to suggest that the small firm effect is driving the M/B effect. The P/E effect was only present in large firms and disappeared as firms became smaller. They suggest that as the small shares used in US studies are generally larger than the largest Australian shares in their sample, there may be interaction between the size and P/E effects in the US such that the P/E effect is absent in very small shares.

Wood's (1991) investigation of the mean-variance efficiency of the CRIF value weighted index over the sample period 1974 to 1988 leads him to reject the null hypothesis of mean variance efficiency using the SLM and Black (1972) versions of the CAPM when test assets are constructed on the basis of size (market capitalisation).

In Faff's (1992) comparison of the CAPM, a five-factor APT model and a ten-factor APT model, he finds a small firm effect for all three models with the effect being strongest for the CAPM.

Fama and French (1998) conduct tests on the US as well as twelve international markets including Australia for the period 1975 to 1995. They find significant M/B, P/E, and cashflow-to-price effects for the Australian market and in fact find that the difference in the performance of "value" stocks to growth stocks is the largest (out of the thirteen countries) for Australia. One of the problems with the study pointed out by Gaunt (2004) is the use of the Morgan Stanley International Capital data set, which is dominated by large firms. "Consequently, Fama and French (1998) can only test a two-factor model (three factor model minus the size factor) and forego any insights from the wider spread of B/M generally evident amongst stocks in the small to mid cap range".

Halliwell, Heaney, and Sawicki (1999a) apply the time-series version of the Fama and French (1993) model to Australian data over the period 1981 to 1991. While their study confirms the importance of a size factor, they find little evidence of a significant M/B effect. They do however note that their study suffers from missing accounting and share price data.

Faff (2001a) examines the Fama and French (1993) three-factor model over the period January 1991 to April 1999. His sample postdates that of Halliwell, Heaney, and Sawicki (1999a) and instead of constructing factors, he uses commercially available measures. He finds the mean return for the size factor surprisingly significantly negative. In providing an explanation, Faff refers to evidence in early anomalies literature such as Brown, Kleidon, and Marsh (1983) that suggest the small firm effect is not stable over time. He also refers to more recent evidence that suggests the size effect may have “gone in reverse” over the past decade (Gompers and Metrick, 1998; Dimson and Marsh, 1999; and Gustafson and Miller, 1999). Dimson and Marsh (1999) argue that the size effect should rather be interpreted as resulting from small companies performing differently to large companies as opposed to an indication of outperformance as suggested by the term “size premium”.

The Faff (2001a) paper also finds a significant M/B factor. Given that this is also in contrast to the findings of Halliwell, Heaney, and Sawicki (1999a), Faff suggests that similar to the size factor, the M/B factor is not stable over time.

Using DataStream International daily data and the shorter examination period of May 1996 to April 1999, Faff (2004) finds the Fama and French (1993) model’s betas to be jointly distinguishable from each other and from zero. He also performs the generalised method of moments test and finds evidence in favour of the three-factor model although again finds the size effect risk premium to be negative.

Gaunt (2004) performs similar tests to those of Halliwell, Heaney, and Sawicki (1999a), but examines the longer period 1981 to 2000. His study also contains a more complete data set. He finds both size and M/B effects, and finds a significant improvement in the explanatory power of the Fama and French (1993) three-factor model over the standard CAPM. However, the size effect is the main driving factor behind the increased explanatory power.

Halliwell, Heaney, and Sawicki (1999b) perform a Fama and French (1992) type cross-sectional analysis over the period 1986 to 1992. While the US Compustat

database used in the Fama and French (1992) study excludes delisted firms and thus suffers from survivorship bias, Halliwell, Heaney, and Sawicki (1999b) use the Australian Stutex database, which includes delisted firms. They find a statistically significant positive linear relationship between the log of the B/M ratio and returns. The size effect, however, is found to be nonlinear. They also test the impact of excluding delisted firms and find the size effect sensitive to the exclusion - the small firm premium increased from 0.6% to 1.1% per month. While survivorship bias is thus an issue for the size effect, they find the B/M effect insensitive to the exclusion. They note that the study suffers from thin trading and a short time period of study.

Gaunt, Gray, and McIvor (2000) report both a firm size and share price effect, showing that these have separate effects on risk-adjusted returns. Their sample covers the period January 1974 to December 1997. They find a significant positive relationship between share price and returns in all months except July and January. While they confirm the direction and significance of the size effect is unaffected by the seasonal effect, the price effect turns significantly negative in July. This serves as a caveat that other style characteristics might also be affected by the seasonal effect. Gaunt, Gray, and McIvor (2000) check their findings by subdividing the sample into two twelve-year periods and find the subperiod results consistent with that of the full sample.

Despite interest in the momentum effect over the last ten years, not much has been written regarding the Australian market. In a recent study, Hurn and Pavlov (2003) attempt to fill the gap in the literature using monthly returns (capital gain and dividend yield) from the top 200 Australian shares (by market capitalisation) over the period December 1973 to December 1998. To avoid survivorship bias, firms delisting and thus exiting the database were assigned a 100% capital loss upon exiting. They use the Jegadeesh and Titman (1993) method for construction of momentum portfolios and report the existence of short- to medium-term momentum. However, they note that there does not appear to be any abnormal profitability in following a contrarian investment strategy, a finding in contrast to previous US studies.

Hurn and Pavlov (2003) also test risk-adjusted portfolios. They find that while “Risk adjustment tends to reduce the size of the momentum profits for individual stocks at the very short end of the investment horizon quite considerably,” the medium-term momentum strategy still remains profitable. They further find that other common reasons for momentum such as cross-sectional dispersion of unconditional mean returns and industry driven momentum fail to offer a complete description of momentum.

3.6. Australian seasonality

The evidence regarding seasonality in Australian returns can be divided into two sections: (1) seasonality in Australian returns; and (2) the relation between the seasonality in returns and significant style characteristics. While evidence of the former is well documented, the style characteristics relation has hardly been explored in the Australian market.

3.6.1. Seasonality in share returns

Officer (1975) examines aggregate Australian stock returns over 1958-1970 and applies the time-series methods of Box and Jenkins (1970). He finds a March-September six-month seasonal effect and suggests it is probably related to the varying opportunity cost of money through the year.

In placing the seasonal effect in the tax-loss selling hypothesis context, Brown, Keim, Kleidon, and Marsh (1983) provide an outline of the Australian tax regime. The Australian tax-year is from 1 July to 30 June for almost all taxpayers. As such, they argue that Australian investors should have incentives for June tax-loss selling comparable to those of US investors in December. In fact, they suggest the incentive may be stronger in Australia as there is no limit to the size of the tax deduction. After examining the period March 1958 to June 1981 using Ordinary Least Squares regression and dummy variables, they find a seasonal effect with peaks in December-

January and July-August, with the largest (and roughly equal) effects in January and July.

While the tax-loss selling hypothesis does not support the January seasonal in Australia, Brown, Keim, Kleidon, and Marsh (1983) suggest that if shares are accessible to both Australian and US investors, an Australian January seasonal may be caused by arbitrage. However, they note that this would in fact create another arbitrage opportunity for those not subject to the US-style tax regime. They conclude 'tax-loss selling still leaves us at a loss for an explanation of the January effect.'

Gultekin and Gultekin (1983) examine seasonality across a number of different countries including Australia. The Kruskal and Wallis (1952) test (referred to as "KW" for the remainder of the chapter) is used to compare the means of the returns in each calendar month over the period January 1970 to December 1979. This nonparametric test requires no distributional assumptions other than the variables are continuous and measurable on an ordinal scale. They find significant December- and January-effects, both with positive premiums, and the December premium is somewhat larger than the January premium.

Agrawal and Tandon (1994) conduct a similar study to that of Gultekin and Gultekin (1983) and examine seasonality in nineteen countries including Australia using the KW test. They use the partially overlapping period of January 1971 to June 1987 for Australia, and while they also find significant positive January and December premiums, it is the January premium that is larger than that of December.

The KW test is also employed by Brailsford (1991) who investigates the previously unexamined earlier period of 1936 to 1957. In order to identify the months responsible for seasonality, Brailsford (1991) calculates the sum of ranks for each month and then investigates the differences in the sum of the ranks in accordance with the multiple sequential pairwise comparisons discussed by Conover (1980). He finds that returns in January are consistently higher than returns in any other month, and also documents low February and June effects. All three monthly effects remain significant after taking account of seasonality in ex-dividend days.

Faff, Brooks, and Josev (1997) analyse the period 1974 to 1992 and confirm the existence of seasonal effects in January, July, and August. As seasonal effects have little impact on the stability of individual stock betas they suggest that the beta measure of risk is invariant to seasonal effects.

3.6.2. Relations between seasonality and style characteristics

In Brown, Keim, Kleidon, and Marsh's (1983) examination of the period March 1958 to June 1981 it was noted that they find a significant size effect as well as a seasonality effect with peaks in December-January and July-August. In contrast to US January-size effect results, the monthly premium of 4% of the smallest portfolio over the next smallest portfolio is fairly unaffected by the seasonal effect.

A similar conclusion can be drawn from the results of Beedles, Dodd, and Officer (1986) who examine the period 1974 to 1984 and find that for each of the market capitalisation-sorted portfolios, January earned a higher return than any other month. They also find that June earned a lower return than any other month for each of the market capitalisation-sorted portfolios.

As noted earlier, Gaunt, Gray, and McIvor (2000) find separate firm size and share price effects for the period January 1974 to December 1997. While they report the negative relation between returns and firm size exists across all months, the return-price relation is negative in July and positive in all other months except January where the relation does not exist.

While Faff, Brooks, and Josev's (1997) seasonality analysis confirms January, July and, August effects, they also find that that on average, stocks with significant seasonal effects have smaller market capitalisations.

3.7. Summary and conclusion

There have been numerous US studies that document anomalous effects in the context of the CAPM and efficient markets. Several explanations have subsequently been developed, yet there is still no consensus as to the true meaning of these anomalies. Some of these argue for investor rationality and thus misspecification of the underlying asset-pricing model, others argue for investor irrationality and inefficient markets, and some arguments blame methodological issues. With regards to the size effect, Schwert (1983) states that: “In sum, several papers have attempted to explain the anomalous results of Banz (1981) and Reinganum (1981b) by showing that risk estimates are biased downward or average return estimates are biased upward for small firms’ stocks. While it is true that the magnitude of the ‘size effect’ is affected by these statistical issues, none of these appears to have been able to completely explain the evidence on the ‘size effect’”.

The chapter introduces the anomalies by briefly mentioning some of the first US studies to find a particular anomaly and then discusses more recent literature on timing these anomalies. While there is a lot of evidentiary support for the existence of these significant characteristics, evidence on the benefits of timing the effects is rather mixed. The well-documented January effect has been found to be related to a number of these style characteristics in the US, which as a result brings a new dimension to the assessment and interpretation of the style-based effects.

The literature has revealed the CAPM to be controversial in an Australian context, with evidence for and against mean-variance efficiency being documented. Comparisons between the CAPM and APT models have as yet yielded conclusive evidence that one is better than the other. There have, however, been numerous arguments, supported with evidence, that the Australian market is dichotomous in nature where industrial shares are priced differently to resources shares. Wood (1991) suggests that the dominant investors in resource shares are foreign investors while the dominant investors in the remaining shares are domestic investors. This argument also points towards a dichotomous market structure.

The Australian literature on the CAPM anomalies confirms their existence and finds anomalous characteristics that are not unlike those documented in international markets. Some of these anomalies even persist when examined in the context of an APT asset-pricing model. Most of the research has focused on the size effect and convincingly finds it significant. The price-per-share, M/B, P/E, cashflow-to-price, and short- to medium-term momentum anomalies are less frequently examined and the evidence is rather mixed. While Australia has a well-documented seasonality effect, the evidence concerned with the relation between the seasonality effect and the anomalies is somewhat weak.

While the actual interpretation and related implications of the anomalies remains to be seen, the existence of these effects in various markets around the world including Australia is fairly certain. However, a particularly complex situation is at hand: these anomalies do not necessarily maintain significance or direction across different time periods, and they are not even required to behave the same way in different markets given the differences in the markets' capital structure, accounting systems, reporting policies, and homogeneity of the universe (Becker and Ochman, 2004). It may very well be a while before these anomalies are completely understood. In the meantime, empirical work should continue to document the anomalies' behaviour in the hopes of providing insight into Roll's (1983) question: "Vas ist das?"

Data and Descriptive Statistics

4.1. Introduction

This chapter introduces the data that are analysed in Chapters Five, Six, and Nine, and from which the data sets used in Chapters Seven and Eight are derived. The data consist of stock returns data and firm-specific attribute data. While these two data sets are later combined as part of the cross-sectional regression empirical tests (and combined to produce the data sets for the timing and seasonality tests), they are described separately in this chapter.

While the Econometrics Views (E-Views) statistical software package is used to perform most of the analyses conducted in this thesis, some analyses are performed in Microsoft Excel and others in the STATISTICA software package.

The remainder of the chapter is set out as follows: Section 4.2 discusses the stock returns and attributes data sets and provides details of their construction and the procedures used in sorting and manipulating the data prior to the empirical analyses that follow in later chapters. This section also presents some descriptive statistics of the attribute data set. Section 4.3 summarises and concludes.

4.2. Data

Both the returns and firm-specific attribute data were obtained from DataStream International, accessed via the Finance Research Laboratory at the University of Cape Town (School of Management Studies). As at 1 September 2004, the DataStream International database had 484 companies listed as constituents of the ASX All

Ordinaries Index. Of course, not all of the companies listed at the end of the period were around at the beginning. Thus the number of shares in the sample at the beginning of the testing period is much smaller and then grows as time progresses. Given that the starting point of company selection was the ASX All Ordinaries constituents at the end of the period, the study is subject to survivorship bias.

4.2.1. Stock returns data

Monthly total returns and trading volume data for the 484 companies were collected for the period 1 July 1992 to 30 June 2004. Total returns comprise both dividend yield and capital gains. While the empirical tests are only performed using the period 1 June 1994 to 31 May 2004, previous returns data are needed to construct the momentum style characteristics.

Preference shares are removed from the sample (four), and two shares are removed due to lack of total returns data. Appendix A.1 shows the cumulative size of the remaining 478 companies as a percentage of the total market capitalisation of the share sample as at 31 May 2004. The largest 50 companies represent 75% of the total market capitalisation. On 31 May 2004, the market capitalisation of these 478 shares totals AUSS\$ 797 867 million, which is fairly comparable with the market capitalisation of the All Ordinaries Index (AUSS\$ 799 078 million).¹⁴

Three shares are removed for insufficient total returns observations required for the CAPM- and APT-risk adjustments required in Chapter Six, leaving 475 shares in the set. Two further shares are removed for insufficient total returns observations required for the tests in Chapter Five, resulting in a 473-share data set thus far for that chapter.

4.2.2. Adjustments to the stock returns data

As total returns comprise dividend yield and capital gains, they are dependant on the periodic movements in price. As the price is determined when the share trades,

¹⁴ Figures are from DataStream International.

problems of “nonsynchronous” trading can arise¹⁵. The first issue occurs when shares are traded in a month, but not at the close of the month. The price of a share is said to reflect all available relevant information under the EMH, and these shares may not be at the correct price levels at the end of the month merely because they have not traded in a while. This means that the capital gains calculated for the month will not be accurate as the information content of the price does not relate to the current period but is rather a carry-over from a prior event. The less frequently traded a share is, the greater the chances of the ending price being mismatched with the true value of the share (and thus the greater the chances that the capital gain is not what the share should have earned).

The second issue is if the share does not trade in a month at all. Not only will there be issues in the measurement of returns, but if the firm does not pay dividends, there in fact will be no return for that month merely because the share has not traded.

Thirdly, Dimson (1979) notes that non-traded shares have a downward bias in the estimation of their covariance with the market, which therefore results in an underestimated beta. Robertson (2002) explains that as systematic risk is estimated from the covariance matrix of stock returns and the market return, the prices of non-traded shares do not change thus giving the appearance that these shares do not move with the market.

The issues of nonsynchronous trading are often referred to as “thin-trading” problems. Haugen and Baker (1996) discuss the “bid-ask bounce” problem, which arises in thinly traded shares because shares trade at the bid or ask prices and returns are usually measured from close-to-close. They illustrate this with a theoretical example: First assume that the underlying market value of a share does not change during a month t and that the bid-ask spread remains constant. Also assume that the stock price remains constant during month $(t + 1)$ (not uncommon for infrequently traded shares), and that the last trade of month t was at the bid. As there is roughly an equal

¹⁵ The first effects of non-synchronous trading are documented by Fama (1965) and Fisher (1966) who find that indexes constructed from the prices of shares that are not traded at the end of a time period (which therefore represent the outcome of a transaction which occurred earlier in or prior to the period in question) show spurious positive serial correlation in the returns of those indexes, and the estimated variances of returns on the indexes is biased downward.

change that the price will close at the ask price at the end of $(t-1)$ or $(t+1)$, the measured return will be either zero or negative for t and either zero or positive for $(t+1)$. This means that returns measured over closing prices can appear to be negatively autocorrelated even when they are not, leading to the false conclusion that last period's return has predictive power.

Various methods have been used in the literature to deal with thin trading. Ibbotson (1975) and Schwert (1977) introduce lagged market returns as additional independent variables in their market model regressions. However, Dimson (1979) notes that this method can only be justified if the constituents of the market index do not suffer from more than a negligible amount of non-trading. Schwert (1977) also calculates returns on a trade-to-trade basis and then regresses these returns on market movements calculated over the exact same trade-to-trade time intervals. The difficulty with this method is that the interval between the transactions must be known, and Dimson (1979) remarks that the market index must have negligible non-trading.

Dimson (1979) corrects for beta estimation effects from thin trading by using an "aggregated coefficients" method where the unbiased beta is estimated by taking the sum of the slope coefficients in a regression of security returns on lagged, matching, and leading market returns.

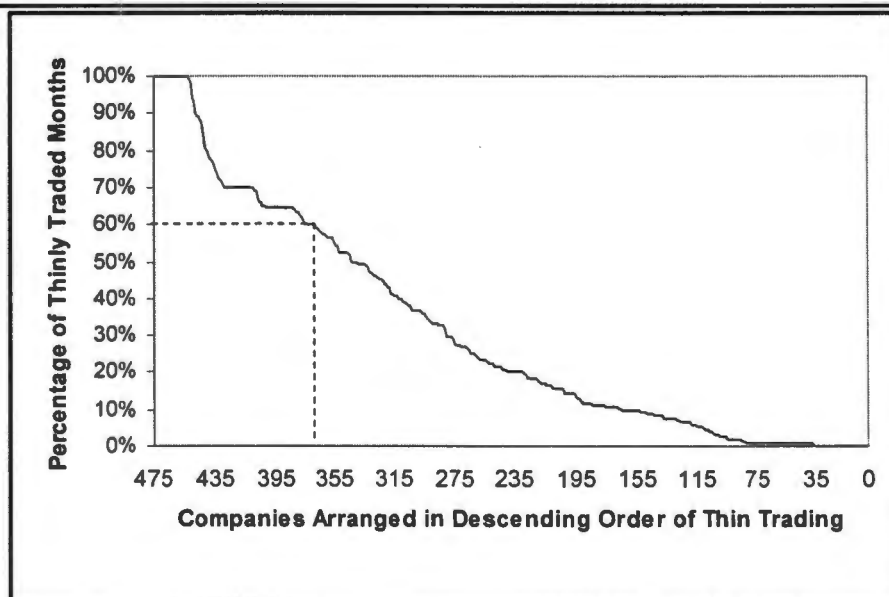
The remedies of Ibbotson (1975), Schwert (1977) and Dimson (1979) do not however solve the other issues of thin trading discussed above. Further, those empirical solutions apply to the CAPM beta estimates and not to style coefficients. Robertson (2002) notes that as thin trading is likely to be more prevalent among smaller companies, simply filtering the sample using market capitalisation alone would be especially problematic for studies that test the relationship between stock returns and attributes of size. In van Rensburg and Slaney's (1997) South African study, shares with zero trading volume for more than twenty weeks out of their 520-week sample are simply excluded.

Van Rensburg and Robertson (2003) filter their data set on a monthly basis to include only shares with a turnover ratio (also called “trading volume ratio”) of greater than 0.01%.

In a private discussion, van Rensburg suggested that ideally shares with a turnover ratio of less than 0.01% in any month should be removed from the sample entirely. The sample was first assessed for the level of thin trading as defined by the 0.01% turnover ratio filter. For every share in each month, the average number of shares traded daily for the month is divided by the number of ordinary shares outstanding at the end of the previous month to yield a turnover ratio (as in van Rensburg and Robertson 2003). The months in which a share’s turnover ratio is less than 0.01% are named “thinly traded months”. For each share, a ratio of thinly traded months to total listed months is calculated. Figure 4.1 below shows the companies on the x -axis in decreasing order of the thin trading ratio, and displays this ratio on the y -axis.

Figure 4.1. Percentage of Thinly Traded Months for Each Company

Monthly turnover ratios for each ASX All Ordinaries constituent are calculated by dividing the average number of shares traded daily by the number of ordinary shares outstanding at the end of the previous month. The months in which a share’s turnover ratio is less than 0.01% are named “thinly traded months”. The graph displays the ratio of thinly traded months to total listed months for each share over the period July 1994 to May 2004 as a percentage. The shares are listed on the x -axis in decreasing order of the thin trading ratio. All data were extracted from DataStream International. Preference shares and shares with no total returns data are excluded.



It is clear that the Australian market is severely affected by thin trading. If all the shares with a turnover ratio of less than 0.01% in any month are removed from the sample entirely, there would only be 35 shares left in the sample. Given this situation, a trade-off has to be made between thin trading effects and a sufficiently large sample size. A unique rule was therefore applied: shares that are thinly traded in 60% or more of the months they were listed are removed from the sample entirely. The shares removed due to thin trading totals 108, thus leaving 367 companies in the sample for Chapters Six and Nine and 365 companies in the sample for Chapter Five. It should be noted, however, that this adjustment does not eliminate thin trading but simply deals with it to some degree.

Not all of the companies were listed throughout the examined period. The first month of the sample has returns data on only 152 companies. Thereafter, the sample size increases until reaching the maximum of 367 (365) companies. The average number of months of returns data for a company is 86 months (out of the total 121 months over the sample). Appendix A.2 shows the number of companies (with returns) in the sample in the first month of each twelve-month period (July). Appendix A.3 displays the number of companies in the sample in each month for each of the nine level three subindexes. Appendix A.4 displays the cumulative size of the remaining 367 companies as a percentage of the total market capitalisation of the share sample as at 31 May 2004. The distribution is similar to that of the initial 478 companies, and here the largest 50 companies represent 78% of the total market capitalisation. The market capitalisation of the 367 shares totals AUS\$ 713 768 million. Appendix A.5 graphically compares the ending market capitalisations of the ASX All Ordinaries Index, the initial 478 shares, and the final 367 shares as at 31 May 2004. While there is a noticeable change in the market capitalisation after the thin trading adjustment is made, the change is relatively small and therefore of little concern.

Outliers in the data set may occur as a result of extremely abnormal events or simply be errors from the data source. The influence of outliers is dealt with using a two-step winsorisation (trimming) procedure and is only performed on the data set for the tests in Chapter Six (and not those in Chapter Five). For each month, the mean and standard deviation of the returns are calculated across the shares. Observations greater

than three standard deviations away from the mean are removed from the sample and a new mean and standard deviation are calculated from the remaining observations. The observations removed at the first step are then brought back into the sample. All the observations are then limited to three standard deviations away from the mean. Lastly, the returns data set is limited to 100%. (This procedure is also performed on the sets of returns that are adjusted for risk in accordance with Chapter Six).

Figure 4.2 below shows the total market capitalisation values for the nine subindexes computed using the data set of 367 companies over the period 1 July 1994 to 31 May 2004.

Figure 4.2. Sectoral Breakdown of Filtered Sample Size (Market Capitalisation)

Market capitalisation over the period July 1994 to May 2004 of the filtered share sample of 367 companies, grouped according to the nine (level-three) DataStream International ASX subindexes. The share sample excludes preference shares and companies with no total monthly returns data, and has been filtered to exclude firms that had turnover ratios of less than 0.01% in more than 60% of the months they were listed. The data were extracted from DataStream International.

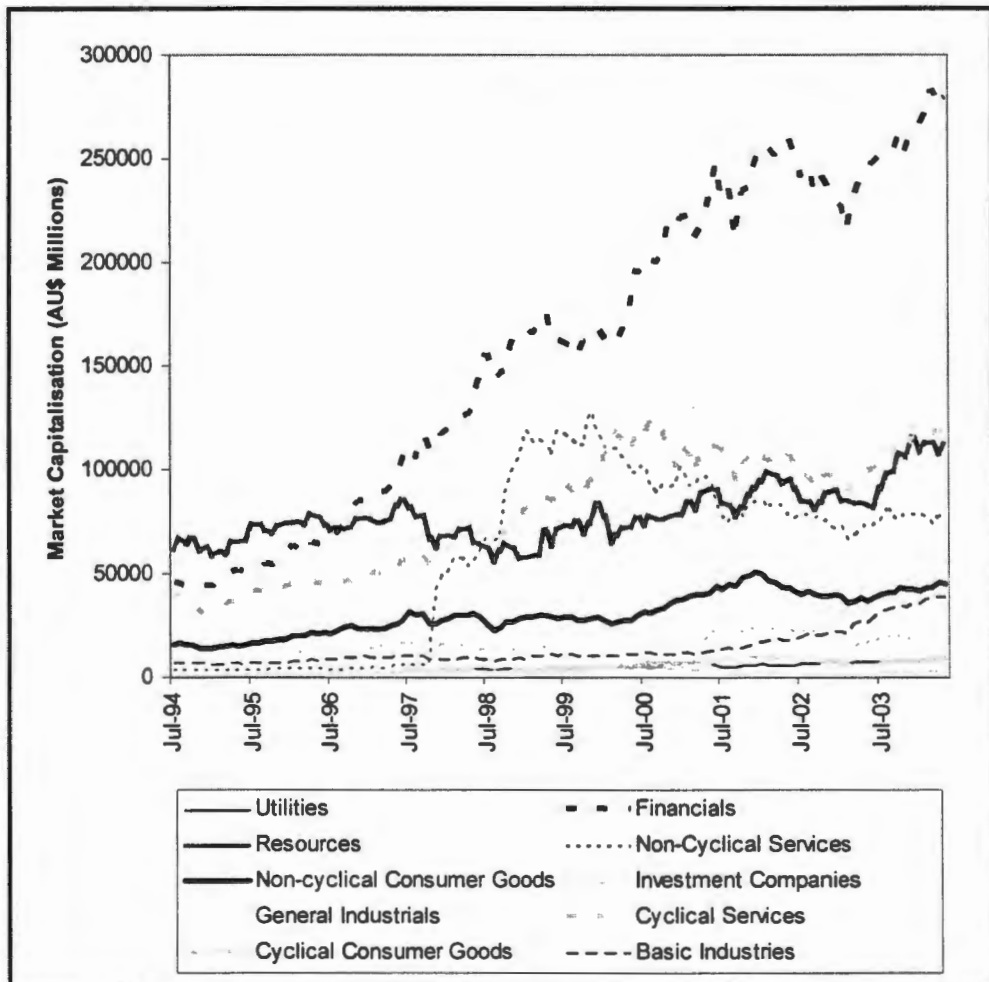


Figure 4.2 clearly shows that while Resources used to dominate the market in terms of size at the beginning of the period, the massive rise in Financials has resulted in a dramatic change in the spread of value across the sectors. The Resources, Cyclical Services, and Non-Cyclical Services indexes also stand out, but to a lesser extent.

4.2.3. Firm-specific attribute data

The term “firm-specific attribute” refers to financial information relating to a specific firm, such as an accounting line item, a financial ratio, a change in that financial ratio (which in itself is a ratio), or a technical indicator. These are also referred to as “style characteristics” (or simply “characteristics”) in this thesis, and in the context of the CAPM anomaly studies, simply “anomalies” or “anomalous factors”.

The data were extracted from DataStream International for the 367 firms (subject to the availability and completeness of the data in the DataStream International database) for the period 1 July 1990 to 30 June 2004. As noted above, the empirical tests are only performed using the period 1 June 1994 to 31 May 2004. The data predating this period are required for the construction of some of the financial ratios. The total returns data collected for Section 4.2.1 are used to construct the momentum characteristics. The attribute data for the companies that are excluded in accordance with the adjustments in Sections 4.2.1 and 4.2.2 are of course not required.

The style characteristics tested are listed in Table 4.1. For many of the characteristics the 1-, 3-, 6-, 12-, 18-, and 24-month percentage changes in the characteristics are also tested as additional style factors. The names of these additional factors end in either: “_1M”, “_3M”, “_6M”, “_12M”, “_18M”, “_24M”, “_1YR”, or “_2YR”. However, this interpretation of these suffixes does not apply to the Momentum or Cross-over constructs, nor to the EPSCH_P characteristics. The constructions of the characteristics are displayed in Table 4.2, and the definitions of the characteristics’ components are included in Appendix A.6. Some characteristics are taken directly from DataStream International, while others are constructed using DataStream International data.

Table 4.1. Firm-specific Attributes

The table shows the list of firm-specific attributes tested and their codenames used in this thesis. The data were extracted from DataStream International. For many of the characteristics, the 1-, 3-, 6-, 12-, 18-, and 24-month percentage changes in those characteristics are also tested as additional style factors (not shown here). The names of these additional factors end in either: “_1M”, “_3M”, “_6M”, “_12M”, “_18M”, “_24M”, “_1YR”, or “_2YR”. However, this interpretation of these suffixes does not apply to the Momentum or Cross-over constructs, nor to the EPSCH_P characteristics. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

CODE USED	STYLE CHARACTERISTIC
A_Turn	Asset Turnover
AccRec_1yr_ch	1-year Change in Accounts Receivable
AccRec_2yr_ch	2-year Change in Accounts Receivable
AccRec_6m_ch	6-month Change in Accounts Receivable
Accru	Non-cash Earnings to Total Assets ("Accruals")
Av6m_TV	6-month Average of Monthly Trading Volume
Borrow	Borrowing Ratio
BTMV	Book Value to Market Value
BVpS	Book Value per Share
CEpS	Cash Earnings per Share
CF	Cashflow
CFMIP	Cashflow Margin to Price
CFIBorrRep	Cashflow to Borrowings Repayable Within 1 year
CFIBorrRepDiv	Cashflow to Borrowings Repayable Within 1 year plus Dividends Paid
CFIP	Cashflow to Price
CFITD	Cashflow to Total Debt
CFITL	Cashflow to Total Loan Capital
chSale_les_chAcRe	Difference Between 1-year Percentage Change in Sales and Accounts Receivable
chSale_les_chIn	Difference Between 1-year Percentage Change in Sales and Inventory
Cross1_Mom18m	1-month Crossover of 18-month Momentum
Cross1_Mom1m	1-month Crossover of 1-month Momentum
Cross1_Mom3m	1-month Crossover of 3-month Momentum
Cross3_Mom12m	3-month Crossover of 12-month Momentum
Cross3_Mom18m	3-month Crossover of 18-month Momentum
Cross3_Mom1m	3-month Crossover of 1-month Momentum
Cross6_Mom12m	6-month Crossover of 12-month Momentum
Div	Dividends Paid
DPS	Dividends per Share
DY	Dividend Yield
ECandRes	Equity Capital and Reserves
EPS	Earnings per Share
EPS_2yrAv	EPS 2-year Average
EPSch_P_12m	12-month Difference in EPS, Over Price
EPSch_P_24m	24-month Difference in EPS, Over Price
EPSch_P_6m	6-month Difference in EPS, Over Price
EY	Earnings Yield
Four_yrEarnGrowA	4-year Earnings Arithmetic Growth
Four_yrEarnGrowG	4-year Earnings Geometric Growth
Gear	Capital Gearing
Grow	Sustainable Rate of Growth
ICBT	Interest Cover Before Tax
IntanMV	Intangibles to Market Value
Inv_1yr_ch	1-year Change in Inventories
Inv_2yr_ch	2-year Change in Inventories
Inv_6m_ch	8-month Change in Inventories
LnMV	Market Value
LnP	Ln of Price
MOM_12M	12-month Momentum in Returns
MOM_18M	18-month Momentum in Returns
MOM_1m	1-month Momentum in Returns
MOM_24M	24-month Momentum in Returns
MOM_3m	3-month Momentum in Returns
MOM_6M	6-month Momentum in Returns
MTBV	Market Value to Book Value
MVtrade	Market Value Traded
MVtradeMV	Market Value Traded to Market Value
NPMP	Net Profit Margin to Price
NS	Shares in Issue
OBOS_3mMA	Overbought-Oversold with 3-month Moving Average of Price
OBOS_6mMA	Overbought-Oversold with 6-month Moving Average of Price
OPMP	Operating Profit Margin to Price
P	Price
Quick	Quick Assets Ratio
Reten	Retention rate
ROCE	Return on Capital Employed
ROEpub	Return on Equity (published)
SalepEmploy	Sales per Employee
SalestP	Sales-to-Price Ratio
TDiTA	Total Debt to Total Assets
TLiTA	Total Loan Capital to Total Assets
TV	Trading Volume Ratio
VO	Absolute Trading Volume
WC	Working Capital Ratio

Table 4.2. Construction of Firm-specific Attributes from DataStream International Data

The table shows the construction of the firm-specific attributes using data from DataStream International. Some attributes are taken directly from DataStream International. Characteristics not listed here but ending in the term “_1M” are calculated as the one-month percentage change in the initial characteristic. Similar construction is used for characteristics ending in “_3M”, “_6M”, “_12M”, “_18M”, “_24M”, “_1YR”, and “_2YR”. The definitions of the attributes’ components are included in Appendix A.6.

Code used	Name	Formula (using DataStream International items)
A_Turn	Asset Turnover	$\frac{[\text{Total Sales}]_t}{[\text{Total Assets}]_t}$
AccRec_1yr_ch	1-year Change in Accounts Receivable	$\frac{([\text{Total Debtors and Equivalent}]_t - [\text{Total Debtors and Equivalent}]_{t-12})}{[\text{Total Debtors and Equivalent}]_{t-12}}$
AccRec_2yr_ch	2-year Change in Accounts Receivable	$\frac{([\text{Total Debtors and Equivalent}]_t - [\text{Total Debtors and Equivalent}]_{t-24})}{[\text{Total Debtors and Equivalent}]_{t-24}}$
AccRec_6m_ch	6-month Change in Accounts Receivable	$\frac{([\text{Total Debtors and Equivalent}]_t - [\text{Total Debtors and Equivalent}]_{t-6})}{[\text{Total Debtors and Equivalent}]_{t-6}}$
Accru	Non-cash Earnings to Total Assets (“Accruals”)	$\frac{([\text{Total Current Assets}]_t - [\text{Total Current Assets}]_{t-12}) - ([\text{Total Cash and Equivalent}]_t - [\text{Total Cash and Equivalent}]_{t-12}) + ([\text{Total Loan Capital}]_t - [\text{Total Loan Capital}]_{t-12}) - [\text{Depreciation}]_t - [\text{Amortisation of Intangibles}]_t}{[\text{Total Assets}]_t}$
Av6m_TV	6-month Average of Monthly Trading Volume	Simple average of $([\text{Turnover by Volume}]_t / [\text{Trading Days}]_t) / [\text{Number of Shares}]_{t-1}$ for the six preceding months
Borrow	Borrowing Ratio	$\frac{[\text{Borrowing Ratio}]_t}{[\text{Total Assets}]_t}$
BTMV	Book Value to Market Value	$\frac{1}{[\text{Market Value to Book Value}]_t}$
BVpS	Book Value per Share	$[\text{Book Value per Share}]_t$
CEpS	Cash Earnings per Share	$[\text{Cash Earnings per Share}]_t$

Table 4.2. Construction of Firm-specific Attributes from DataStream International Data

- continued

Code used	Name	Formula (using DataStream International items)
CF	Cashflow	$[\text{Price}] \times [\text{Number of Shares}] \times (1 / [\text{Price/Cashflow Ratio}])$
CFMTP	Cashflow Margin to Price	$[\text{Cashflow Margin}] / [\text{Price}]$
CFtBorrRep	Cashflow to Borrowings Repayable Within 1 year	$([\text{Price}] \times [\text{Number of Shares}] \times (1 / [\text{Price/Cashflow Ratio}])) / [\text{Borrowings Repayable Within 1 year}]$
CFtBorrRepDiv	Cashflow to Borrowings Repayable Within 1 year plus Dividends Paid	$([\text{Price}] \times [\text{Number of Shares}] \times (1 / [\text{Price/Cashflow Ratio}])) / ([\text{Borrowings Repayable Within 1 year}] + [\text{Dividends Paid}])$
CFtP	Cashflow to Price	$1 / [\text{Price/Cashflow Ratio}]$
CFtTD	Cashflow to Total Debt	$([\text{Price}] \times [\text{Number of Shares}] \times (1 / [\text{Price/Cashflow Ratio}])) / [\text{Total Debt}]$
CFtTL	Cashflow to Total Loan Capital	$([\text{Price}] \times [\text{Number of Shares}] \times (1 / [\text{Price/Cashflow Ratio}])) / [\text{Total Loan Capital}]$
chSale_les_chAcRe	Difference Between 1-year Percentage Change in Sales and Accounts Receivable	$(([\text{Total Sales}]_t - [\text{Total Sales}]_{t-12}) / [\text{Total Sales}]_{t-12}) - (([\text{Total Stock and Work in Progress}]_t - [\text{Total Stock and Work in Progress}]_{t-12}) / [\text{Total Stock and Work in Progress}]_{t-12})$
chSale_les_chIn	Difference Between 1-year Percentage Change in Sales and Inventory	$(([\text{Total Sales}]_t - [\text{Total Sales}]_{t-12}) / [\text{Total Sales}]_{t-12}) - (([\text{Total Debtors and Equivalent}]_t - [\text{Total Debtors and Equivalent}]_{t-12}) / [\text{Total Debtors and Equivalent}]_{t-12})$
Div	Dividends Paid	$[\text{Dividends Paid}]$
DPS	Dividends per Share	$[\text{Dividends per Share}]$
DY	Dividend Yield	$[\text{Dividend Yield}]$
ECandRes	Equity Capital and Reserves	$[\text{Equity Capital and Reserves}]$

Table 4.2. Construction of Firm-specific Attributes from DataStream International Data

- continued

Code used	Name	Formula (using DataStream International items)
EPS	Earnings per Share	[Earnings per Share]
EPS_2yrAv	EPS 2-year Average	$([\text{Earnings per Share}]_t + [\text{Earnings per Share}]_{t-12}) / 2$
EPSch_P_12m	12-month Difference in EPS, Over Price	$([\text{Earnings per Share}]_t - [\text{Earnings per Share}]_{t-12}) / [\text{Price}]_{t-12}$
EPSch_P_24m	24-month Difference in EPS, Over Price	$([\text{Earnings per Share}]_t - [\text{Earnings per Share}]_{t-24}) / [\text{Price}]_{t-24}$
EPSch_P_6m	6-month Difference in EPS, Over Price	$([\text{Earnings per Share}]_t - [\text{Earnings per Share}]_{t-6}) / [\text{Price}]_{t-6}$
EY	Earnings Yield	$[\text{Earnings per Share}] / [\text{Price}]$
Four_yrEarnGrowA	4-year Earnings Arithmetic Growth	Simple average of [Earnings per Share] x [Number of Shares] for the four preceding years
Four_yrEarnGrowG	4-year Earnings Geometric Growth	$([\text{Earnings per Share}]_t \times [\text{Number of Shares}]_t) - ([\text{Earnings per Share}]_{t-48} \times [\text{Number of Shares}]_{t-48}) / [\text{Earnings Per Share}]_{t-48} \times [\text{Number of Shares}]_{t-48}$
Gear	Capital Gearing	[Capital Gearing]
Grow	Sustainable Rate of Growth	$[\text{Return on Equity (Published)}] \times (1 - [\text{Payout Ratio}])$
ICBT	Interest Cover Before Tax	[Interest Cover Before Tax]
IntanMV	Intangibles to Market Value	$[\text{Total Intangibles}] / [\text{Market Value}]$
Inv_1yr_ch	1-year Change in Inventories	$([\text{Total Stock and Work in Progress}]_t - [\text{Total Stock and Work in Progress}]_{t-12}) / ([\text{Total Stock and Work in Progress}]_{t-12})$

Table 4.2. Construction of Firm-specific Attributes from DataStream International Data

- continued

Code used	Name	Formula (using DataStream International items)
Inv_2yr_ch	2-year Change in Inventories	$([\text{Total Stock and Work in Progress}]_t - [\text{Total Stock and Work in Progress}]_{t-24}) / [\text{Total Stock and Work in Progress}]_{t-24}$
Inv_6m_ch	6-month Change in Inventories	$([\text{Total Stock and Work in Progress}]_t - [\text{Total Stock and Work in Progress}]_{t-6}) / [\text{Total Stock and Work in Progress}]_{t-6}$
LnMV	Market Value	$\text{Ln} [\text{Market Value}]$
LnP	Ln of Price	$\text{Ln} [\text{Price}]$
MTBV	Market Value to Book Value	$[\text{Market Value to Book Value}]$
MVtrade	Market Value Traded	$[\text{Turnover by Volume}] \times [\text{Price}]$
MVtradeMV	Market Value Traded to Market Value	$[\text{Turnover by Volume}] \times [\text{Price}] / [\text{Market Value}]$
NPMIP	Net Profit Margin to Price	$[\text{Net Profit Margin}] / [\text{Price}]$
NS	Shares in Issue	$[\text{Number of Shares}]$
OBOS_3mMA	Overbought-Oversold with 3-month Moving Average of Price	$([\text{Price}]_t - (([\text{Price}]_t + [\text{Price}]_{t-1} + [\text{Price}]_{t-2}) / 3)) / (([\text{Price}]_t + [\text{Price}]_{t-1} + [\text{Price}]_{t-2}) / 3)$
OBOS_6mMA	Overbought-Oversold with 6-month Moving Average of Price	$([\text{Price}]_t - (([\text{Price}]_t + [\text{Price}]_{t-1} + [\text{Price}]_{t-2} + [\text{Price}]_{t-3} + [\text{Price}]_{t-4} + [\text{Price}]_{t-5}) / 6)) / (([\text{Price}]_t + [\text{Price}]_{t-1} + [\text{Price}]_{t-2} + [\text{Price}]_{t-3} + [\text{Price}]_{t-4} + [\text{Price}]_{t-5}) / 6)$
OPMIP	Operating Profit Margin to Price	$[\text{Operating Profit Margin}] / [\text{Price}]$
P	Price	$[\text{Price}]$

Table 4.2. Construction of Firm-specific Attributes from DataStream International Data

- continued

Code used	Name	Formula (using DataStream International items)
Quick	Quick Assets Ratio	[Quick Assets Ratio]
Reten	Retention rate	100 - [Payout Ratio]
ROCE	Return on Capital Employed	[Return on Capital Employed]
ROEpub	Return on Equity (published)	[Return on Equity (Published)]
SalepEmploy	Sales per Employee	[Total Sales] / [Total Number of Employees]
SalestP	Sales-to-Price Ratio	([Total Sales] / [Number of Shares]) / [Price]
TDtTA	Total Debt to Total Assets	[Total Debt] / [Total Assets]
TLtTA	Total Loan Capital to Total Assets	[Total Loan Capital] / [Total Assets]
TV	Trading Volume Ratio	([Turnover by Volume] _t / [Trading Days] _t) / [Number of Shares] _{t-1}
VO	Absolute Trading Volume	[Turnover by Volume]
WC	Working Capital Ratio	[Working Capital Ratio]

Table 4.2. Construction of Firm-specific Attributes from DataStream International Data

- continued

Code used	Name	Formula (using DataStream International items)
MOM_1m	Prior 1-month Momentum in Returns	$[\text{Total Return}_t - \text{Total Return}_{t-1}] / [\text{Total Return}_{t-1}]$
MOM_3m	Prior 3-month Momentum in Returns	$[\text{Total Return}_t - \text{Total Return}_{t-3}] / [\text{Total Return}_{t-3}]$
Cross1_Mom1m	Similar construction for MOM_6m, 12m, 18m, and 24m characteristics	Percentage change of the 1-month Momentum of last month to that of the current month
Cross3_Mom1m	1-month Crossover of Prior 1-month Momentum 3-month Crossover of Prior 1-month Momentum	Percentage change of the 1-month Momentum from 3 months ago to that of the current month
	Similar construction for Cross1_Mom_3m, Cross3_Mom12m, Cross6_Mom12m, Cross1_Mom18m, and Cross3_Mom18m characteristics	

DataStream International sources its company accounts data from the Quoted Published Accounts of the companies: the published Profit and Loss, Balance Sheet, and Cash Flow (Sources and Uses) Statements. To enable comparability between the companies' financial statements, DataStream International adjusts, rearranges and repositions the company accounts data thus providing consistent treatment of each item. However, this is somewhat restricted by different accounting policies and valuation methods (DataStream International does not adjust for valuation differences). DataStream International's normal policy is to analyse consolidated accounts. If consolidated accounts are not available, parent accounts are used. Interim accounts data are not as a rule used. If the interim data are used, this is noted in the definition of the item (see Appendix A.6).

The characteristics chosen for this thesis cover some of the characteristics previously found to have a relation with stock returns, but this is by no means a constraint or requirement.

If a firm lacked data on a style characteristic in a particular month, it is excluded from the data set for that month for that style characteristic's test in Chapters Six and Nine. Together with the fact that some companies were not listed throughout the period, the number of observations for each characteristic in each month does not total 367. Appendix A.7 shows the number of observations for each characteristic in July 1994, the first month of the examined sample. This month contains the fewest number of observations for returns and characteristics data. Appendix A.8 shows the average number of observations for each characteristic for each month over the entire sample. Both appendices are sorted in ascending order of number of observations. Appendix A.2 shows the number of observations for each characteristic in the sample for the first month (July) of each twelve-month period.

As mentioned earlier, DataStream International only updates information once it becomes known to the public. The study is thus free from look-ahead bias. The attribute data set used in this study holds more than 4.85 million data points, which

makes it the most comprehensive collection of financial ratios, line items, and technical indicators yet assembled for an Australian asset-pricing study.

Two of the included factors need special mention. The size effect is tested using the market value of the companies. Given the non-normal distribution of company size across the market (there are a few large firms and many small firms as shown in Appendix A.4), the natural log of market value has been used. It should be noted though that the analyses in Chapters Six and Nine do not require the attribute data to be normally distributed.

The factor of earnings growth causes problems when the earnings are negative and later turn positive, as this yields a negative figure of percentage change in earnings when in fact the growth in earnings is positive. The issue is dealt with through the inclusion of a new factor – change in earnings expressed over price, where the numerator is simply the difference in earnings.

4.2.4. Adjustments to the firm-specific attribute data

Deakin (1976) examines eleven financial ratios over the period 1954 to 1972 and finds that none of them are normally distributed even after applying a logarithm to the data. So (1987) reports that outliers are responsible for the non-normality in the distribution of financial ratios. Frecka and Hopwood (1983) suggest removing outliers completely from the population while Foster (1986) lists several approaches such as deleting true outliers, winsorising outliers to less extreme values, and trimming the tails of the distribution. Fama and French (1992) trim the tails of the data points of the attribute data set by setting the largest and smallest half-percent of the data points in each month to the values of the 99.5th and 0.5th percentiles respectively. While distributional normality is not required for the tests in this thesis, the attribute outliers still need to be dealt with as they may represent extremely abnormal events or may simply be erroneous.

A similar winsorisation method to that used on the returns data is performed for the attribute data set, except that here the monthly mean and standard deviation across the

shares is calculated using the attribute data and performed for each attribute. Also, the attributes are not subject to the 100% limitation. The winsorisation procedure successfully “clips” the extreme outliers from the attribute data set such that the number of observations is not reduced.

4.2.5. Descriptive statistics

The averages of the monthly cross-sectional mean, median, and standard deviation of the attributes are reported in Table 4.3, and are calculated using the list of 367 stocks from July 1994 to May 2004 after conducting the winsorisation procedure discussed previously. Also included are the maximum and minimum of the monthly cross-sectional means. This set of descriptive statistics may not be the most effective way to represent the data set, but the sheer size of the set places constraints on the way the data can be meaningfully characterised.

For almost all characteristics, the median value is lower (in magnitude) than the mean, thus providing evidence of a skewness in the data towards the right. Only twelve of the 207 characteristics display a left skewness (again judged on magnitudes), with the natural log of Price (LNP) being one of the twelve. Three of these characteristics are crossover indicators and four are changes in operating-profit-margin-to-price. As noted earlier, this skewness is not of concern as the tests of the attributes in Chapters Six and Nine do not require the attribute data to be normally distributed.

Table 4.3. Descriptive Statistics of the Firm-specific Attributes

The table displays the averages of the monthly cross-sectional mean, median, and standard deviation of the firm-specific attributes of the ASX All Ordinaries Index constituent shares as at 31 May 2004. Also included are the minimum and maximum of the monthly cross-sectional means. The statistics are calculated after conducting a winsorisation procedure to exclude outliers. The sample excludes preference shares and shares with no monthly total returns data, and has been filtered to exclude shares that had turnover ratios of less than 0.01% in more than 60% of the months they were listed. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Characteristic	Mean of Monthly Means	Mean of Monthly Medians	Mean of Monthly Standard Deviations	Maximum Monthly Mean	Minimum Monthly Mean
EPS	0.20	0.12	0.28	0.25	0.18
EPS_6M	0.18	0.01	1.60	0.88	-0.02
EPS_1YR	0.34	0.04	2.38	1.37	0.02
EPS_2YR	0.61	0.10	3.63	1.76	0.10
DY	3.84	3.40	8.30	5.80	2.84
DY_6M	0.10	0.01	0.77	1.20	-0.11
DY_1YR	0.16	0.02	1.00	1.52	-0.11
DY_2YR	0.20	0.01	1.08	0.58	-0.17
LNMV	5.55	5.40	1.88	6.08	5.15
LNMV_1M	0.00	0.00	0.06	0.09	-0.03
LNMV_3M	0.01	0.00	0.10	0.07	-0.04
LNMV_6M	0.02	0.01	0.17	0.09	-0.02
LNMV_1YR	0.05	0.02	0.28	0.22	-0.03
LNMV_2YR	0.10	0.04	0.47	0.22	-0.02
MTBV	2.40	1.54	3.50	3.56	1.39
MTBV_6M	0.14	0.02	1.11	0.78	-0.12
MTBV_1YR	0.24	0.03	1.55	0.80	-0.24
MTBV_2YR	0.37	0.05	2.31	2.12	-0.05
BTMV	0.77	0.65	0.81	1.06	0.52
BTMV_6M	0.08	-0.01	0.88	0.49	-0.20
BTMV_1YR	0.15	-0.02	1.44	0.70	-0.27
BTMV_2YR	0.18	-0.04	1.64	1.16	-0.23
EY	0.06	0.06	0.10	0.09	0.05
EY_6M	0.16	-0.01	1.62	0.95	-0.14
EY_1YR	0.28	-0.02	2.26	1.38	-0.13
EY_2YR	0.39	-0.04	3.12	1.76	-0.21
P	3.59	2.06	5.04	5.36	2.53
P_1M	0.01	0.00	0.14	0.11	-0.11
P_3M	0.04	0.02	0.29	0.25	-0.11
P_6M	0.10	0.03	0.53	0.38	-0.14
P_1YR	0.21	0.06	1.02	0.70	-0.16
P_2YR	0.52	0.14	2.49	1.39	0.07
LNP	0.64	0.72	1.18	0.88	0.42
LNP_1M	-0.02	0.00	1.16	0.25	-0.51
LNP_3M	-0.03	0.01	1.98	0.37	-0.59
LNP_6M	-0.03	0.01	2.68	0.68	-0.64
LNP_1YR	-0.04	0.01	4.17	1.34	-1.39
LNP_2YR	-0.08	0.02	5.87	1.55	-2.33
RETEN	49.64	42.92	32.51	55.15	43.93
RETEN_1YR	0.32	0.00	3.23	1.48	-0.09
RETEN_2YR	1.44	-0.02	20.30	10.92	-0.09
CFTP	0.09	0.09	0.37	0.15	-0.02
CFTP_6M	0.00	-0.02	5.94	1.11	-1.41
CFTP_1YR	-0.07	-0.05	9.90	1.24	-1.37
CFTP_2YR	-1.67	-0.08	27.02	1.35	-19.55
BORROW	93.71	42.47	462.11	239.34	56.91
BORROW_6M	0.87	0.00	8.73	8.52	-0.05
BORROW_1YR	1.79	-0.02	15.84	9.32	0.32
BORROW_2YR	3.91	-0.02	32.15	13.67	0.50
GEAR	30.14	29.33	30.84	35.47	27.22
GEAR_6M	0.43	0.00	5.16	4.08	-0.71
GEAR_1YR	0.88	-0.01	9.20	4.48	-0.46
GEAR_2YR	1.87	-0.01	16.54	5.71	0.27
ROEPUB	12.08	11.12	49.42	20.72	3.56
ROEPUB_6M	0.85	0.00	20.46	17.05	-2.07
ROEPUB_1YR	1.81	-0.02	39.76	17.86	-2.07
ROEPUB_2YR	0.15	-0.07	7.83	2.28	-1.67
WC	3.11	1.40	10.64	5.29	1.80

Table 4.3. Descriptive Statistics of the Firm-specific Attributes
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Characteristic	Mean of Monthly Means	Mean of Monthly Medians	Mean of Monthly Standard Deviations	Maximum Monthly Mean	Minimum Monthly Mean
WC_6M	0.21	0.00	2.18	1.15	-0.02
WC_1YR	0.41	0.01	3.64	1.65	0.01
WC_2YR	0.71	0.00	6.66	3.08	0.04
VO	15075.57	3256.80	36455.01	28079.73	6725.33
MVTRADE	80151.11	5468.60	265385.00	145490.93	28075.21
MVTRADE_1M	0.70	0.01	4.41	7.84	-0.33
MVTRADE_3M	0.98	0.05	5.50	5.58	-0.12
MVTRADE_6M	1.47	0.10	8.72	7.97	-0.19
MVTRADE_1YR	2.73	0.22	17.32	30.73	-0.43
MVTRADE_2YR	11.98	0.52	120.63	223.58	0.45
MVTRADEMV	37.69	26.06	59.03	99.06	16.59
MVTRADEMV_1M	0.63	0.00	4.10	8.06	-0.31
MVTRADEMV_3M	0.73	0.01	3.84	5.20	-0.18
MVTRADEMV_6M	0.87	0.03	4.75	3.56	-0.14
MVTRADEMV_1YR	1.34	0.06	8.94	16.63	-0.33
MVTRADEMV_2YR	1.95	0.15	12.86	12.87	0.09
TV	0.00	0.00	0.00	0.01	0.00
TV_1M	0.59	0.01	3.80	10.50	-0.20
TV_3M	0.66	0.02	3.29	7.13	-0.13
TV_6M	0.76	0.04	3.63	3.15	-0.29
TV_1YR	1.26	0.08	7.63	10.88	-0.37
TV_2YR	1.76	0.19	10.79	15.37	0.14
AV6M_TV	0.00	0.00	0.00	0.00	0.00
QUICK	2.64	0.94	10.69	4.83	1.26
QUICK_6M	0.24	0.00	2.31	1.15	-0.03
QUICK_1YR	0.48	0.00	3.91	1.50	0.01
QUICK_2YR	0.83	0.01	7.52	3.01	0.15
NS	375903.20	143844.76	818981.60	440770.16	334529.43
CEPS	0.36	0.24	0.57	0.48	0.28
CEPS_6M	-0.16	0.00	4.64	0.81	-2.20
CEPS_1YR	-0.31	0.04	7.97	0.86	-2.35
CEPS_2YR	-0.54	0.09	12.95	1.06	-3.00
INTANMV	166.13	20.33	411.66	265.96	111.49
INTANMV_6M	4.09	-0.03	40.85	24.95	-0.17
INTANMV_1YR	6.33	-0.04	53.34	26.26	-0.17
INTANMV_2YR	12.83	-0.02	104.20	204.28	0.17
NPMTTP	-139.63	2.17	1687.81	31.32	-1179.04
NPMTTP_6M	1.93	-0.05	37.94	53.78	-0.82
NPMTTP_1YR	5.62	-0.10	108.06	102.80	-1.27
NPMTTP_2YR	-0.40	-0.20	17.98	5.50	-4.64
OPMTP	-117.37	3.03	1320.39	9.59	-770.92
OPMTP_6M	0.00	-0.05	3.99	1.56	-0.71
OPMTP_1YR	0.00	-0.11	8.25	2.53	-1.59
OPMTP_2YR	0.10	-0.18	22.82	17.50	-7.91
CFMTP	-79.89	4.23	1042.71	32.43	-587.13
CFMTP_6M	0.01	-0.04	5.09	1.84	-1.52
CFMTP_1YR	-0.02	-0.08	9.20	2.19	-2.11
CFMTP_2YR	-2.02	-0.16	33.40	2.97	-23.91
DIV	62297.65	8784.82	209862.00	78469.56	43221.72
DIV_6M	0.97	0.04	12.72	9.12	0.02
DIV_1YR	1.97	0.15	25.11	9.99	0.25
DIV_2YR	2.94	0.33	25.06	16.89	0.57
DPS	0.13	0.07	0.32	0.20	0.10
DPS_6M	0.12	0.00	0.82	1.74	-0.01
DPS_1YR	0.20	0.04	1.00	1.74	0.03
DPS_2YR	0.32	0.13	1.03	0.66	0.14
BVPS	1.99	1.40	2.01	2.24	1.83
BVPS_6M	0.06	0.01	0.47	0.19	0.00
BVPS_1YR	0.12	0.05	0.69	0.22	0.06
BVPS_2YR	0.29	0.11	1.47	0.69	0.12
CF	210547.70	29417.99	689881.26	268910.69	171462.24
CF_6M	-0.02	0.01	6.46	1.62	-1.80
CF_1YR	-0.06	0.10	11.81	2.12	-1.93
CF_2YR	-1.34	0.20	23.04	3.47	-13.76
TDTTA	0.21	0.20	0.18	0.22	0.19
TDTTA_6M	2.14	0.00	22.45	33.52	-0.04
TDTTA_1YR	4.34	-0.01	43.79	34.09	0.20
TDTTA_2YR	30.73	-0.01	315.39	259.51	0.48
TLTTA	0.16	0.14	0.15	0.18	0.15
TLTTA_6M	2.13	0.00	25.64	18.05	-0.04
TLTTA_1YR	4.31	-0.02	48.11	20.70	0.18
TLTTA_2YR	5.91	-0.01	55.95	26.47	0.38
CFTTL	10.87	0.44	80.91	31.00	1.51
CFTTL_6M	0.49	0.00	18.62	14.01	-7.11
CFTTL_1YR	0.12	-0.02	44.23	21.02	-82.08

Table 4.3. Descriptive Statistics of the Firm-specific Attributes
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Characteristic	Mean of Monthly Means	Mean of Monthly Medians	Mean of Monthly Standard Deviations	Maximum Monthly Mean	Minimum Monthly Mean
CFTTL_2YR	-0.93	-0.08	48.39	15.82	-10.35
CFTTD	63.88	0.37	608.59	336.93	1.28
CFTTD_6M	-0.07	0.00	7.51	2.72	-3.23
CFTTD_1YR	-0.24	-0.02	14.34	5.36	-8.59
CFTTD_2YR	-1.77	-0.08	39.84	9.41	-241.20
ROCE	9.46	8.56	27.48	14.87	3.43
ROCE_6M	-0.02	0.00	6.75	3.05	-2.38
ROCE_1YR	-0.04	-0.03	12.62	3.17	-2.53
ROCE_2YR	0.26	-0.08	8.10	1.47	-1.37
ECANDRES	988290.50	189018.30	2652293.51	1160082.56	863567.05
ECANDRES_6M	0.18	0.02	1.57	0.96	0.01
ECANDRES_1YR	0.36	0.09	2.47	0.99	0.06
ECANDRES_2YR	0.78	0.20	4.37	1.90	0.27
ICBT	226.78	4.43	3060.66	871.51	-1.81
ICBT_1YR	1.26	-0.04	22.98	6.97	-0.76
ICBT_2YR	4.02	-0.10	44.59	22.50	-2.86
CFTBORRREP	249.62	2.46	2122.11	706.63	30.06
CFTBORRREP_6M	12.89	0.00	131.29	88.73	-2.65
CFTBORRREP_1YR	26.72	-0.05	247.20	101.38	-0.56
CFTBORRREP_2YR	28.57	-0.08	629.54	1275.47	-223.67
CFTBORRREPDIV	6.25	1.33	98.22	29.88	-38.15
CFTBORRREPDIV_6M	1.76	-0.01	28.84	26.11	-3.93
CFTBORRREPDIV_1YR	3.83	-0.08	57.18	30.71	-3.99
CFTBORRREPDIV_2YR	-6.58	-0.12	242.39	1084.24	-197.71
GROW	363.12	341.56	4409.88	1323.64	-450.94
GROW_6M	1.05	0.00	21.53	17.89	-1.86
GROW_1YR	2.25	-0.07	42.82	19.38	-2.21
GROW_2YR	1.75	-0.20	31.10	29.63	-2.22
MOM_1M	0.02	0.01	0.14	0.11	-0.11
MOM_3M	0.06	0.03	0.30	0.26	-0.10
MOM_6M	0.12	0.06	0.55	0.42	-0.12
MOM_12M	0.27	0.11	1.10	0.75	-0.13
MOM_18M	0.46	0.17	2.09	1.86	-0.06
MOM_24M	0.66	0.26	2.82	1.50	0.15
CROSS1_MOM1M	-0.81	-0.98	15.27	12.85	-10.32
CROSS3_MOM1M	-0.83	-0.95	12.29	7.68	-8.92
CROSS1_MOM3M	-0.52	-0.30	12.85	2.29	-11.56
CROSS3_MOM12M	-0.31	-0.19	17.25	6.05	-18.26
CROSS6_MOM12M	-0.39	-0.42	20.16	6.85	-12.54
CROSS1_MOM18M	0.05	-0.03	6.34	5.91	-5.43
CROSS3_MOM18M	0.23	-0.11	13.71	14.50	-6.81
OBOS_3MMA	0.01	0.00	0.08	0.08	-0.07
OBOS_6MMA	0.02	0.01	0.15	0.13	-0.10
INV_6M_CH	0.22	0.01	1.55	1.03	-0.03
INV_1YR_CH	0.45	0.06	2.76	1.11	0.06
INV_2YR_CH	1.02	0.14	5.45	2.74	0.27
ACCREC_6M_CH	3.49	0.02	38.91	28.61	-0.01
ACCREC_1YR_CH	7.00	0.12	73.66	32.99	0.13
ACCREC_2YR_CH	15.85	0.25	144.53	66.04	0.33
CHSALE_LES_CHIN	1.66	0.02	25.23	10.03	-0.89
CHSALE_LES_CHACRE	-1.14	0.00	50.40	8.83	-21.89
SALESTP	1.41	0.65	2.50	2.12	0.92
SALESTP_6M	0.90	0.00	11.78	7.87	-0.35
SALESTP_1YR	1.78	0.01	22.32	10.37	-0.49
SALESTP_2YR	4.67	-0.01	51.31	28.55	-0.15
EPS_2YRAV	0.20	0.13	0.26	0.24	0.17
EPS_2YRAV_6M	0.15	0.02	1.07	0.61	-0.01
EPS_2YRAV_1YR	0.25	0.07	1.35	0.70	0.01
EPS_2YRAV_2YR	0.63	0.15	3.01	1.90	0.11
SALEPEMPLY	487.47	276.81	988.83	796.17	255.32
SALEPEMPLY_1YR	0.16	0.05	0.76	0.46	0.03
SALEPEMPLY_2YR	0.41	0.10	1.94	1.95	0.04
A_TURN	0.88	0.55	1.16	1.10	0.77
A_TURN_6M	0.86	0.00	11.76	6.89	-0.01
A_TURN_1YR	1.72	0.01	22.92	7.26	0.02
A_TURN_2YR	2.68	0.00	32.59	13.88	0.01
ACCRU	-0.05	-0.03	0.30	0.01	-0.14
ACCRU_6M	-3.57	-0.21	36.62	0.84	-25.45
ACCRU_1YR	-7.60	-0.88	62.06	2.16	-40.54
FOUR_YREARNGROWG	1.93	0.46	11.29	9.28	0.06
FOUR_YREARNGROWA	0.44	0.20	1.31	1.06	0.10
EPSCH_P_6M	0.00	0.00	0.08	0.04	-0.02
EPSCH_P_12M	0.01	0.00	0.12	0.07	-0.02
EPSCH_P_24M	0.02	0.01	0.16	0.07	-0.01

4.3. Summary and conclusion

The chapter introduces the share returns and firm-specific attribute data sets. After preference shares and shares with insufficient returns data were removed from the sample, a unique thin trading filtering procedure is applied to remove shares that are thinly traded (monthly turnover ratio less than 0.01%) in more than 60% of the months they are listed. The adjustment however does not completely remove thin trading and many shares are still thinly traded in numerous months. If shares exhibiting thin trading in any month are removed from the sample entirely, the sample would be reduced to 35 shares, severely reducing the value of the results of the empirical tests. The unique filtering procedure attempts to partially satisfy both sample size and liquidity requirements and results in the sample being reduced by almost a quarter.

Both returns and attributes data sets are windsorised to deal with outliers and share returns are further limited to 100%. There is evidence of a right skewness in the data for all the attributes, but this is however not an issue for the cross-sectional methodology employed in Chapters Six and Nine.

Given that the starting point of company selection was the ASX All Ordinaries constituents at the end of the period, the author recognises that the study is subject to survivorship bias.

The firm-specific attribute data set is the largest ever assembled for an Australian study in asset pricing.

Exploratory Analysis and Market Risk Decomposition

5.1. Introduction

There are two main objectives of the exploratory tests. First, they provide an overall view of the Australian stock market factor structure and give an indication of how the shares cluster together. Second, if the market displays evidence of a multifactor structure, the analysis will aid in the construction of an APT model to be used for risk adjustment in Chapter Six.

As noted in Chapter Two, the construction of APT models depends on empirical work. McElroy and Burmeister (1988) criticised factor analytic techniques by stating that they give rise to unknown random factors that have no straightforward economic interpretations. van Rensburg and Slaney (1997) work around this problem by including subindexes in the rotation and then using the subindexes with high loadings on the factors as proxies for those factors.

While a multifactor market can also be modelled using a multisecurity market line (SML) approach, van Rensburg and Slaney (1997) argue that a multifactor index model such as their two-factor APT is more appropriate than multiple single factor models. In the context of a two-factor Industrials-Resources model, they state, "First, the more general two index model captures all the benefits (in terms of explanatory power) of the two SML approach. Second, the two SML may produce misleading results for those conglomerates with both mining and industrial operations....Third, the two index approach is similarly much easier to apply to investment portfolios that comprise shares from both the mining and industrial sectors. Fourth, the two index APT model enjoys a less controversial theoretical motivation than the mean-variance inefficient market proxies employed in the two SML approach." Their industrials-resources-based advice can be extended to the more general multifactor models.

This chapter follows the methodology of van Rensburg and Slaney (1997) and constructs the APT model using principle components analysis and subsequent rotation procedures on the subindexes. The tests are used to identify subindexes that are suitable proxies for these factors.

The CAPM and APT models are ultimately statements about ex ante (expected) returns. In practice, however, only ex post (realised) returns are directly observable. When moving from expected to realised returns, the Single- and Multi-index models need to be employed. As such, the chapter then aims to compare the ability of the Single-index model to explain the time-series variation in share returns to that of a Multi-index model which makes use of the derived APT model's factor proxies as explanatory variables.

The remainder of the chapter is set out as follows: Section 5.2 discusses the data and methodologies employed, Section 5.3 reports the results, and Section 5.4 summarises and concludes.

5.2. Data and Methodology

5.2.1. Exploratory analysis

The cluster and factor analyses are performed on the monthly total returns of various sector and subsector indexes of the ASX. The ASX uses the Global Industry Classification Standard (GICSSM) developed by Standard & Poor's (S&P) and Morgan Stanley Capital International (MSCI) in 1999. However, the related S&P/ASX sector and subsector indexes only have data from March 2000 onwards. As a slightly longer sample period is preferred, the analysis is performed on the DataStream International ASX Indexes¹⁶ over the period 1 January 1999 to 31

¹⁶ DataStream International uses six levels of indexes for share classification. The first five are those of the FTSE Actuaries classification structure. The sixth level is a DataStream International customized

December 2003 thus resulting in a total of 60 monthly returns for each index. Total returns are used, which comprise both dividend yield and capital gains on each sector's constituent shares. As share indexes are used, the problem of thinly traded shares is avoided.

All the data were obtained from DataStream International. Appendix B.1 displays the share indexes used, and Appendices B.2 and B.3 illustrate the FTSE Actuaries hierarchical classifications of the indexes.

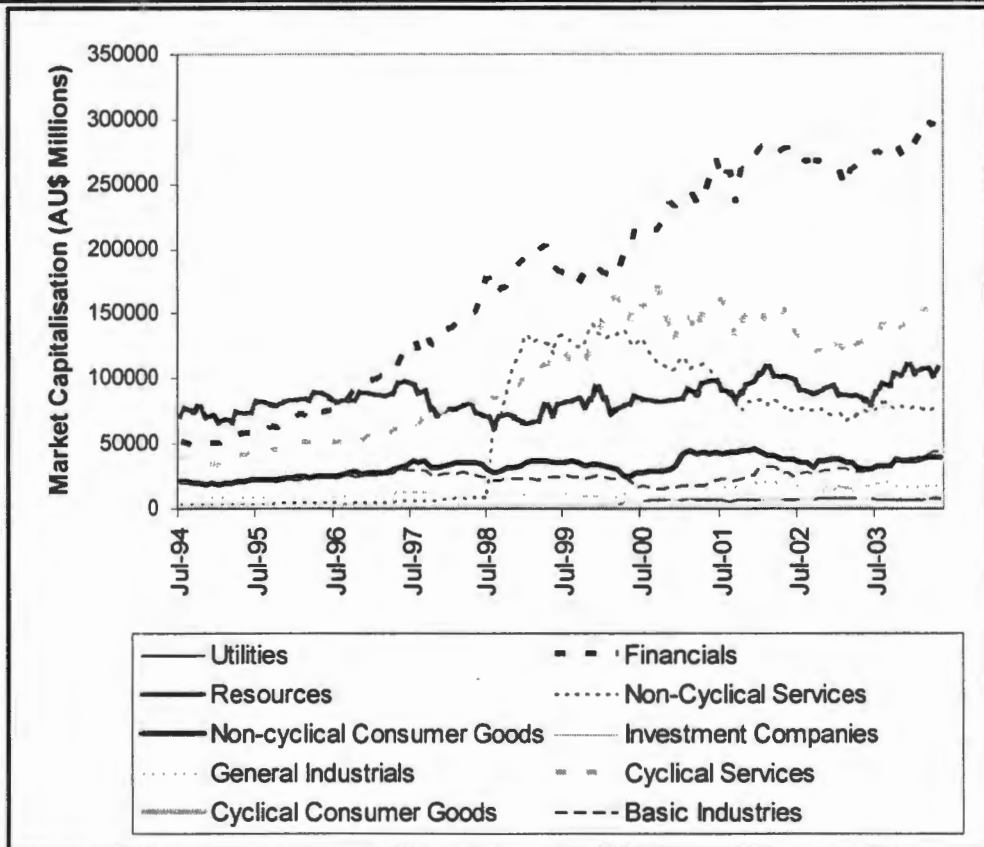
According to Cheng (1995), "...in factor analysis, observations with missing values for any variable in the analysis have to be omitted from the computations, because calculation of correlations requires simultaneous observations". Due to insufficient data, four indexes are removed from the sample, namely: (1) Forestry and Paper; (2) Insurance Brokers; (3) Paper; and (4) Property Agency. Thus, only 77 DataStream International ASX Indexes are analysed. The ASX All Ordinaries Index as well as the S&P200 and S&P300 Indexes are also included in the analysis.

The total market capitalisation values for the nine subindexes computed using the data set of 367 companies are displayed in Figure 4.2 in Chapter Four. This can be contrast with Figure 5.1 below, which shows the total market capitalisation values for the actual nine subindexes over the period 1 July 1994 to 31 May 2004.

Both the actual market and the sample of 367 companies are dominated by Financials companies, with Resources, Cyclical Services and Non-Cyclical Services also standing out but to a lesser extent. The similarity between the graphs indicates that the sample of 367 companies appears to represent the market well in terms of relative market value between the subindexes as well as in the way these indexes have changed over the ten-year period.

Figure 5.1. Size of the Nine Level-Three DataStream International Indexes

Market capitalisations of level-three DataStream International ASX subindexes over the period July 1994 to May 2004. The data were extracted from DataStream International.



A comparison between the market capitalisation of the S&P/ASX 300 Industrials and the S&P/ASX 300 Resources (both indexes were calculated by DataStream International) over the period January 1974 to January 2004 is shown in Figure 5.2 below.

The graph reveals that Industrials have gradually come to dominate Resources, so much so that for the last five years the market capitalisation of Industrials is more than four times greater than that of Resources. Figure 5.3 indicates that this was not a result of a decline in Resources but rather an “explosion” of Industrials.

Figure 5.2. Ratio of the Market Capitalisations of the Resources and Industrials Sectors

Market capitalisations of the S&P/ASX 300 Industrials and S&P/ASX 300 Resources indexes expressed as a percentage of their combined value over the period January 1974 to January 2004 using monthly intervals. The data were extracted from DataStream International. The indexes used are calculated by DataStream International.

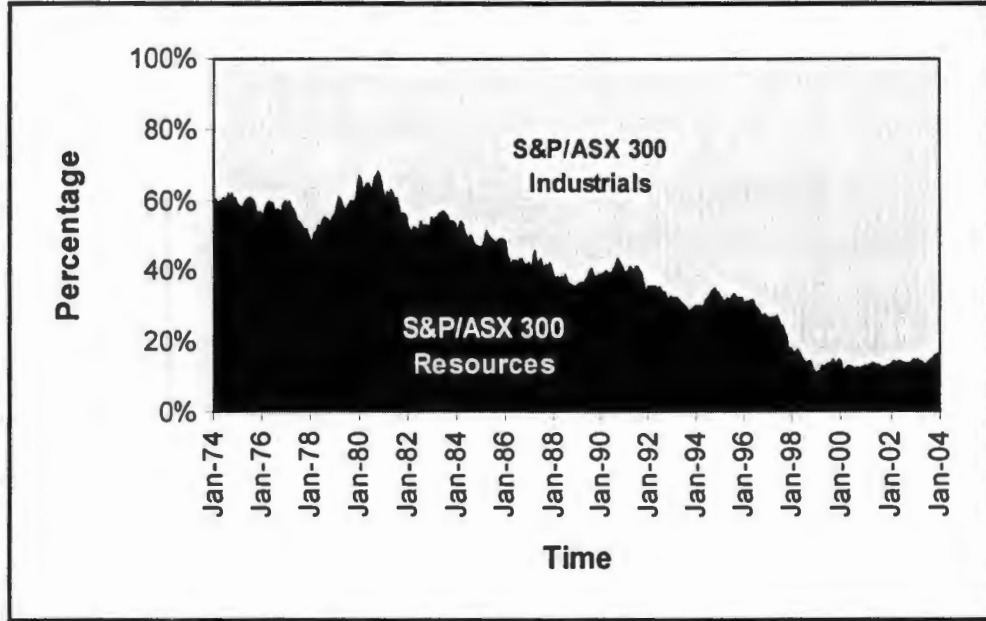
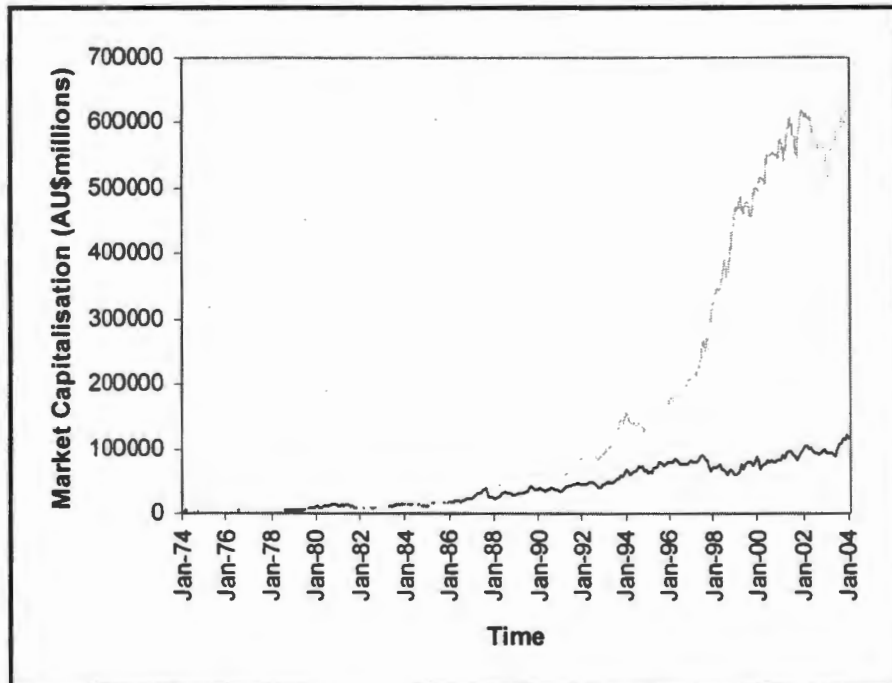


Figure 5.3. Market Capitalisations of the Resources and Industrials Sectors

Market capitalisations of the S&P/ASX 300 Industrials and S&P/ASX 300 Resources indexes over the period January 1974 to January 2004 using monthly intervals. The data were extracted from DataStream International. The indexes used are calculated by DataStream International.



Faff's (2001b) indication that the Australian market is characterised by the substantial influences of the resources and equally strong industrial sectors may therefore no longer apply. Rather, the market appears to be dominated by industrials at present.

5.2.1.1. Cluster analysis

The first preliminary test involves a cluster analysis methodology, which groups data in such a way that variables assigned to the same cluster present similarities while variables in separate clusters exhibit significant differences. An agglomerative hierarchical clustering algorithm is used to compute dissimilarities between clusters based on Euclidean distance (Statsoft Inc. Electronic Textbook). The complete linkage (furthest neighbour) rule is used in the cluster analysis. The Statsoft Inc. Electronic Textbook notes, "In this method, the distances between clusters are determined by the greatest distance between any two objects in the different clusters (i.e. by the 'furthest neighbours')".

The process starts with as many clusters as there are share indexes, and the two share indexes with the highest correlation are grouped together to form a "cluster". At each successive iteration the two clusters that are most closely related are merged together. A vertical tree diagram is used to depict the results of the cluster analysis and shows the clustering of the share indexes. After visual inspection, an arbitrary horizontal cut-off line is used to determine the number of clusters extracted and the constituents of the clusters.

The Statsoft Inc. Electronic Textbook notes cluster analysis is "not as much a typical statistical test as it is a 'collection' of different algorithms that 'put objects into clusters'". Thus the number of clusters extracted need not match the number of factors extracted from factor analytic procedures despite the ability to do so given the subjective cut-off line used for the cluster analysis.

5.2.1.2. Principal components analysis

The second preliminary test involves a principal components methodology. The defining characteristic between principal components analysis and principal factor analysis is that the former assumes that all variability in an item should be used in the

analysis, while the latter only uses the variability in an item that is common to the other items (Statsoft Inc. Electronic Textbook). The methods yield similar results in most cases.

Multicollinearity and singularity are issues that arise when the correlations between the variables are high. Multicollinearity is when variables are highly correlated, and singularity is when the variables are perfectly correlated. Multicollinearity and singularity expose the redundancy of variables and the need to remove variables from the analysis. A correlation matrix of the indexes is thus assessed before conducting the principal components analysis. The correlation statistic used is the Pearson (1896) product moment correlation statistic (referred to as “correlation” for the remainder of the chapter) and is calculated as:

$$r_{j,k} = \frac{\sum_{t=1}^n (j_t - \bar{j})(k_t - \bar{k})}{\sqrt{\sum_{t=1}^n (j_t - \bar{j})^2 \sum_{t=1}^n (k_t - \bar{k})^2}} \quad (5.1)$$

where j_t and k_t are the total monthly returns for the indexes in month t for any two indexes, \bar{j} and \bar{k} are the mean monthly returns of those indexes, and n is the number of months. Where two indexes are highly (or even perfectly) correlated with each other, the index lower down in the hierarchical classification is excluded. Where two variables are on the same level, an arbitrary decision is made in choosing the one to be excluded.

The eigenvalues for each factor are then cumulatively plotted on a graph. A scree test is performed to determine the number of factors extracted. The idea is that factors are extracted to the point where the extraction of an additional factor does not significantly increase the total variation in the model. Van Rensburg and Slaney (1997) refer to two possible cut-off points: the factor at which the scree plot first starts to flatten out (Hair, Anderson, Tathom, and Black, 1999); or the factor before the scree plot flattens out (Cattell and Jaspars, 1967). Van Rensburg and Slaney (1997) point out that the factor extraction decision is essentially a trade-off between the

increased parsimony offered by a smaller number of factors and the increased explanatory power that results as more factors are extracted. A third cut-off point often used extracts all factors with eigenvalues greater than 1.00.

The correlation between a variable and an individual factor is known as a loading, and the variables are assigned to the factor they load most heavily upon. The variables can be plotted on a set of axes representing the factors. The axes are then rotated to ensure the variables are assigned to one and only one factor. Each factor thus represents a group of shares that behave similarly.

Orthogonal rotation rotates the axes in such a way so that the axes are maintained at 90 degrees thus enforcing that the factors remain uncorrelated throughout the rotation process. However, oblique rotation allows for the rotation of the axes such that the 90-degree angle does not have to be maintained. Hair, Anderson, Tathom, and Black (1999) note that the oblique rotation method represents the clustering of variables more accurately and that this accuracy is a result of the fact that each rotated factor axis is closer to the respective group of variables than if the 90-degree rule of orthogonal rotation was applied.

Two methods are used to rotate the variables, namely varimax (normalised) rotation, which is an orthogonal rotation, and promax rotation, which is an oblique rotation. The promax rotation is performed using the “R” statistical software package.¹⁷

Faff (1988) emphasises the importance of nonstationarity: “The longer the total period analysed, the less likely it is that the underlying economic parameters will remain constant. Other things equal, statistical tests will be more powerful over shorter periods with finer intervals. While no precise optimal figure can be stated, a rule of thumb of five years is sometimes quoted in the literature.” The length of the period used for the exploratory analysis is in accordance with this rule of thumb.

¹⁷ The R-statistical software package is open source software created by the not-for-profit “R Foundation” which was founded by members of the R Development Core Team. The package is available at the Comprehensive R Archive Network (CRAN) website: <http://cran.r-project.org/>

5.2.1.3. Construction of an APT model

The methodology of van Rensburg and Slaney (1997) is employed to construct the APT model and as such the subindexes loading highly on the factors extracted from the principle components analysis and subsequent rotation procedures are used as proxies for the APT factors.

5.2.2. Testing the Single- and Multi-index models

The monthly total returns data over the period 1 June 1994 to 30 June 2004 were obtained for 365 companies from DataStream International. The filtering procedures used are discussed in Chapter Four. As previously mentioned, the returns are not adjusted for outliers nor limited to 100% for this chapter.

The regressions performed also require data for a market proxy, factor proxies, and the risk-free rate. The S&P/ASX 100 is primarily a large capitalisation index, while the S&P/ASX 200 index is recognised as the “investable” benchmark. The S&P/ASX 300 provides additional depth, and as it is subject to strict liquidity guidelines it does not necessarily contain 300 companies. The All Ordinaries index, Australia’s market indicator, represents the 500 largest companies on the ASX regardless of liquidity (www.standardandpoors.com).

As at 30 June 2002, the S&P/ASX 200 represented 90% of the total market capitalisation of the Australian market. The S&P/ASX 300 and ASX All Ordinaries indexes represented 91% and 99% respectively (Australian Stock Exchange Website). Although there is only a small difference in terms of market capitalisation between the S&P/ASX 200 and the S&P/ASX 300, the latter is used as the market proxy in this study. The risk-free rate of return is proxied by the Australian 90-day dealer’s bill rate. The market proxy and risk-free rate data were also obtained from DataStream International.

The first level of tests deals with how well the models explain variation in share returns. For the Single-index model, each share’s time series of excess monthly returns are regressed against the excess market return using Ordinary Least Squares (OLS) regressions. The regression equation used is thus:

$$(r_{i,t} - r_{f,t}) = \alpha_i + \beta_i(r_{m,t} - r_{f,t}) + \varepsilon_{i,t} \quad (5.2)$$

where:

- $r_{i,t}$ = realised return on share i for month t
- α_i = constant intercept term
- β_i = slope coefficient estimated from the regression
- $r_{m,t}$ = realised return on the market for month t
- $r_{f,t}$ = risk-free rate for month t
- $\varepsilon_{i,t}$ = residual error

If a share was not listed or returns data not available for part of the ten-year period, a regression equation is still estimated using the returns data that are available.

Each regression yields an R^2 , an R^2 -adjusted, a p-value statistic, and a time-series of residuals.

A similar procedure is used for the Multi-index model. The company regressions take the form:

$$(r_{i,t} - r_{f,t}) = \alpha_i + \beta_{factor1,t}(r_{factor1,t} - r_{f,t}) + \beta_{factor2,t}(r_{factor2,t} - r_{f,t}) + \dots + \beta_{factorK,t}(r_{factorK,t} - r_{f,t}) + \varepsilon_{i,t} \quad (5.3)$$

The $r_{i,t}$ and $r_{f,t}$ terms again represent realised share return for share i and the risk-free rate respectively. The $r_{factor,t}$ terms are the returns for the K factors over the period t .

The Multi-index model uses the factor proxies of the derived APT model as explanatory variables. The Australian 90-day dealer's bill rate is again used as a proxy for the risk-free rate. The $\beta_{factor,t}$ terms indicate the relationship between the variation of share return and that of the factor's (index's) return.

Again, each regression yields an R^2 , an R^2 -adjusted and a p-value statistic, and a time-series of residuals.

The second level of tests basically follows the same procedure as above, but uses the other models' residuals from the level one regressions as the dependent variable in place of the shares' returns. Thus the Multi-index model's residuals are regressed on the explanatory variable of the Single-index model, and the Single-index model's residuals are regressed on the explanatory variables of the Multi-index model. This tests the ability of a model to explain the variation in share returns not explained by the competing model.

Yet again, each regression yields an R^2 , an R^2 -adjusted, a p-value statistic, and a time-series of residuals.

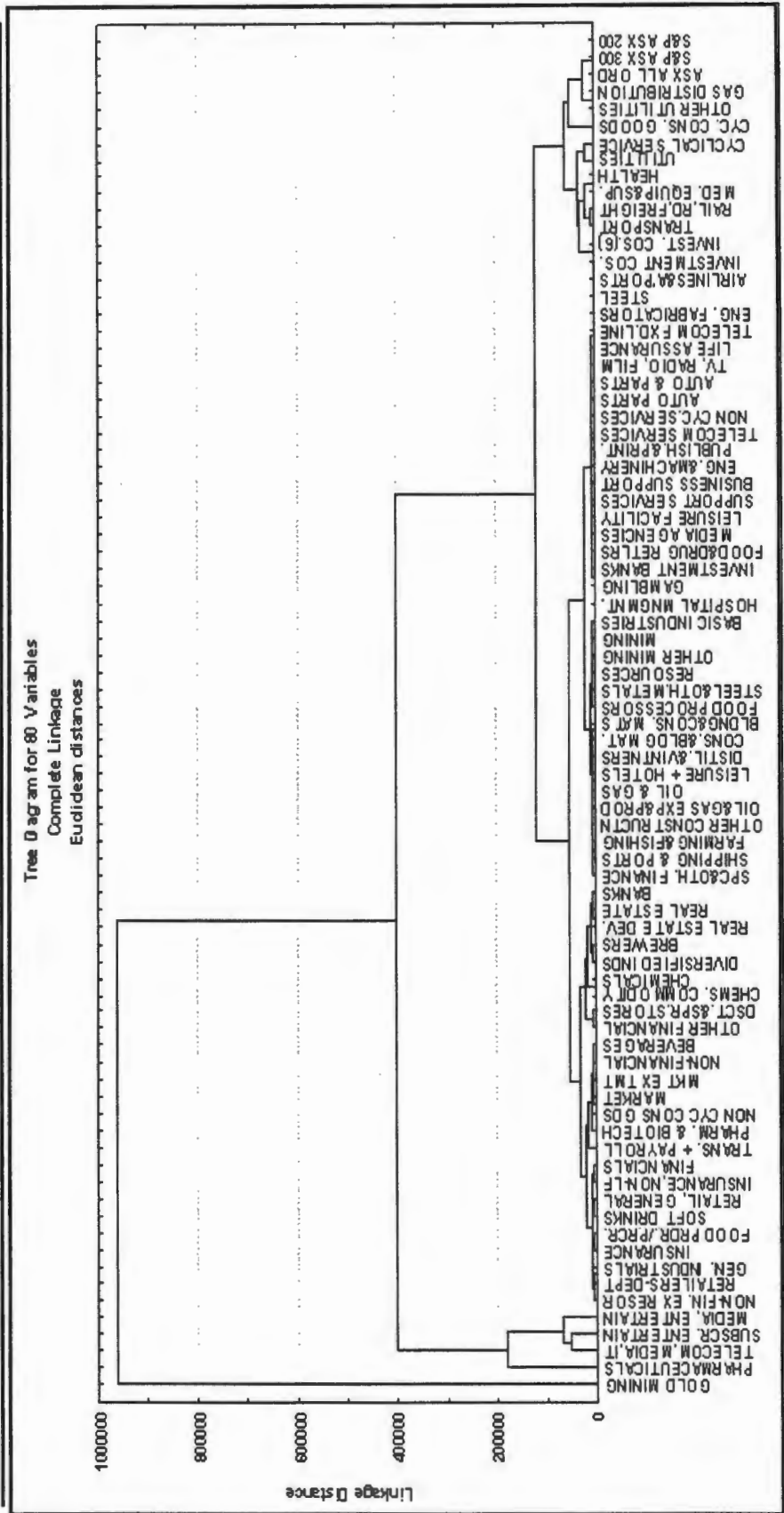
5.3. Results

5.3.1. Cluster analysis

The results of the cluster analysis are illustrated in Figure 5.4. The row labels on the left of the diagram represent the linkage distance between share indexes or clusters. The smaller the linkage distance the more "similar" the share indexes/clusters are in nature. The formation of clusters is seen by starting at the bottom of the figure and slowly moving upwards. From the diagram, there appears to be three to five clusters.

Figure 5.4. Vertical Tree Diagram of Cluster Analysis Results

Vertical tree diagram showing the hierarchical cluster analysis of total monthly returns of 77 Australian Stock Exchange (ASX) sector and subsector indexes over the period 1 January 1999 to 31 December 2003. Also included are the ASX All Ordinary Index, and the S&P300 and S&P200 indexes of Standard and Poor's. The data concerning the sector and subsector indexes were extracted from DataStream International. Four indexes are excluded from the analysis due to insufficient data. Clusters are extracted based on the complete linkage distance between the sector and subsector indexes. The smaller the linkage distance, the more "similar" the indexes/clusters are in nature. Refer to Appendix B.1 for the full names of the indexes.



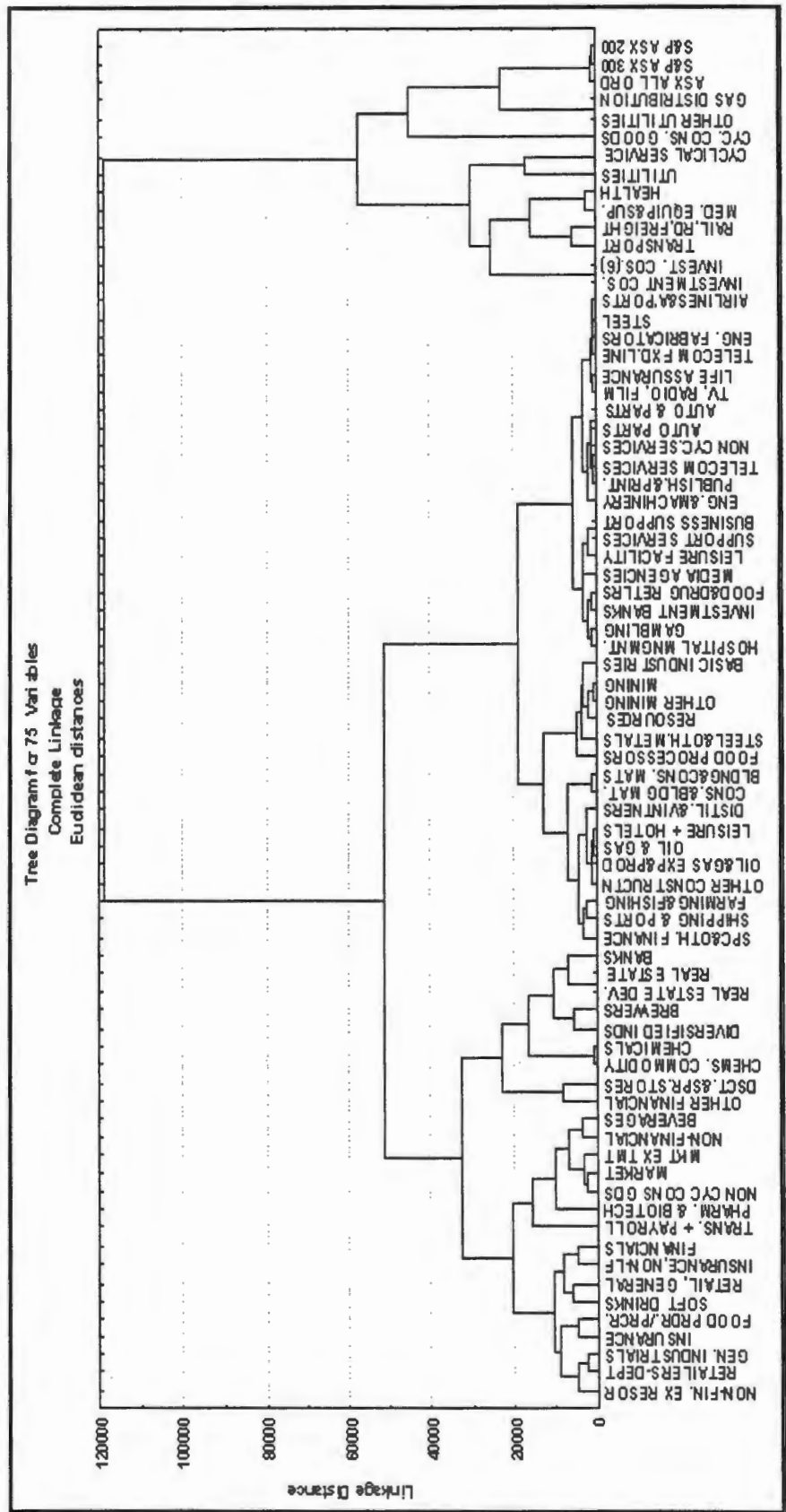
Given the large linkage distances between the Gold Mining, Pharmaceuticals, Telecom Media IT, Subscr. Entertain and Media Entertain indexes and the other clusters, these five indexes were removed from the tree so the other clusters could be more clearly displayed. This adjusted tree diagram is displayed in Figure 5.5. Appendices B.4, B.5, and B.6 give the breakdowns of the cluster constituents for three, four, and five clusters.

From the five-cluster breakdown, the first three clusters can basically be described as Gold Mining, Pharmaceuticals, and Entertainment clusters respectively. Cluster 5 contains Utilities, Cyclical, Transport, Investment, Health, and market indexes. As not all of these relationships are easily explainable, it is difficult to describe this cluster. Lastly, the nature of Cluster 4 is even harder to characterise as it contains indexes from virtually all the level three classifications. It however contains all the Industrials indexes. The late clustering of the Gold Mining index with Cluster 4 may be an indication of the aforementioned dichotomy.

Another finding from the cluster analysis is that while the ASX All Ordinaries, S&P ASX 300 and S&P 200 Indexes display similarity, the DataStream International market index surprisingly clusters far from these three indexes. The S&P indexes select shares based on liquidity and thus represent the most liquid shares on the Australian equity market. Their constituents are reviewed on a quarterly basis. The DataStream International market index constituents are primarily determined by market value and availability of data. Here, liquidity is ignored and the list of constituents is updated on an annual basis. This may explain why the DataStream International market index clusters far away from the S&P/ASX indexes. However, the clustering of the ASX All Ordinaries index with the S&P indexes is puzzling as the ASX All Ordinaries index follows a similar construction to the DataStream International market index in the sense that it is based on market capitalisation and disregards liquidity.

Figure 5.5. Vertical Tree Diagram of Cluster Analysis Results (Adjusted*)

Vertical tree diagram showing the hierarchical cluster analysis of total monthly returns of 77 Australian Stock Exchange (ASX) sector and subsector indexes over the period 1 January 1999 to 31 December 2003. Also included are the ASX All Ordinary Index, and the S&P300 and S&P200 indexes of Standard and Poor's. The data concerning the sector and subsector indexes were extracted from DataStream International. Four indexes are excluded from the analysis due to insufficient data. Clusters are extracted based on the complete linkage distance between the individual sector and subsector indexes. The smaller the linkage distance, the more "similar" the indexes/clusters are in nature. * Gold Mining, Pharmaceuticals, Telecom Media II, Subscr. Entertain, and Media Entertain Indexes are excluded to display the other clusters more clearly. Refer to Appendix B.1 for the full names of the indexes.



5.3.2. Principal components analysis

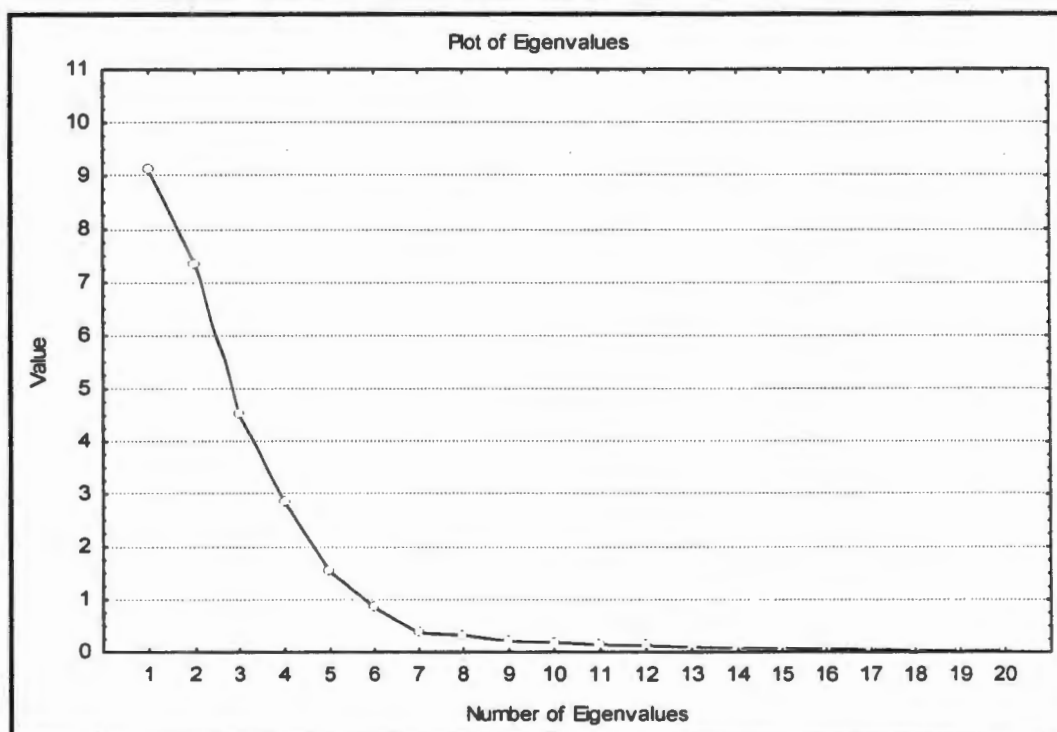
In order to deal with multicollinearity and singularity, a correlation matrix displaying correlations between the total monthly returns of the indexes is examined. Where two indexes show correlation of greater than 0.875 (or less than -0.875) with each other, the index lower down in the hierarchical classification (see Appendices B.1 and B.2) is removed. If two indexes are on the same level, an arbitrary decision is made as to which one is removed.

The correlation matrix is displayed in Appendix B.7. Correlations greater than 0.875 (less than -0.875) are displayed in white with a black background. The assessment leads to the exclusion of 51 indexes thus leaving 29 indexes.

Principal components analysis is performed and the resulting plot of eigenvalues is displayed in Figure 5.6.

Figure 5.6. Scree Plot of Eigenvalues

Eigenvalues of the first 20 factors derived from principal components analysis on the total monthly returns of 29 Australian Stock Exchange (ASX) sector and subsector indexes over the period 1 January 1999 to 31 December 2003. The data were extracted from DataStream International. Of the 80 DataStream International and three Standard and Poor's indexes extracted, four are excluded due to insufficient data and 51 are excluded due to multicollinearity and singularity. Six factors can be extracted using the cut-off rule of Cattell and Jaspars (1967), but only five factors have eigenvalues greater than 1.00.



As the plot starts to flatten out at the seventh factor, six factors can be extracted using the cut-off point suggested by Cattell and Jaspars (1967). However, only five factors have eigenvalues greater than 1.00. Table 5.1 displays the percentage variation explained by the first five factors. The five factors together explain just over 90% of the common variation of the sample.

Table 5.1. Eigenvalues and Percentage Variation Explained by the First Five Factors

Eigenvalues and percentage variation attributed by the first five factors extracted using principal components analysis on the total monthly returns of 29 Australian Stock Exchange (ASX) sector and subsector indexes over the period 1 January 1999 to 31 December 2003. The data were extracted from DataStream International. Of the 80 DataStream International and three Standard and Poor's indexes extracted, four are excluded due to insufficient data and 51 are excluded due to multicollinearity and singularity.

Factor	Eigenvalue	% Total	Cumulative Eigenvalues	Cumulative %
1	9.109738	32.53478	9.10974	32.53478
2	7.333865	26.19237	16.44360	58.72715
3	4.509571	16.10561	20.95317	74.83276
4	2.838114	10.13612	23.79129	84.96888
5	1.527928	5.45688	25.31922	90.42577

The factor loadings after varimax rotation using five factors are displayed in Appendix B.8. Appendix B.9 shows the decomposition of significantly loaded indexes into five factors.

The nature of the factors (based on the factor constituents) is described in Table 5.2 below, along with the index with the highest loading for each factor.

The five-factor varimax rotation has in part confirmed the existence of the aforementioned Resources-Industrials dichotomy (Wood, 1991; Faff, Brooks, and Tan, 1999; Faff, 2001a; Faff, 2001b; Faff, 2004), except that here it manifests itself as a Resources-Financials dichotomy. The first factor is predominantly a mining factor, while the second is a financials (and noncyclical consumer goods) factor. The dichotomy therefore only appears to be over from a market capitalisation perspective and not from a pricing perspective. The economy is not strictly a dichotomy, though, as the factor analysis also identifies three other lesser factors that still play a fair part in explaining the variation in index monthly returns. The nature of the factors closely

resembles the nature of the clusters extracted from the cluster analysis in Section 5.3.1.

Table 5.2. Varimax-rotated Factor Descriptions

The table below shows the results of principal components analysis on the total monthly returns of 29 Australian Stock Exchange (ASX) sector and subsector indexes over the period 1 January 1999 to 31 December 2003. The data were extracted from DataStream International. Of the 80 DataStream International and three Standard and Poor's indexes extracted, four are excluded due to insufficient data and 51 are excluded due to multicollinearity and singularity. Five-factor varimax rotations are used and the index with the highest loading displayed for each factor. All indexes listed above had at least a loading of 0.700 on their respective factor. Factor descriptions are based on the indexes that are significantly (loading greater than 0.700) loaded on the factors. Refer to Appendix B.1 for the full names of the indexes.

	FACTOR DESCRIPTION	INDEX WITH HIGHEST LOADING
FACTOR 1	Mining and Resources	STEEL&OTH.METALS
FACTOR 2	Financials and Non-cyclical consumer goods	PHARM. & BIOTECH
FACTOR 3	Non-financial, Entertainment and Cyclical Services	NON-FINANCIAL
FACTOR 4	General Industrials and Retailers	GEN. INDUSTRIALS
FACTOR 5	Utilities	UTILITIES

The factor loadings after promax rotation using five factors are displayed in Appendix B.10, and Appendix B.11 shows the decomposition of significantly loaded indexes into five factors. It is clear that both the varimax and promax rotations produce virtually the same results for this market as the nature of the promax-rotated factors is the same as that of the varimax-rotated factors and the indexes with the highest loadings on the factors are exactly same for both rotations.

5.3.3. Construction of an APT model

A five-factor APT model can be constructed following the methodology of van Rensburg and Slaney (1997). As the factor proxies used are the indexes with the highest loadings on the factors, the model uses the following indexes as proxies: (1) Steel & Other Metals; (2) Pharmaceuticals and Biotechnology; (3) Non-financial; (4)

General Industrials; and (5) Utilities. The factor proxies of this APT model have economic identity and are directly observable.

5.3.4. Testing the Single- and Multi-index models

The explanatory variables used for the Multi-index model are the factors proxies of the derived APT model.

Table 5.3 displays the averages (across the companies) of the R^2 , R^2 -adjusted, and p-values from each set of regressions at each level. Also included is the number of regressions that are significant at the 5% level ($p < 0.05$) as a percentage of the total number of regressions in the set.

Table 5.3. Explanatory Power of the Single- and Multi-index Models

The table displays the averages (across the companies) of the R^2 , R^2 -adjusted and p-values from time-series regressions. The first set of regressions regresses the excess monthly returns data of the companies on excess returns of the Single-index model's market proxy (S&P300 Index) and the proxies of a five-index model (Steel & Other Metals; Pharmaceuticals and Biotechnology; Non-financial; General Industrials; and Utilities). The second set of regressions regresses the residuals from the first set of regressions on the excess returns of the alternative model's proxies. The 90-day dealer's bill rate is used as the risk-free rate. Also included is the number of regressions that are significant at the 5% level ($p < 0.05$) as a percentage of the total number of regressions in the set.

Regression	Mean R2	Mean R2adj	Mean p-value of regression	Percentage of Regressions significant at 5% level
Single-index Model	9.93%	8.33%	0.1373	60%
Multi-index residuals on Single-index Model	0.70%	-1.06%	0.6380	2%
Multi-index Model	18.12%	10.17%	0.1674	26%
Single-index residuals on Multi-index Model	10.14%	1.32%	0.3111	4%

The Multi-index model has the highest mean R^2 figure for the level one tests. The R^2 -adjusted figure adjusts for the degrees of freedom lost when more explanatory variables are used. However, the Multi-index model still explains more variation in individual share returns than the Single-index model. The Multi-index model has a higher R^2 -adjusted than the Single-index model for 221 of the 365 companies tested.

The table shows that neither model explains the variation in share returns very well, with the higher average R^2 -adjusted (Multi-index model) being only 10.17%. The poor results of the Single-index model is in contrast to the early study of Ball, Brown, and Officer (1976) who find that the model “describes the data quite well....”

The level two regressions indicate whether a model is able to explain variation in share returns after another model has already attempted to do so. Here, the Multi-index model shows only slight explanatory power for the variation in returns not explained by the Single-index model, while the Single-index model is unable to explain additional variation (a negative R^2 -adjusted occurs with poorly fitting models).

While the level one regressions (and to a much lesser extent level two) display evidence that appears to be support for the Multi-index model, only a few of its level one regressions were found to be significant at the 5% level (26%) as opposed to 60% of the Single-index model's regressions, and both the Single- and Multi-index models yield a fairly large mean p-value ($p > 0.1$).

5.4. Summary and conclusion

This chapter investigates the overall structure of the Australian market using monthly total returns data of the DataStream International share indexes and subindexes over the period 1 January 1999 to 31 December 2003. A comparison between the final sample of 367 companies and the actual market for sectoral representation reveals that the sample represents the market well in terms of relative market value between the subindexes as well as in the way these indexes have changed over the examined period.

A cluster analysis methodology is first employed and the indexes divided into five clusters. The identity of the first three clusters is easily identifiable and can basically be described as Gold Mining, Pharmaceuticals, and Entertainment clusters

respectively. The fourth and fifth clusters are difficult to describe given the wide variety of their constituents. The fourth cluster contains indexes from virtually all the FTSE level three classifications and contains all the Industrials indexes. Some of the indexes of the fifth cluster include the Utilities, Cyclical, Investment, and market indexes.

Principal components analysis results in six factors being extracted using the extraction rule of Cattell and Jaspars (1967). However, only five of these factors display eigenvalues greater than 1.00. This is clear evidence that the market displays evidence of a multifactor structure as predicted by Faff and Mittoo (1999), Wood (1991), and Faff (2004). The five factors together explain just over 90% of the common variation of the sample. Varimax and promax rotations are performed using five factors. The way the indexes with significant loadings loaded onto the factors is virtually identical for both rotations, and the nature of the factors (as determined by their constituents) resembles the identity of the five extracted clusters.

The chapter then undertakes to assess and compare the ability of the Single-index model to explain the time-series variation in share returns to that of a Multi-index model which makes use of the derived APT model's factor proxies as explanatory variables. The average (across the companies) R^2 -adjusted statistics are calculated for each model, and while the Multi-index model displays a higher average R^2 -adjusted as well as higher R^2 -adjusted values for more companies than the Single-index model, 60% of the Single-index model's regressions are significant at the 5% level as opposed to 26% of the Multi-index model's. Nevertheless, both models are found to have poor explanatory power in describing the time-series return generating process.

The residuals of the Single-index model are also regressed on the Multi-index model (and the Multi-index model's residuals regressed on the Single-index model) in order to test if the models can explain variation that the other model is unable to explain. The Multi-index model shows only slight explanatory value, while the Single-index model displays a negative R^2 -adjusted indicating that it has no ability to explain the Multi-index model's residuals.

It should be noted that even if the p-values were small and thus the regressions significant, the low R^2 -adjusted figures imply that the factors used in the models only explain a small part of the variation in share returns. Given the joint-hypothesis problem, this may be evidence of either market inefficiency or a misspecification of the model explaining the return generating process. Further, it may even be a result of the use of incorrect proxies.

The CAPM was built in part from the theory laid down by Markowitz (1952; 1959) and as such requires the use of a “market portfolio” that consists of all risky assets. In execution, however, it is the convention to use an *equity* market index representative of the whole *equity* market, and such an index was employed as the market proxy for the Single-index model tests in this study. It may be that such convention is in fact problematic, as it does not adhere to the all-encompassing nature of the Markowitz market portfolio. Further, the subindexes chosen to proxy the factors may in fact still be poor proxies (but the best out of the subindexes included in the analysis).

The comparison of the models yields mixed results. In the style characteristics tests that follow, the characteristics tests will therefore be run for both CAPM risk-adjusted returns and APT risk-adjusted returns.

Univariate Cross-sectional Style Analysis

6.1. Introduction

The international and Australian literature discussed in Chapter Three finds numerous firm-specific attributes able to explain the variation in share returns even after CAPM-based risk adjustment. Most of the Australian studies however investigate isolated attributes, and no exhaustive cross-sectional analysis of a broad set of attribute data has yet been conducted for this market. Further, while Chapter Three presents some compelling arguments for a multifactor asset-pricing model for the Australian market, not much evidence is available on the behaviour of the anomalous characteristics after a multifactor asset-pricing model is used for risk adjustment.

The aim of the univariate cross-sectional analysis is to uncover the identity of the ASX style-based factors that are able to explain share variation before and after adjustment for systematic risk. The methodology used basically follows that of Fama and Macbeth (1973) where the pooled time-series regression coefficients and t-statistics for the characteristics are assessed. Cluster analysis and correlation matrices are used to simplify the list of significant characteristics, and the consistency in the direction of the characteristics' monthly payoffs is assessed. The remainder of the chapter is set out as follows: Section 6.2 discusses the data and methodology, Section 6.3 reports the results, and Section 6.4 summarises and concludes.

6.2. Data and methodology

The monthly returns and attribute data were obtained from DataStream International and were sorted and manipulated as described in Chapter Four, leaving 367

companies for the sample period 1 July 1994 to 30 May 2004. The cross-sectional distribution of each style characteristic in each month is standardised to yield a mean of zero and a standard deviation of one. This procedure allows for comparison between the magnitudes of the slopes derived from the cross-sectional regressions that follow. The effect of the standardising procedure on the results is discussed in Appendix C.1. For each of the 207 attributes, the value of the attribute is taken to be the exposure of the stock to the attribute.

To adjust the returns for CAPM and APT risk, a market proxy, factor proxies, and risk-free rate data are needed. This chapter makes use of the same data used in Chapter Five and thus uses the S&P/ASX 300 as the market proxy, the indexes determined in Chapter Five as the factor proxies, and the Australian 90-day dealer's bill rate as the risk-free rate of return.

The methodology used for the main analysis basically follows that used by van Rensburg and Robertson (2003). All the regressions performed are Ordinary Least Squares (OLS) regressions.

6.2.1. Unadjusted returns

The first test examines the individual significance of the listed style characteristics using returns not adjusted for risk. Each characteristic is tested using a univariate cross-sectional OLS regression similar to that of Fama and MacBeth (1973). The regression takes the following form:

$$r_{i,t+1} = \gamma_{0,t+1} + \gamma_{1,t+1}A_t + \varepsilon_{i,t+1} \quad (6.1)$$

where:

$r_{i,t+1}$ = realised return on share i for month $t + 1$

$\gamma_{0,t+1}$ = constant intercept term

$\gamma_{1,t+1}$ = cross-sectional slope coefficient estimated from the regression

A_t = standardised value of the attribute of the share at end of each month t

$\varepsilon_{i,t+1}$ = residual error

Thus the characteristics as at the beginning of a month are regressed against the shares' returns earned over that month. The regression is repeated for every characteristic in each month, giving rise to a time-series of slopes representing the "reward" to each characteristic in each month. The mean value of every characteristic's time-series of slope coefficients is then subjected to Student's (1908) t-test (referred to as "t-test" for the remainder of the chapter) to identify those significantly different from zero. The t-statistic is calculated as:

$$t_1 = \frac{\bar{y}_1 - 0}{\sigma_{y_1} / \sqrt{n}} \quad (6.2)$$

6.2.2. Risk-adjusted returns: CAPM

The second test examines whether the attributes can explain the variation of share returns beyond that already explained by the CAPM's market beta. The share returns data undergo a CAPM-based risk adjustment, conducted before allowing style attributes to explain returns so as to be conservative in the direction of the adjustment's bias.

Using the CAPM, realised returns can be broken down into the following formula:

$$r_{i,t} = r_{f,t} + \beta_i(r_{m,t} - r_{f,t}) + U_{i,t} \quad (6.3)$$

Here $r_{i,t}$ and $r_{m,t}$ are the respective realised returns on share i and the market for month t . The $r_{f,t}$ term represents the risk-free rate and β_i shows the magnitude of the relationship between the variation of returns for share i and the variation of returns of the market portfolio. The $U_{i,t}$ term is supposed to represent a random error term. However, in contradiction to the CAPM, part of this error may be caused by a pervasive effect resulting in a constant intercept term shown below as α_i . The equation has also been rearranged to show excess share return on the left hand side:

$$(r_{i,t} - r_{f,t}) = \alpha_i + \beta_i(r_{m,t} - r_{f,t}) + \varepsilon_{i,t} \quad (6.4)$$

Now $\varepsilon_{i,t}$ represents the random error term. The portion of return that is either above or below the return predicted by the CAPM thus consists of the constant α_i and the random error term $\varepsilon_{i,t}$. As we are now using excess returns as the dependent variable, the estimated intercept term is no longer $(r_{f,t} + \alpha_i)$ but simply α_i .

Using the S&P/ASX 300 and the Australian 90-day dealer's bill rate as proxies for $r_{m,t}$ and $r_{f,t}$ respectively, the excess share return $(r_{i,t} - r_{f,t})$ is regressed (time-series) on the excess market return $(r_{m,t} - r_{f,t})$ for each share over the period 1 June 1994 to 30 June 2004. The resulting intercept term (α_i) for each share is then added to the monthly error term for each share ($\varepsilon_{i,t}$) thus giving a data set of monthly CAPM risk-adjusted returns for all shares.

The CAPM risk-adjusted return is thus calculated as:

$$(\alpha_i + \varepsilon_{i,t}) = (r_{i,t} - r_{f,t}) - \beta_i(r_{m,t} - r_{f,t}) \quad (6.5)$$

Here $(\alpha_i + \varepsilon_{i,t})$ represents the total return for share i in month t that is not explained by the CAPM.

The univariate cross-sectional regressions from the first test are now rerun using $(\alpha_i + \varepsilon_{i,t+1})$ as the dependant variable in place of $r_{i,t+1}$. These regressions are of the form:

$$(\alpha_i + \varepsilon_{i,t+1}) = \gamma_{0,t+1} + \gamma_{1,t+1}A_t + e_{i,t+1} \quad (6.6)$$

While $\varepsilon_{i,t+1}$ was previously estimated from the time-series regressions, $e_{i,t+1}$ is the residual error in this regression. The means of the resulting time-series of slope

coefficients are again tested for significance and the significant characteristics used in the multifactor tests.

6.2.3. Risk-adjusted returns: APT

The third test examines whether the attributes still have explanatory power after using the APT for risk adjustment. As with the CAPM adjustment, a time-series regression for each share is run over the period 1 June 1994 to 30 June 2004 and takes the form:

$$(r_{i,t} - r_{f,t}) = \alpha_i + \beta_{factor1,i}(r_{factor1,t} - r_{f,t}) + \beta_{factor2,i}(r_{factor2,t} - r_{f,t}) + \dots + \beta_{factor5,i}(r_{factor5,t} - r_{f,t}) + \varepsilon_{i,t} \quad (6.7)$$

The $r_{i,t}$ and $r_{f,t}$ terms again represent realised share return for share i and the risk-free rate respectively. The $r_{factor,t}$ terms are the return for Factors 1 to 5 over the period t . As discussed earlier, the Steel & Other Metals, Pharmaceuticals and Biotechnology, Non-financial, General Industrials, and Utilities indexes are used as factor proxies. The Australian 90-day dealer's bill rate is again used as a proxy for the risk-free rate. The $\beta_{factor,i}$ terms indicate the relationship between the variation of share return and that of the factor's (index's) return.

As in the second test, the error term $\varepsilon_{i,t}$ is added to the α_i term to get a data set of monthly APT risk-adjusted returns for all shares, where the APT risk-adjusted return is calculated as:

$$(\alpha_i + \varepsilon_{i,t}) = (r_{i,t} - r_{f,t}) - \beta_{factor1,i}(r_{factor1,t} - r_{f,t}) - \beta_{factor2,i}(r_{factor2,t} - r_{f,t}) - \dots - \beta_{factor5,i}(r_{factor5,t} - r_{f,t}) \quad (6.8)$$

The univariate cross-sectional regressions from the first test are then rerun using the APT test's $(\alpha_i + \varepsilon_{i,t+1})$ as the dependant variable in place of $r_{i,t+1}$. This cross-sectional regression of the APT risk-adjusted share returns on beginning period individual attribute values can be restated as:

$$(\alpha_i + \varepsilon_{i,t+1}) = \gamma_{0,t+1} + \gamma_{1,t+1}A_t + e_{i,t+1} \quad (6.9)$$

Again, $\varepsilon_{i,t+1}$ is estimated from the time-series regressions, while $e_{i,t+1}$ is the residual error in this regression. The means of the resulting time-series of slope coefficients are again tested for significance.

As the CAPM and APT betas are derived from the data set that the style tests are performed on, the CAPM and APT risk-adjusted tests are less likely to reveal style effects. This results in the tests being biased against identifying significant characteristics and thus strengthens the importance of any significant characteristics found.

6.2.4. Comparison between unadjusted and risk-adjusted results

The t-statistics for the slopes of the characteristics derived using unadjusted returns are visually compared to those derived using the CAPM- and APT-risk adjusted returns.

Further, the monthly payoffs of the significant characteristics are clustered (complete linkage), thus enabling division of the list of significant characteristics into clusters or groups. The nature of the clusters is then compared between the unadjusted and risk adjusted results.

6.2.5. Simplification of significant characteristics list

The full list of characteristics tested is meant to be a comprehensive list thus naturally resulting in similarity between various characteristics. This makes interpretation of the results a rather daunting task. The results can however be somewhat simplified through the use of cluster analysis and correlation matrix examination.

The extraction of clusters serves as the first level of division. The process of cluster analysis indicates whether a characteristic is similar to another by clustering them together. However, this is only in the context of the other characteristics included in

the analysis. This may give rise to a situation where a characteristic clusters with another not because they are very similar, but rather because of the characteristic's dissimilarity with the other characteristics in the analysis.

A correlation matrix of the monthly payoffs of the characteristics provides a truer picture of the relationships within the clusters. So, after the cluster analysis reveals the broad categories, an examination of correlation matrices for each of the clusters is required. The correlation statistic used is the Pearson (1896) product moment correlation statistic described in Chapter Five Section 5.2.1.2 Equation 5.1, except that here j_t and k_t are the payoffs for any two characteristics in month t , \bar{j} and \bar{k} are the mean payoffs to those characteristics, and n is the number of months. This statistic is referred to as "correlation" for the remainder of the chapter.

Starting with the highest correlations, where two factors are highly correlated, the one with the lower t-statistic in the cross-sectional style tests (unadjusted returns) is excluded from the list (high correlation is defined as being greater than 0.7 or less than -0.7). If a characteristic "A" has been excluded due to highly correlated characteristic "B" having a higher t-statistic and characteristic "C" is highly correlated with "A" but not "B", then it remains in the list.

Finally, a correlation matrix of the remaining characteristics is assessed to identify high correlations between characteristics from different clusters. Again, the elimination process described above is followed and yields a set of the most significant characteristics that are not highly correlated with each other. Ultimately, the procedure of first separating the characteristics into clusters is not required as the combination of the intra-cluster and inter-cluster correlation assessments amount to applying the correlation assessment methodology to all the significant characteristics before they are divided into clusters. The cluster analysis is however merely used for illustrative purposes.

6.2.6. Style consistency assessment

The consistency of the direction of monthly payoffs to the final set of significant characteristics is assessed using two measures: (1) the ratio of the number of times the payoff is positive (negative); and (2) the number of times the payoff direction changed expressed as a percentage over total number of months.

The ratio of the number of times the payoff is positive (negative) lies between 0% and 100%. Characteristics with a higher consistent direction have ratios close to either 100% or 0%. The significance of the ratio can be assessed using a binomial distribution: the nonparametric Sign Test is used to test the null hypothesis that the payoffs are positive in 50% of the months and are negative in the other 50%. The probability mass function is given by:

$$P(c) = \binom{N}{c} 0.5^c (1-0.5)^{N-c} \quad (6.10)$$

where N is the total number of months and c is the number of positive (negative) payoff months.¹⁸ The null is rejected if the cumulative probability associated with the number of positive (negative) payoffs is greater than $(1-p)$ where p is the level of significance. The interpretation of ratios close to 50% is however a little bit more ambiguous.

The first measure does not consider the number of times the payoff direction changes. A characteristic may have a ratio of 50% as calculated above while having all its negative payoffs over the first half of the sample and all its positive payoffs over the second. To be deemed inconsistent, a characteristic should more accurately have a high number of direction *changes*. The second measure accounts for this fluctuation.

The above two measures do not however consider the magnitude related to the direction changes. A style with monthly payoffs that change direction every month

¹⁸ The statistical combination notation $\binom{N}{c}$ represents $\frac{N!}{c!(N-c)!}$

may consistently have a high magnitude when the payoff is positive and a low magnitude when the payoff is negative. In this situation, the ability to time the direction of the monthly payoff will not be of much benefit. A more accurate picture of the direction-timing benefits is derived from the comparison between the t-statistics calculated as outlined above, and a t-statistic calculated on the assumption that the direction of the monthly payoff can be forecast perfectly. This second t-statistic is calculated as in Equation 6.2, but instead uses the absolute value of the monthly payoffs to each characteristic as the data set.

6.3. Results

6.3.1. Unadjusted and risk-adjusted results

The results of the univariate cross-sectional regressions are displayed in Tables 6.1 to 6.3 below. The average of the time-series slopes of each characteristic is displayed along with the related t-statistic. The tables are ordered in descending order of the absolute values of the t-statistics, and display only those characteristics found to be significant at the 5% level (two tailed). The full set of payoffs and t-statistics can be found in Appendix C.2, where the characteristics are sorted in descending order of the absolute value of the t-statistic relating to the unadjusted returns slopes. Appendix C.3 shows the characteristics' average monthly slopes from the unadjusted returns regressions over each year of the sample, ordered in descending order of absolute overall t-statistic value.

The tables show the identification of numerous significant factors, many of which maintain their significance after risk adjustment. However, not all of the factors showed similar direction and magnitude of payoffs across the risk-adjusted results.

Figures 6.1 to 6.3 show the cluster analysis tree diagrams of the significant factors' monthly payoffs (slopes), clustered using the complete linkage method.

Table 6.1. Significant Attributes: Unadjusted Returns

Univariate cross-sectional regressions of standardised firm-specific attributes on unadjusted total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of regression slope coefficients for each characteristic. The share sample comprises ASX All Ordinary Index constituents as at 31 May 2004, and has been filtered for thin trading, excludes preference shares and shares with insufficient returns data, and has been adjusted for outliers. The data were extracted from DataStream International. The table displays the average monthly coefficient for each attribute that is significant at the 5% level using Student's (1908) t-test. Related t-statistics are also displayed. The attributes are ordered in descending order of the absolute value of the t-statistics. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Characteristic	Average		Characteristic	Average	
	Slope	t-stat		Slope	t-stat
LNP	-0.008	-5.4805	LNMV_1YR	0.0053	3.0386
MOM_12M	0.0086	5.0548	DIV_2YR	-0.0027	-2.902
BVPS	-0.0047	-4.6467	LNMV_3M	0.0055	2.8673
MVTRADEM_1YR	0.0044	4.5636	CFTP	0.0039	2.865
P_1YR	0.0079	4.4603	TV_2YR	0.0029	2.8235
MOM_6M	0.0077	4.4467	MVTRADE_1M	0.0027	2.7317
P_3M	0.0078	4.3553	DPS_6M	0.0033	2.6616
TV_1YR	0.0048	4.2608	EPS_2YRAV	-0.0025	-2.6309
MOM_3M	0.0078	4.182	ACCRU	-0.004	-2.5853
MVTRADE_1YR	0.0047	4.1784	TV_3M	0.0027	2.5599
P_6M	0.0074	4.1562	MTBV_2YR	-0.0038	-2.5593
MVTRADEM_2YR	0.0038	4.1182	ROCE_6M	-0.0036	-2.5567
LNMV	-0.0064	-3.9974	MVTRADEM_3M	0.0019	2.4763
BTMV	0.0057	3.798	EPS	-0.0024	-2.4229
TV_6M	0.0032	3.7417	CFTBORRREPDIV_2YR	0.0027	2.4192
OBOS_6MMA	0.0071	3.6359	TV	0.0036	2.3754
MVTRADE_3M	0.0033	3.5646	MTBV	-0.0031	-2.3677
P	-0.0037	-3.5067	LNMV_2YR	0.0033	2.2226
MOM_18M	0.0053	3.4789	MVTRADE	-0.0015	-2.2102
RETEN_1YR	-0.0022	-3.456	DPS_1YR	0.0015	2.1253
TV_1M	0.0034	3.4001	LNMV_6M	0.0035	2.0872
MVTRADEM_6M	0.003	3.3444	RETEN_2YR	-0.0014	-2.0716
MVTRADE_2YR	0.0041	3.1834	MVTRADEM	0.0033	2.0696
MVTRADE_6M	0.0037	3.0778	MOM_24M	0.0029	2.0266
MVTRADEM_1M	0.0026	3.0522	EPS_6M	0.0017	2.0014
			CFTBORRREPDIV	-0.0033	-1.9885

Table 6.2. Significant Attributes: CAPM Risk Adjusted Returns

Univariate cross-sectional regressions of standardised firm-specific attributes on CAPM risk adjusted total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of regression slope coefficients for each characteristic. The share sample comprises ASX All Ordinary Index constituents as at 31 May 2004, and has been filtered for thin trading, excludes preference shares and shares with insufficient returns data, and has been adjusted for outliers. The data were extracted from DataStream International. The table displays the average monthly coefficient for each attribute that is significant at the 5% level using Student's (1908) t-test. Related t-statistics are also displayed. The attributes are ordered in descending order of the absolute value of the t-statistics. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Characteristic	Average		Characteristic	Average	
	Slope	t-stat		Slope	t-stat
LNP	-0.0078	-5.3722	DIV_2YR	-0.0028	-3.0658
MOM_12M	0.0083	4.7792	MVTRADE_2YR	0.0039	3.0585
MVTRADEM_1YR	0.0046	4.6185	LNMV_3M	0.0057	2.9712
MOM_6M	0.0076	4.384	LNMV_1YR	0.005	2.96
BVPS	-0.0044	-4.3657	MTBV	-0.0036	-2.8788
P_3M	0.0078	4.3346	TV_3M	0.003	2.8639
TV_1YR	0.005	4.3267	MVTRADEM_3M	0.0022	2.8298
BTMV	0.0061	4.2121	CFTP	0.0039	2.8187
P_1YR	0.0075	4.2062	DPS_6M	0.0032	2.6665
MOM_3M	0.0078	4.1955	ROCE_6M	-0.0037	-2.5634
TV_6M	0.0036	4.1182	MVTRADE	-0.0016	-2.517
MVTRADEM_2YR	0.0039	4.0913	ACCRU	-0.0039	-2.5019
P_6M	0.0072	4.0848	MTBV_2YR	-0.0036	-2.4485
LNMV	-0.0064	-4.0295	TV	0.0035	2.3799
MVTRADE_1YR	0.0047	3.9367	EPS_2YRAV	-0.0022	-2.3757
OBOS_6MMA	0.0074	3.895	CFTBORRREPDIV_2YR	0.0025	2.3182
P	-0.0037	-3.5941	DPS_1YR	0.0016	2.317
TV_1M	0.0035	3.5898	OBOS_3MMA	0.004	2.2388
MVTRADEM_6M	0.0032	3.5065	RETEN_2YR	-0.0015	-2.2319
MVTRADEM_1M	0.0029	3.4189	ECANDRES	-0.0016	-2.1795
MVTRADE_3M	0.0034	3.3696	INTANMV_6M	-0.0023	-2.1793
RETEN_1YR	-0.0021	-3.2868	EPS	-0.0021	-2.1679
TV_2YR	0.0032	3.1996	LNMV_6M	0.0035	2.1408
MVTRADE_1M	0.0031	3.1265	SALEPEMPLOY_2YR	0.0029	2.0829
MOM_18M	0.0048	3.1209	EPS_6M	0.0017	2.0332
MVTRADE_6M	0.0039	3.1169	LNMV_2YR	0.0029	1.999

Table 6.3. Significant Attributes: APT Risk-adjusted Returns

Univariate cross-sectional regressions of standardised firm-specific attributes on five-factor APT risk adjusted total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of regression slope coefficients for each characteristic. The share sample comprises ASX All Ordinary Index constituents as at 31 May 2004, and has been filtered for thin trading, excludes preference shares and shares with insufficient returns data, and has been adjusted for outliers. The data were extracted from DataStream International. The table displays the average monthly coefficient for each attribute that is significant at the 5% level using Student's (1908) t-test. Related t-statistics are also displayed. The attributes are ordered in descending order of the absolute value of the t-statistics. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Characteristic	Average Slope	t-stat	Characteristic	Average Slope	t-stat
LNP	-0.0081	-5.5334	MVTRADE_6M	0.0035	2.8213
BVPS	-0.0045	-4.5919	RETEN_1YR	-0.0017	-2.816
MVTRADEM_V_1YR	0.0043	4.4491	P_1YR	0.0051	2.7828
BTMV	0.006	4.2107	ROCE_6M	-0.0038	-2.6561
LNMV	-0.0067	-4.2059	LNMV_3M	0.0052	2.6528
TV_1YR	0.0048	4.1633	MVTRADE	-0.0016	-2.5909
MVTRADEM_V_2YR	0.0037	3.9693	EPS_2YRAV	-0.0023	-2.5617
TV_6M	0.0032	3.7175	MTBV_2YR	-0.0038	-2.4622
P_3M	0.0066	3.667	EPS	-0.0023	-2.4605
MVTRADEM_V_1M	0.003	3.6532	TV_3M	0.0025	2.4486
P	-0.0035	-3.6305	MVTRADE_2YR	0.0028	2.4151
TV_1M	0.0034	3.6069	MVTRADEM_V_3M	0.0017	2.3545
MOM_3M	0.0065	3.5129	DPS_6M	0.0027	2.2648
TV_2YR	0.0034	3.3858	TV	0.0031	2.2435
MVTRADE_1M	0.003	3.3326	CFTP	0.0031	2.2051
MVTRADEM_V_6M	0.0029	3.2742	ECANDRES	-0.0015	-2.1755
MOM_6M	0.0056	3.2224	CFTBORRREPDIV_2YR	0.0024	2.1532
MOM_12M	0.0057	3.1516	MVTRADEM_V	0.0029	2.1229
MVTRADE_1YR	0.0037	3.1202	BTMV_2YR	0.0033	2.1225
P_6M	0.0055	3.1181	SALESTP	0.003	2.1209
OBOS_6MMA	0.0056	3.0956	ACCURU	-0.0032	-2.0678
DIV_2YR	-0.0026	-2.9764	EPS_6M	0.0017	2.0276
MVTRADE_3M	0.0028	2.9401	DPS_1YR	0.0014	2.0237
MTBV	-0.0035	-2.9218	QUICK	0.0032	2.011

Figure 6.1. Tree Diagram of Clusters of Monthly Payoffs: Unadjusted Returns

Vertical tree diagram showing the hierarchical cluster analysis of monthly payoffs to standardised firm-specific attributes as calculated from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. Only attributes displaying an average of monthly coefficients significant at the 5% level in a Student's (1908) t-test are included. The data were extracted from DataStream International. The complete linkage method is used for clustering. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

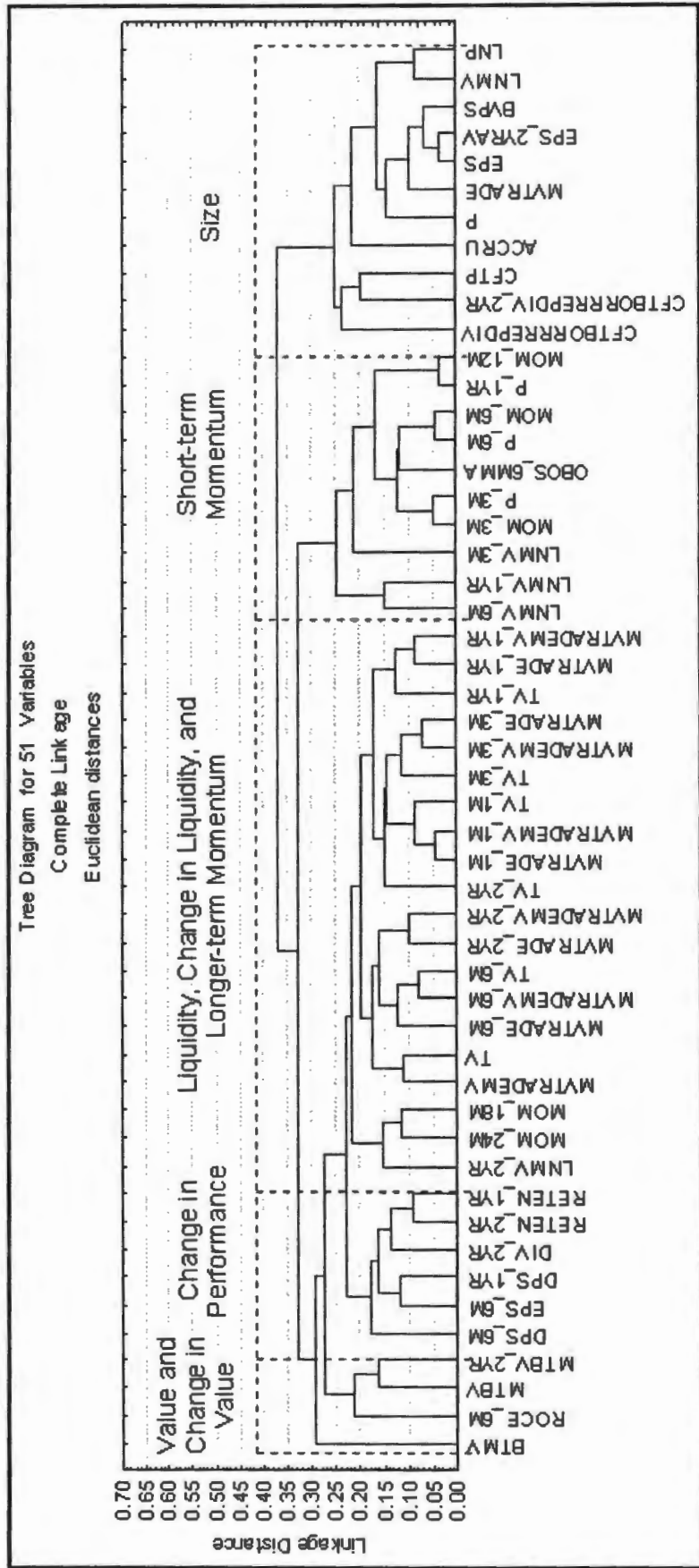


Figure 6.2. Tree Diagram of Clusters of Monthly Payoffs: CAPM Risk Adjusted Returns

Vertical tree diagram showing the hierarchical cluster analysis of monthly payoffs to standardised firm-specific attributes as calculated from univariate cross-sectional regressions on CAPM risk adjusted total monthly returns data over the period July 1994 to May 2004. Only attributes displaying an average of monthly coefficients significant at the 5% level in a Student's (1908) t-test are included. The data were extracted from DataStream International. The complete linkage method is used for clustering. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

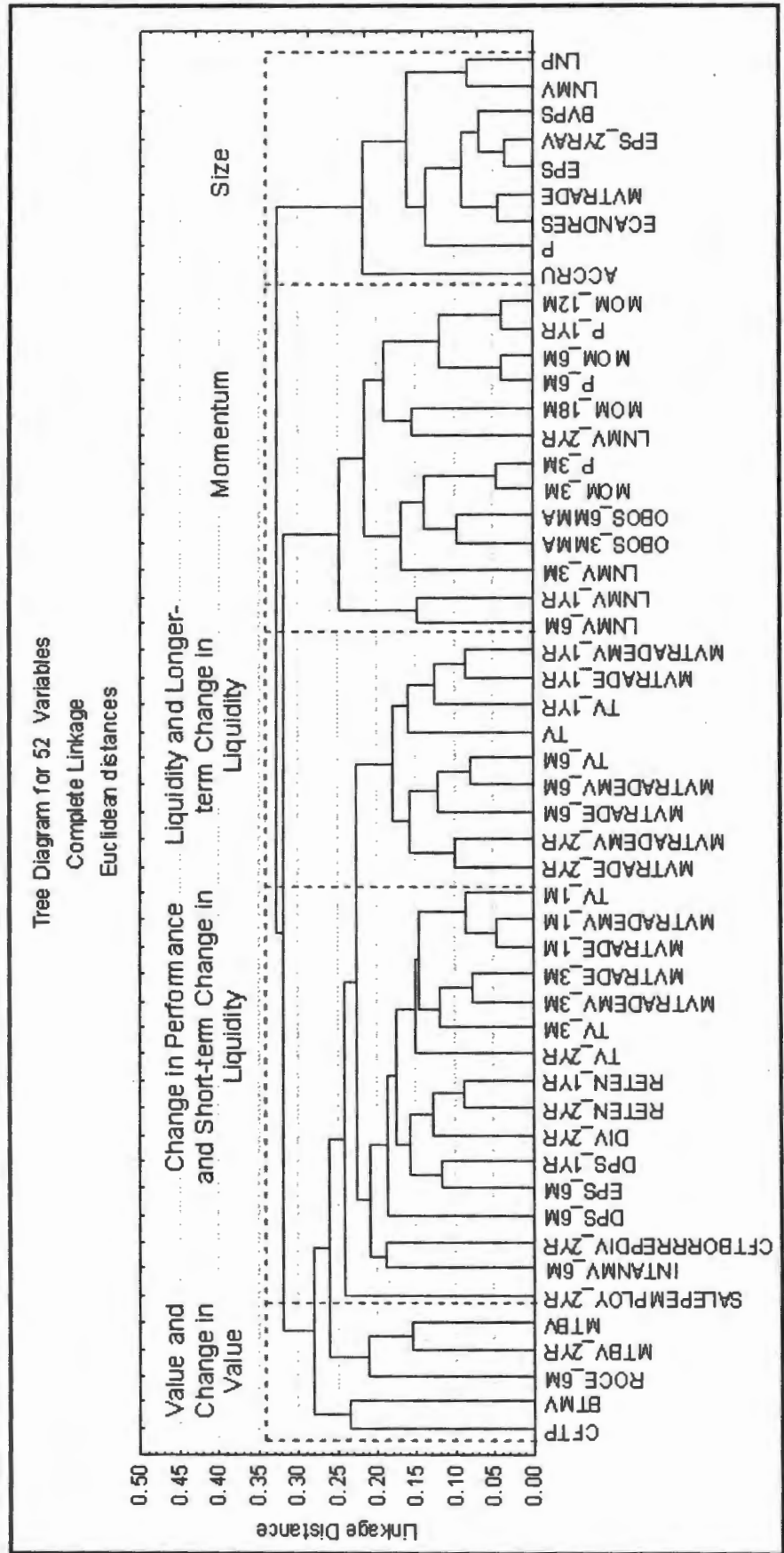
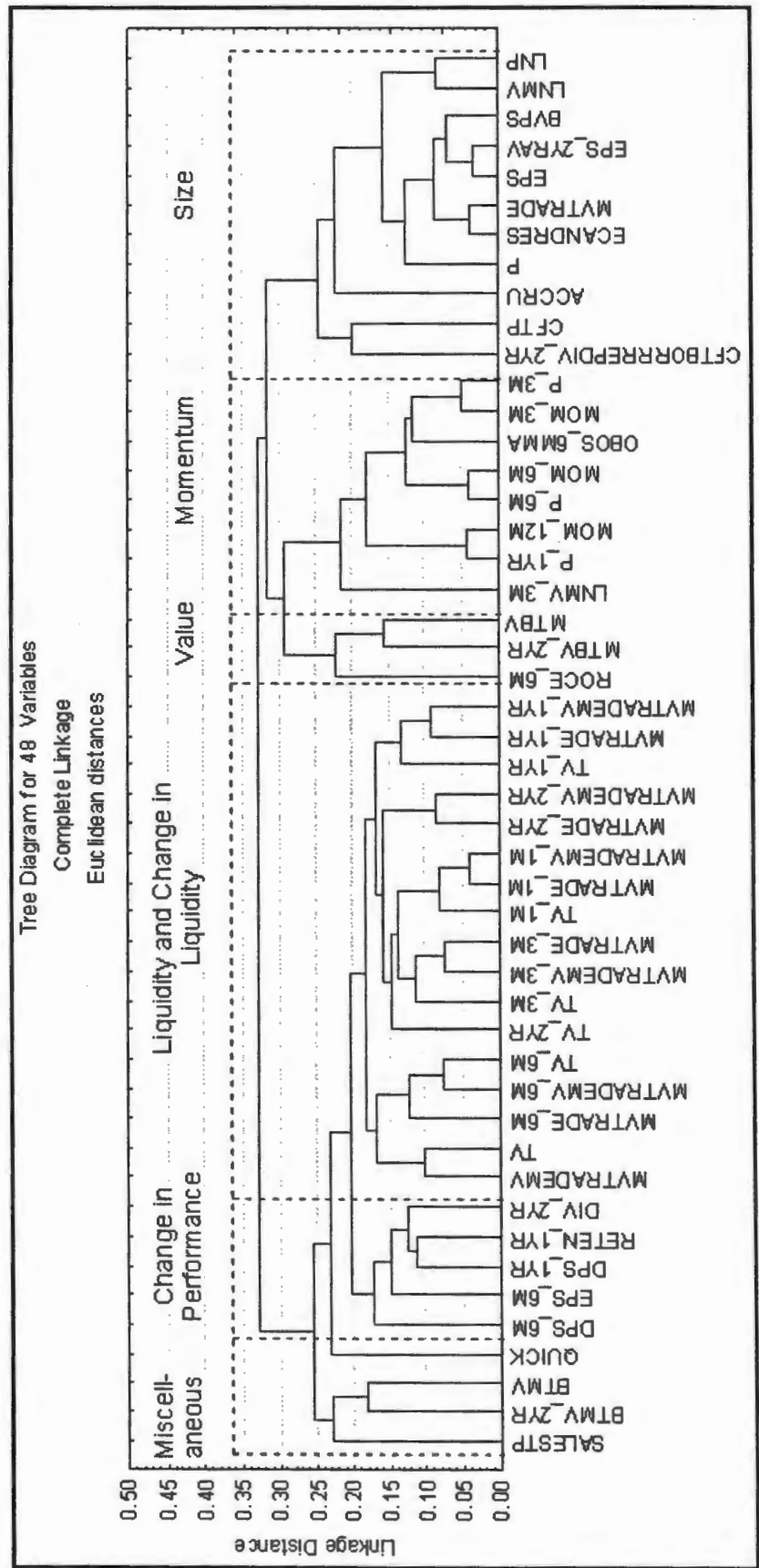


Figure 6.3. Tree Diagram of Clusters of Monthly Payoffs: APT Risk Adjusted Returns

Vertical tree diagram showing the hierarchical cluster analysis of monthly payoffs to standardised firm-specific attributes as calculated in univariate cross-sectional regressions on five-factor APT risk adjusted total monthly returns data over the period July 1994 to May 2004. Only attributes displaying an average of monthly coefficients significant at the 5% level in a Student's (1908) t-test are included. The data were extracted from DataStream International. The complete linkage method is used for clustering. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.



The cluster analysis tree diagram for the significant unadjusted payoffs can be divided into five clusters, namely: (1) Size (LNP to CFTBORRREPDIV); (2) Short-term Momentum (MOM_12M to LNMV_6M); (3) Liquidity, Change in Liquidity, and Longer-term Momentum (MVTRADEMV_1YR to LNMV_2YR); (4) Change in Company Performance (RETEN_1YR to DPS_6M); and (5) Value and Change in Value (MTBV_2YR to BTMV). The Change in Company Performance group can also be interpreted as a “growth” cluster.

Similar clusters are found using the CAPM and five-factor APT significant characteristics and related payoffs. The CAPM tree diagram can be divided into the following five clusters: (1) Size (LNP to ACCRU); (2) Momentum (MOM_12M to LNMV_6M); (3) Liquidity and Longer-term Change in Liquidity (MVTRADEMV_1YR to MVTRADE_2YR); (4) Change in Performance and Short-term Change in Liquidity (TV_1M to INTANMV_6M); and (5) Value and Change in Value (SALEPEMPLY_2YR to CFTP). The APT diagram can be divided into six clusters, namely: (1) Size (LNP to CFTBORRREPDIV_2YR); (2) Momentum (P_3M to LNMV_3M); (3) Value (MTBV to ROCE_6M); (4) Liquidity and Change in Liquidity (MVTRADE_1YR to MVTRADEMV); (5) Change in Performance (DIV_2YR to DPS_6M); and (6) Miscellaneous (QUICK to SALESTP).

6.3.2. Simplification of significant characteristics list

Given that the nature of the clusters is fairly similar across the unadjusted and risk adjusted significant characteristics, the remainder of the analysis focuses solely on the unadjusted factors and related data.

Figures 6.4 to 6.8 below display the correlations between significant factors for each extracted cluster. Correlations above 0.85 (and below -0.85) are displayed in white with a black background. Correlations above 0.7 (and below -0.7) are displayed in bold with a grey background. (A full correlation matrix of all the significant factors is included in Appendix C.4)

Figure 6.4. Correlation Matrix of Monthly Payoffs: Size

Matrix of Pearson (1896) correlation coefficients between the monthly payoffs to standardised firm-specific attributes as calculated in univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The attributes displayed are those significant at the 5% level in a Student's (1908) t-test and whose monthly payoffs cluster together (complete linkage method). The data were extracted from DataStream International. Correlations above 0.85 and below -0.85 are displayed in white with a black background. Correlations above 0.7 and below -0.7 are displayed in bold with a grey background. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	ACCRU	BVPS	CFTBORRREPDIV	CFTBORRREPDIV_2YR	CFTP	EPS	EPS_2YRAV	LNMV	LNP	MVTRADE	P
ACCRU	1.00										
BVPS	0.30	1.00									
CFTBORRREPDIV	0.13	0.36	1.00								
CFTBORRREPDIV_2YR	0.14	0.12	0.09	1.00							
CFTP	0.08	0.27	0.37	0.13	1.00						
EPS	0.33	0.86	0.42	0.11	0.31	1.00					
EPS_2YRAV	0.26	0.87	0.39	0.06	0.28	0.96	1.00				
LNMV	0.32	0.72	0.29	0.13	0.27	0.80	0.78	1.00			
LNP	0.32	0.71	0.22	0.17	0.27	0.72	0.71	0.89	1.00		
MVTRADE	0.10	0.63	0.18	0.14	0.15	0.66	0.66	0.77	0.65	1.00	
P	0.17	0.39	-0.06	0.00	0.00	0.29	0.29	0.54	0.70	0.48	1.00

Figure 6.5. Correlation Matrix of Monthly Payoffs: Short-term Momentum

Matrix of Pearson (1896) correlation coefficients between the monthly payoffs to standardised firm-specific attributes as calculated in univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The attributes displayed are those significant at the 5% level in a Student's (1908) t-test and whose monthly payoffs cluster together (complete linkage method). The data were extracted from DataStream International. Correlations above 0.85 and below -0.85 are displayed in white with a black background. Correlations above 0.7 and below -0.7 are displayed in bold with a grey background. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	LNMV_1YR	LNMV_3M	LNMV_6M	MOM_12M	MOM_3M	MOM_6M	OBOS_6MMA	P_1YR	P_3M	P_6M
LNMV_1YR	1.00									
LNMV_3M	0.42	1.00								
LNMV_6M	0.74	0.64	1.00							
MOM_12M	0.57	0.54	0.38	1.00						
MOM_3M	0.34	0.77	0.48	0.69	1.00					
MOM_6M	0.44	0.68	0.53	0.84	0.88	1.00				
OBOS_6MMA	0.44	0.81	0.54	0.74	0.87	0.87	1.00			
P_1YR	0.56	0.57	0.38	0.98	0.70	0.83	0.75	1.00		
P_3M	0.35	0.82	0.50	0.71	0.98	0.88	0.89	0.72	1.00	
P_6M	0.40	0.70	0.48	0.85	0.84	0.98	0.88	0.85	0.88	1.00

Figure 6.6. Correlation Matrix of Monthly Payoffs: Liquidity, Change in Liquidity and Longer-term Momentum

Matrix of Pearson (1896) correlation coefficients between the monthly payoffs to standardised firm-specific attributes as calculated in univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The attributes displayed are those significant at the 5% level in a Student's (1908) t-test and whose monthly payoffs cluster together (complete linkage method). The data were extracted from DataStream International. Correlations above 0.85 and below -0.85 are displayed in white with a black background. Correlations above 0.7 and below -0.7 are displayed in bold with a grey background. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	LNMV_2YR	MOM_18M	MOM_24M	MVTRADE_1M	MVTRADE_1YR	MVTRADE_2YR	MVTRADE_3M	MVTRADE_6M	MVTRADEM_1M	MVTRADEM_1YR	MVTRADEM_2YR	MVTRADEM_3M	MVTRADEM_6M	TV	TV_1M	TV_1YR	TV_2YR	TV_3M	TV_6M	
LNMV_2YR	1.00																			
MOM_18M	0.63	1.00																		
MOM_24M	0.73	0.81	1.00																	
MVTRADE_1M	0.21	0.23	0.20	1.00																
MVTRADE_1YR	0.52	0.46	0.44	0.20	1.00															
MVTRADE_2YR	0.65	0.63	0.68	0.26	0.46	1.00														
MVTRADE_3M	0.37	0.32	0.34	0.37	0.49	0.37	1.00													
MVTRADE_6M	0.54	0.55	0.50	0.33	0.55	0.45	0.54	1.00												
MVTRADEM	0.49	0.40	0.38	0.31	0.49	0.51	0.47	0.54	1.00											
MVTRADEM_1M	0.03	0.06	0.06	0.92	0.05	0.10	0.23	0.16	0.19	1.00										
MVTRADEM_1YR	0.19	0.20	0.14	0.25	0.78	0.28	0.40	0.32	0.39	0.20	1.00									
MVTRADEM_2YR	0.42	0.30	0.31	0.22	0.40	0.76	0.38	0.29	0.50	0.16	0.36	1.00								
MVTRADEM_3M	0.16	0.06	0.11	0.24	0.34	0.15	0.77	0.35	0.31	0.24	0.40	0.33	1.00							
MVTRADEM_6M	0.30	0.26	0.23	0.35	0.37	0.28	0.45	0.78	0.43	0.31	0.39	0.27	0.46	1.00						
TV	0.42	0.42	0.35	0.30	0.57	0.48	0.44	0.46	0.83	0.15	0.48	0.43	0.20	0.32	1.00					
TV_1M	0.02	-0.01	0.03	0.73	0.20	0.13	0.21	0.11	0.22	0.77	0.37	0.24	0.24	0.28	0.30	1.00				
TV_1YR	0.12	0.14	0.11	0.23	0.58	0.23	0.23	0.20	0.35	0.21	0.74	0.28	0.23	0.25	0.51	0.43	1.00			
TV_2YR	0.26	0.07	0.12	0.22	0.14	0.29	0.19	0.07	0.28	0.22	0.13	0.50	0.19	0.03	0.26	0.25	0.21	1.00		
TV_3M	0.19	0.05	0.17	0.34	0.35	0.22	0.52	0.23	0.42	0.30	0.37	0.30	0.55	0.23	0.48	0.48	0.42	0.28	1.00	
TV_6M	0.23	0.20	0.20	0.35	0.32	0.34	0.29	0.57	0.39	0.32	0.31	0.31	0.29	0.71	0.40	0.31	0.36	0.17	0.34	1.00

Figure 6.7. Correlation Matrix of Monthly Payoffs: Change in Performance

Matrix of Pearson (1896) correlation coefficients between the monthly payoffs to standardised firm-specific attributes as calculated in univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The attributes displayed are those significant at the 5% level in a Student's (1908) t-test and whose monthly payoffs cluster together (complete linkage method). The data were extracted from DataStream International. Correlations above 0.85 and below -0.85 are displayed in white with a black background. Correlations above 0.7 and below -0.7 are displayed in bold with a grey background. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	DIV_2YR	DPS_1YR	DPS_6M	EPS_6M	RETEN_1YR	RETEN_2YR
DIV_2YR	1.00					
DPS_1YR	0.26	1.00				
DPS_6M	0.17	0.46	1.00			
EPS_6M	-0.03	0.22	0.14	1.00		
RETEN_1YR	0.04	0.03	-0.01	-0.05	1.00	
RETEN_2YR	0.03	-0.18	-0.03	-0.03	0.34	1.00

Figure 6.8. Correlation Matrix of Monthly Payoffs: Value and Change in Value

Matrix of Pearson (1896) correlation coefficients between the monthly payoffs to standardised firm-specific attributes as calculated in univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The attributes displayed are those significant at the 5% level in a Student's (1908) t-test and whose monthly payoffs cluster together (complete linkage method). The data were extracted from DataStream International. Correlations above 0.85 and below -0.85 are displayed in white with a black background. Correlations above 0.7 and below -0.7 are displayed in bold with a grey background. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	BTMV	MTBV	MTBV_2YR	ROCE_6M
BTMV	1.00			
MTBV	-0.38	1.00		
MTBV_2YR	-0.10	0.53	1.00	
ROCE_6M	0.06	0.22	0.25	1.00

Many of the correlations within clusters are fairly low. However, the high correlations enable simplification of the list of factors. Following the elimination procedure outlined in the methodology, the list of factors is first simplified by examining the correlation between characteristics in the same cluster. A correlation matrix of the

remaining characteristics reveals a few more high correlations, indicating that some characteristics are highly correlated with characteristics in another cluster (see Appendix C.5). Again, the characteristics with the lower t-statistics are removed.

Both MTBV and BTMV characteristics are included in the analysis thus far, and despite them being merely the inverse of one another, their monthly payoffs are not highly correlated. However, given that they are basically the same thing with regards to information value, MTBV is excluded from the final list given its lower t-statistic.

The final list of characteristics is displayed in Table 6.4 below, along with their average slopes and related t-statistics from the earlier tests. Note that none of the characteristics have a correlation of greater (less) than 0.7 (-0.7) with another characteristic in the list.

Table 6.4. Final List of 27 Significant, Uncorrelated Attributes

The table displays the average coefficients and related t-statistics of the univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The firm-specific attributes are standardised before the regressions are performed. The attributes displayed are those significant at the 5% level in a Student's (1908) t-test and who remain after correlation analysis was conducted to eliminate the attributes with the lower t-statistic out of every pair of highly correlated attributes. The data were extracted from DataStream International. Attributes are classified according to logical interpretation. * This may also be due to debt, but given that the debt ratios were not found to be significant, this most probably represents performance. ** Assuming the size of the dividends represents performance. This may also be interpreted as change in growth prospects, where a higher dividend may indicate lower growth opportunities. *** This may also be due to change in debt, but given that the debt ratios were not found to be significant, this most probably represents change in performance. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Characteristic	Average Slope	t-statistic
Liquidity	TV	0.004	2.375
Momentum	MOM_12M	0.009	5.055
	MOM_3M	0.008	4.182
Performance	ACCRU	-0.004	-2.585
	CFTBORRREPDIV*	-0.003	-1.988
Size	LNP	-0.008	-5.481
Value	BTMV	0.006	3.798
	CFTP	0.004	2.865
Change in Liquidity	MVTRADEMV_1YR	0.004	4.564
	MVTRADEMV_2YR	0.004	4.118
	TV_6M	0.003	3.742
	MVTRADEMV_1M	0.003	3.052
	TV_2YR	0.003	2.824
	TV_3M	0.003	2.56
Change in Performance	DIV_2YR**	-0.003	-2.902
	DPS_6M**	0.003	2.662
	ROCE_6M	-0.004	-2.557
	CFTBORRREPDIV_2YR***	0.003	2.419
	DPS_1YR**	0.002	2.125
Change in Size	LNMV_1YR	0.005	3.039
	LNMV_2YR	0.003	2.223
Change in Value	RETEN_1YR	-0.002	-3.456
	MTBV_2YR	-0.004	-2.559
	RETEN_2YR	-0.001	-2.072
Liquidity / Size	MVTRADE	-0.001	-2.21
Change in Liquidity / Change in Size	MVTRADE_3M	0.003	3.565
Change in Size / Change in Performance	EPS_6M	0.002	2.001

The nature of these significant characteristics can be divided into the nine interpretation groups used above (or combinations thereof), namely: (1) Liquidity; (2) Momentum; (3) Performance; (4) Size; (5) Value; (6) Change in Liquidity; (7) Change in Performance; (8) Change in Size; and (9) Change in Value. Given that the characteristics are not highly correlated with each other (even those belonging to the same interpretation group), they represent different areas of those interpretations. Again, the Change in Performance group can also be interpreted as “growth”.

Figures 6.9 to 6.17 display the cumulative monthly payoffs of the 27 remaining significant characteristics over the period. Characteristics having the same “interpretation” are displayed on the same set of axes. Those characteristics falling into more than one such group are included on the graph of each of the groups it belongs to.

The calculation of the monthly payoffs is based on share data that is not weighted according to the market capitalisation of the shares. Thus the cumulative payoff graphs represent payoffs to an equally-weighted portfolio rather than a market-weighted portfolio.

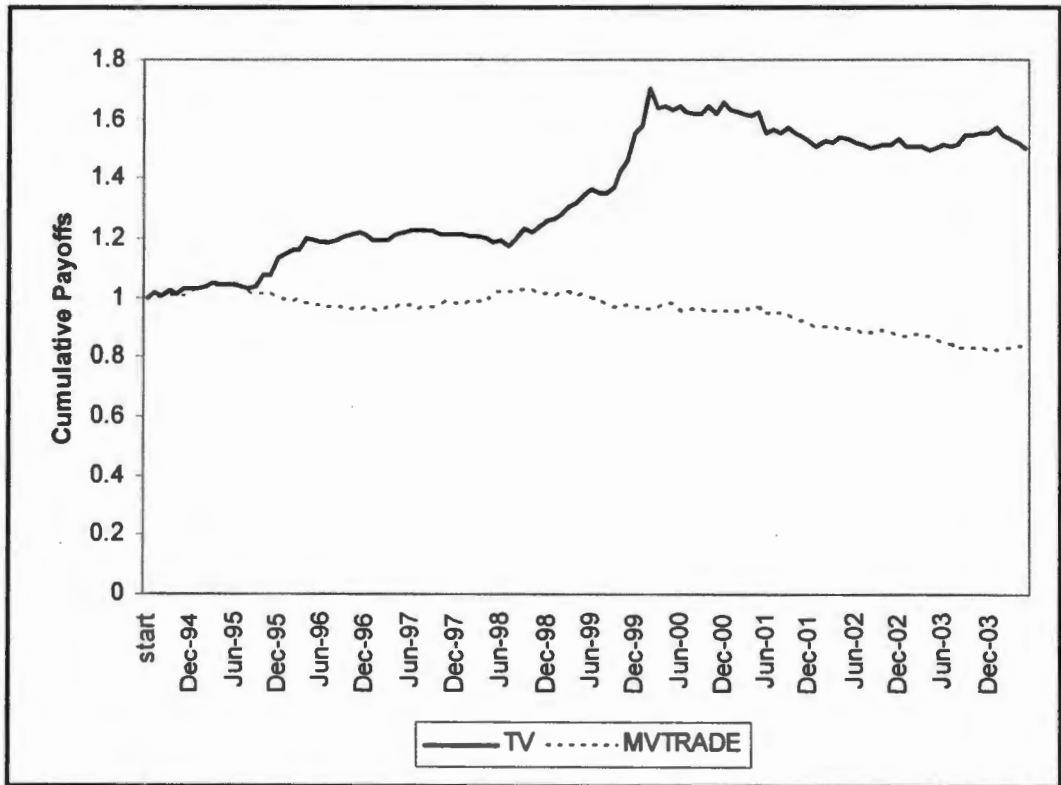
6.3.2.1. Liquidity

The TV characteristic shows a strong positive cumulative payoff over the first half of the period and then turns rather flat indicating a reversal in the relationship. The initial upward payoff is in line with that expected from the positive relationship between liquidity risk and return.

The MVTRADE is initially fairly flat and then shows a mild negative cumulative payoff. Given that the characteristic is a combination of the TV and P factors, the strong negative payoff to the Price (and LNP) characteristic offsets the initial upward payoff of TV leading to the fairly flat line over the first half of the period.

Figure 6.9. Cumulative Monthly Payoffs: Liquidity

The cumulative monthly payoffs of the uncorrelated significant (5% level) standardised attributes that fall into the Liquidity logical interpretation group. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The average payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) *t*-test. The data were extracted from DataStream International. The graphs start at the value 1. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.



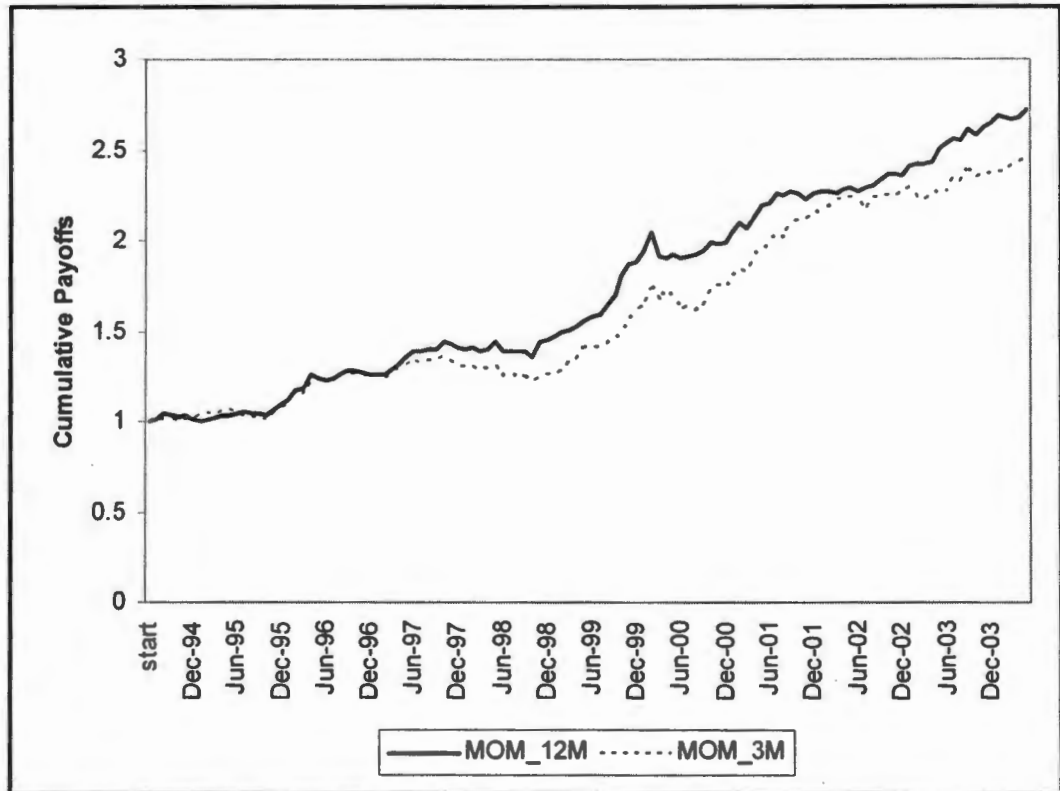
6.3.2.2. Momentum

Both momentum factors payoff strongly and positively over the period. The larger payoff belongs to that of the more significant MOM_12M characteristic, which pays off a cumulative 172% over the period.

Hurn and Pavlov (2003) examine the period 1973 to 1998 and find both medium and short-term momentum, but it is only the medium term momentum that remains significant after risk adjustment. In this study, both the MOM_12M and MOM_3M characteristics retain their significance after risk adjustment (using both CAPM and APT to adjust for risk).

Figure 6.10. Cumulative Monthly Payoffs: Momentum

The cumulative monthly payoffs of the uncorrelated significant (5% level) standardised attributes that fall into the Momentum logical interpretation group. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The average payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. The graphs start at the value 1. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

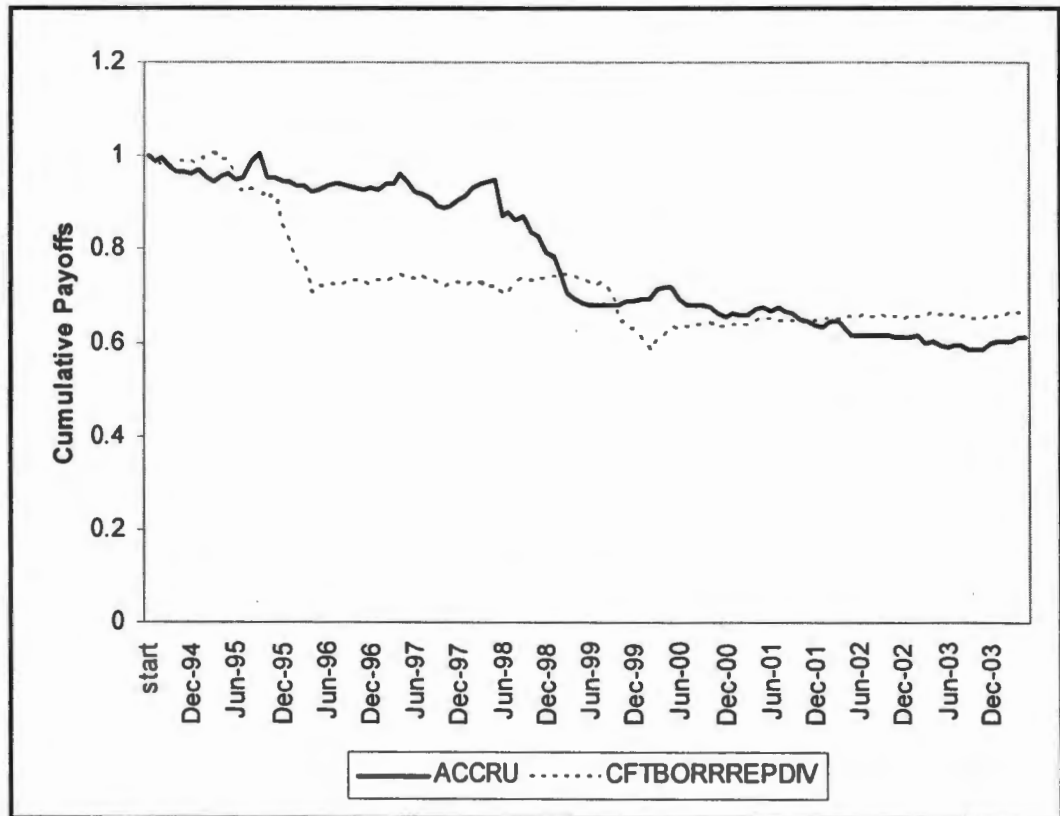


6.3.2.3. Performance

The ACCRU characteristic, representing non-cash earnings standardised by total assets, pays off negatively over the period. While its general trend is negative, its largest negative payoffs occur over the years 1998 and 1999. The CFTBORRREPDIV characteristic also shows an overall negative cumulative payoff, but this is more erratic with two short but large negative payoff periods while having a small positive payoff for the rest of the period.

Figure 6.11. Cumulative Monthly Payoffs: Performance

The cumulative monthly payoffs of the uncorrelated significant (5% level) standardised attributes that fall into the Performance logical interpretation group. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The average payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. The graphs start at the value 1. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.



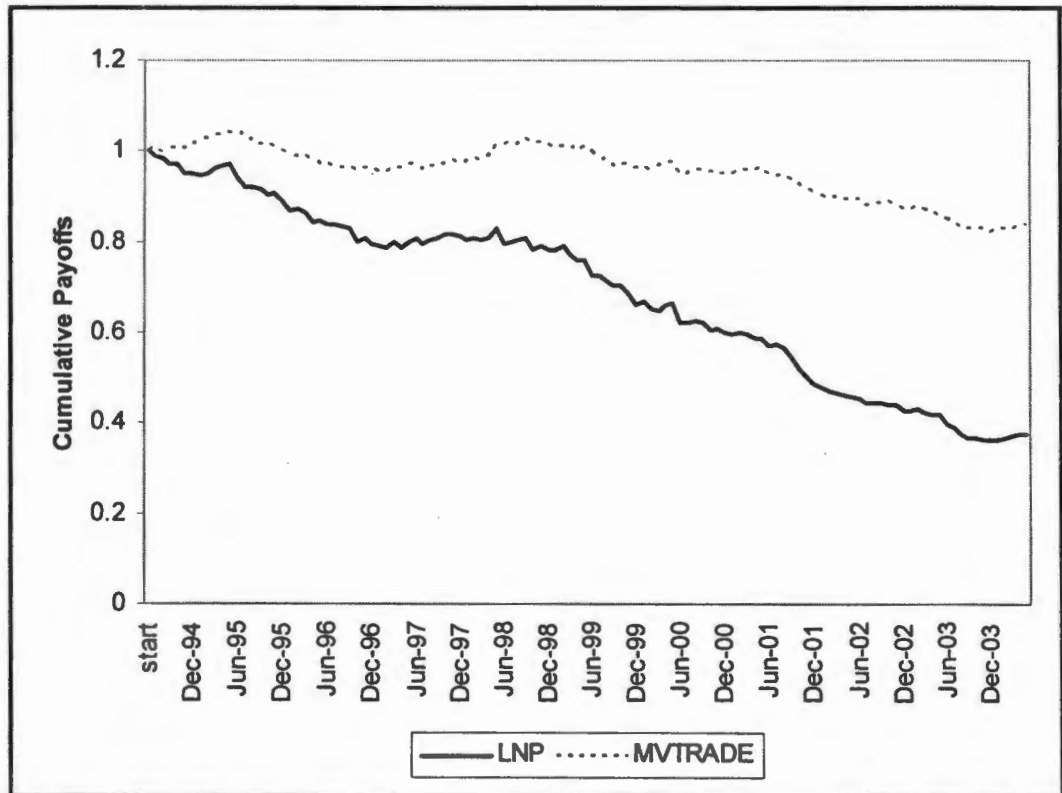
6.3.2.4. Size

The well-documented size effect is confirmed. The LNP characteristic shows the strongest negative cumulative payoff, it being the most significant characteristic both before and after risk adjustment.

These results support the tests of Brown, Keim, Kleidon, and Marsh (1983), Beedles, Dodd, and Officer (1988), and Halliwell, Heaney, and Sawicki (1999a) using earlier periods. While Faff (2001) found a reversal of the size effect over the 1991 to 1999 period, the size effect here is clearly negative and thus in agreement with the studies on earlier periods as well as the findings of Gaunt (2004) who examines the period 1981 to 2000.

Figure 6.12. Cumulative Monthly Payoffs: Size

The cumulative monthly payoffs of the uncorrelated significant (5% level) standardised attributes that fall into the Size logical interpretation group. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The average payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. The graphs start at the value 1. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.



Wood (1991) argues that the pricing of shares on the ASX should follow a dichotomous structure, as foreign investors are the dominant investors in resource sector stocks and domestic investors are dominant in the other sectors of the market. As the resource sector stocks are high capitalisation stocks, finding a size effect using unadjusted returns may simply be caused by the different pricing of these groups of shares. However, the APT model used to adjust the returns for risk includes a resources factor and an industrials (financials) factor, and the size effect is virtually the same for both unadjusted and APT-risk adjusted returns. This implies that the size effect in fact exists within each sector.

The LNP characteristic is more accurately called the "price-effect", but its clustering and high correlation with the size characteristics has placed it in this group. The finding of this price effect is in accordance with the findings of Beedles, Dodd, and

Officer (1988) covering the period 1974 to 1984, and Gaunt, Gray, and McIvor (2000) who examine the period 1974 to 1997. A spin-off implication of the high correlation between price and size is that larger companies tend to have higher priced shares.

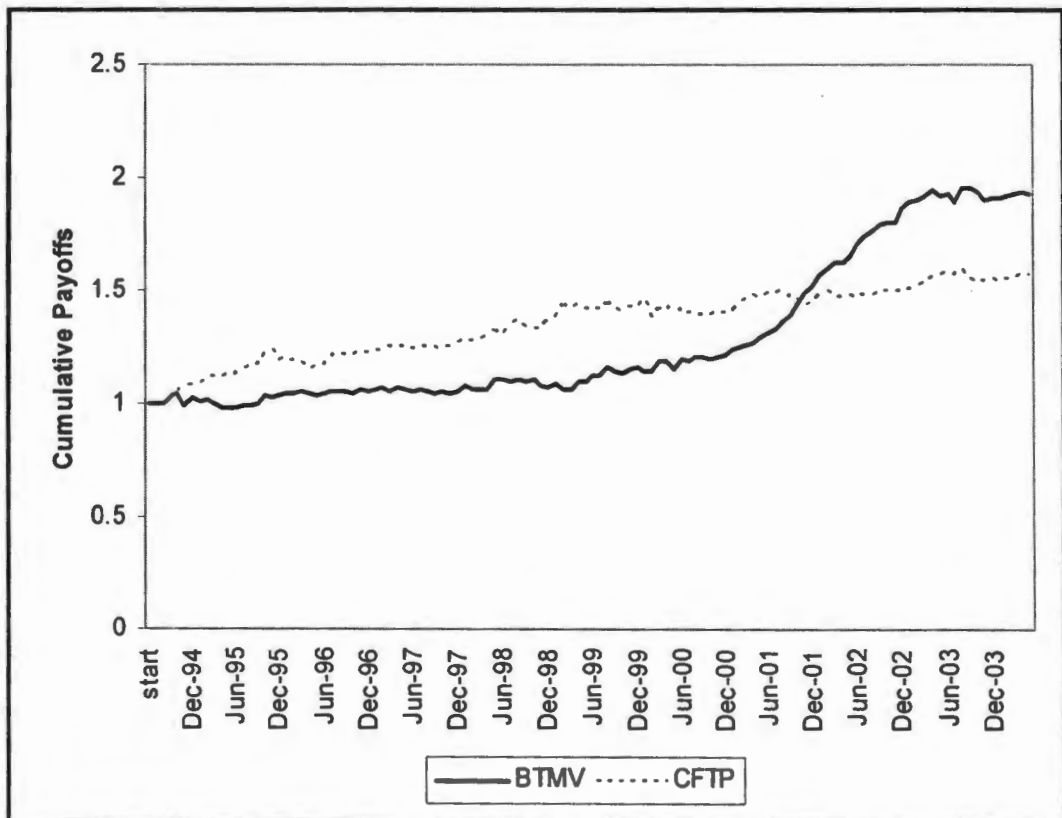
The MVTRADE characteristic, as discussed above, takes its initial flat cumulative payoff from its initially conflicting components of TV and P.

6.3.2.5. Value

The CFTP characteristic, representing cash earnings standardised by price, pays off positively over the period. This evidence supports the findings of Fama and French (1998).

Figure 6.13. Cumulative Monthly Payoffs: Value

The cumulative monthly payoffs of the uncorrelated significant (5% level) standardised attributes that fall into the Value logical interpretation group. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The average payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. The graphs start at the value 1. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.



The BTMV characteristic hardly pays off up until late 2000, after which it exhibits a strong positive cumulative payoff for about three years. Thereafter, the graph turns somewhat flat indicating little payoff towards the end of the period.

This inconsistent behaviour has been captured to some extent by the contradictory findings of previous research. As mentioned in the literature review, while Halliwell, Heaney, and Sawicki (1999a) examine the period 1981 to 1991 and find no such effect, studies examining later periods by Faff (2001), Gaunt (2004), and Fama and French (1998) find a significant effect. Anderson, Lynch, and Mathiou (1990) examine 1975 to 1984 and find a weak and non-persistent effect.

While Fama and French (1998) report a significant P/E effect in the Australian market, their study is one of the few that reports on this effect in this market. In contrast to their findings, this study does not find the P/E effect to be significant. This finding also differs from various tests on other markets around the world, most notably the US. Anderson, Lynch, and Mathiou's (1990) Australian tests however find that the P/E effect is only present in large firms and disappears as firms became smaller. It is therefore not surprising that no P/E effect is found here, as the tests use cross-sectional regressions and the sample is dominated (in number) by small firms (see Appendix A.4). Anderson, Lynch, and Mathiou (1990) note that Australia's shares are much smaller than those of the US (implying that the definition of a "large" share is considerably different) and suggest there may be interaction between the size and P/E effects in the US such that the P/E effect is absent in very small shares. This suggestion is somewhat backed up by Reinganum's (1981b) US study which finds that the P/E effect disappears when returns are controlled for the firm size effect (although there have been US studies with differing results¹⁹).

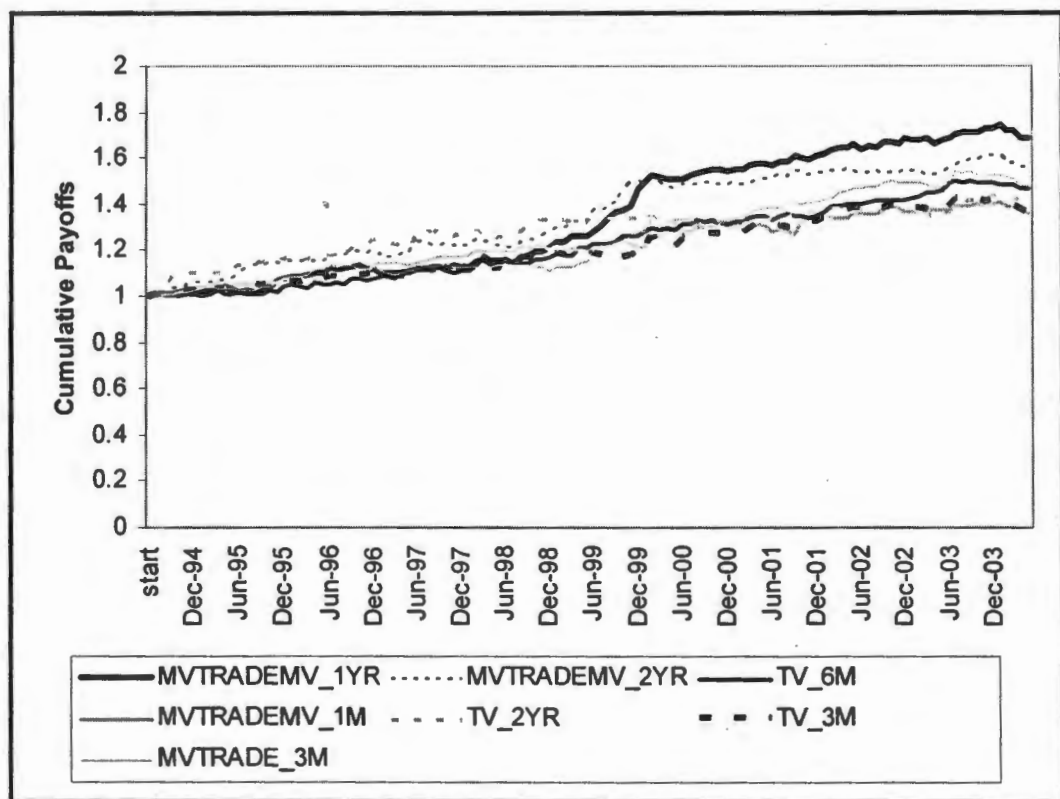
¹⁹ One such example is the work of Cooke and Rozeff (1984), which concludes, "it does not appear that either market value subsumes earnings/price ratio or the earnings/price ratio subsumes market value...."

6.3.2.6. Change in Liquidity

All seven characteristics show a fairly consistent positive cumulative payoff over the entire period. This shows that not only does the magnitude of the liquidity characteristic pay off, but also the degree of change in liquidity.

Figure 6.14. Cumulative Monthly Payoffs: Change in Liquidity

The cumulative monthly payoffs of the uncorrelated significant (5% level) standardised attributes that fall into the Change in Liquidity logical interpretation group. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The average payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. The graphs start at the value 1. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.



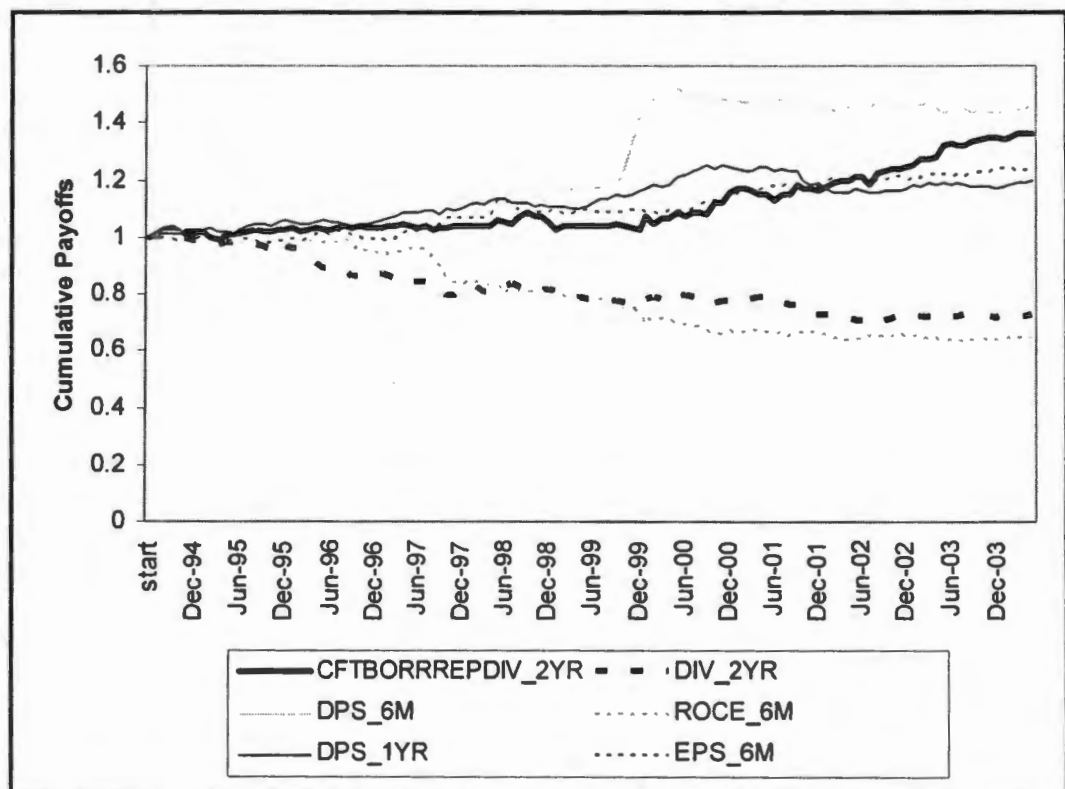
6.3.2.7. Change in Performance

Four characteristics show cumulative positive payoffs while two show negative cumulative payoffs. Most surprising is that while DPS_6M and DPS_1YR show positive cumulative payoffs, DIV_2YR shows a negative cumulative payoff. While this may largely be affected by the change-in-size effect, the opposing direction of their payoffs suggests otherwise.

The payoff to DPS_6M is the largest, but almost solely due to the spike seen between mid-1999 and mid-2000. The EPS_6M characteristic pays off more similarly to the characteristics in this group than those in the Change in Size group.

Figure 6.15. Cumulative Monthly Payoffs: Change in Performance

The cumulative monthly payoffs of the uncorrelated significant (5% level) standardised attributes that fall into the Change in Performance logical interpretation group. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The average payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. The graphs start at the value 1. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.



6.3.2.8. Change in Size

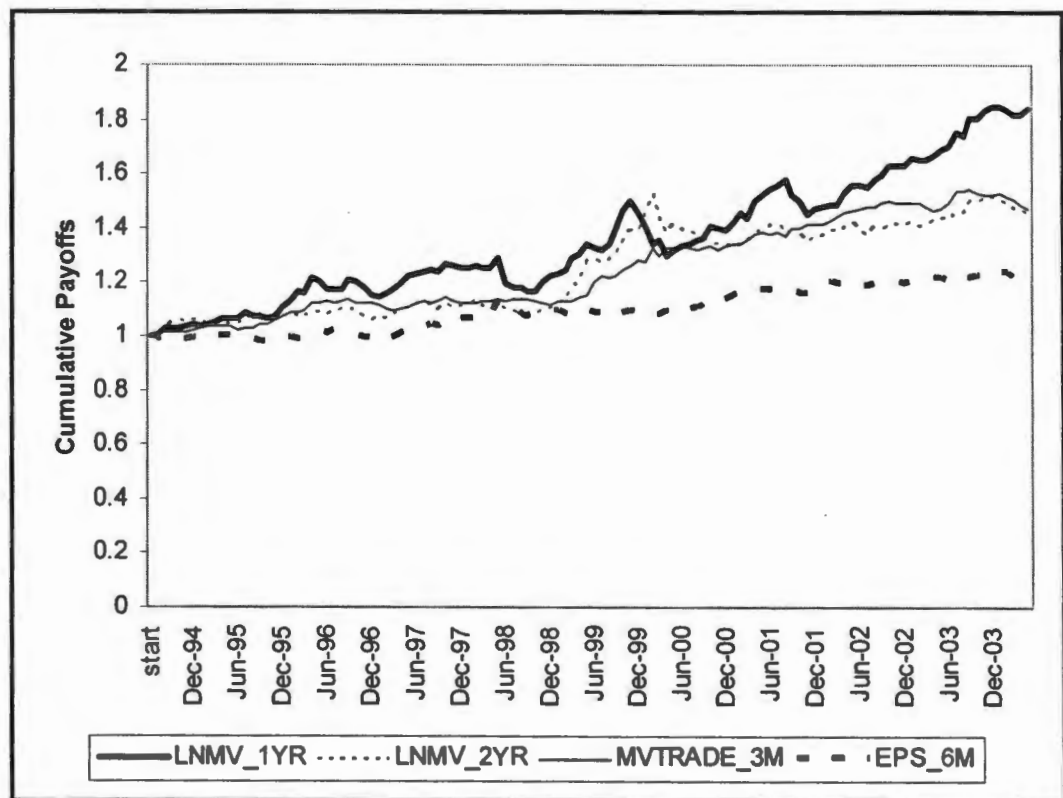
All these characteristics show a somewhat erratic but overall positive cumulative payoff over the period. The LNMV_1YR characteristic gives the strongest payoff, while the EPS_6M characteristic gives the weakest.

While size itself is a significant characteristic, a large change in size pays off over a small change in size. The MVTRADE_3M characteristic pays off in a similar way to

both the characteristics in this group as well as those in the Change in Liquidity group.

Figure 6.16. Cumulative Monthly Payoffs: Change in Size

The cumulative monthly payoffs of the uncorrelated significant (5% level) standardised attributes that fall into the Change in Size logical interpretation group. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The average payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. The graphs start at the value 1. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

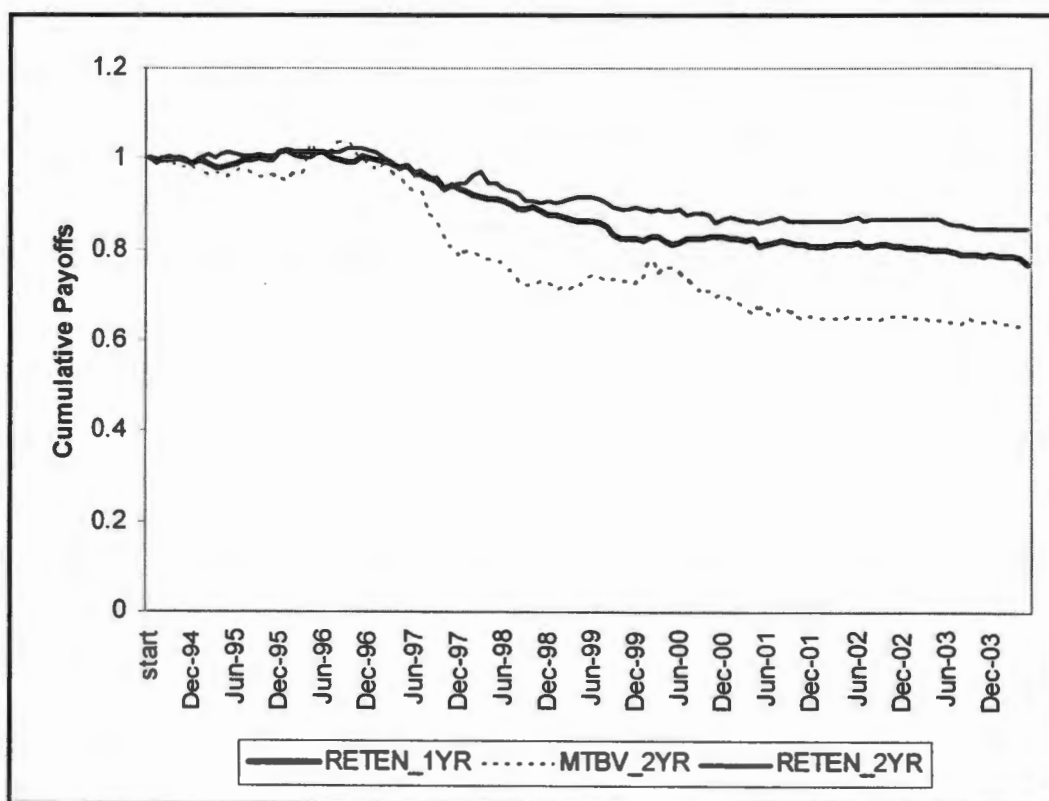


6.3.2.9. Change in Value

All characteristics show a negative cumulative payoff over the period. The RETEN_1YR and RETEN_2YR show similar movements, and the MTBV_2YR has the highest negative cumulative payoff despite being the most inconsistent, showing hardly any payoff between 1998 and 2000.

Figure 6.17. Cumulative Monthly Payoffs: Change in Value

The cumulative monthly payoffs of the uncorrelated significant (5% level) standardised attributes that fall into the Change in Value logical interpretation group. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The average payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. The graphs start at the value 1. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.



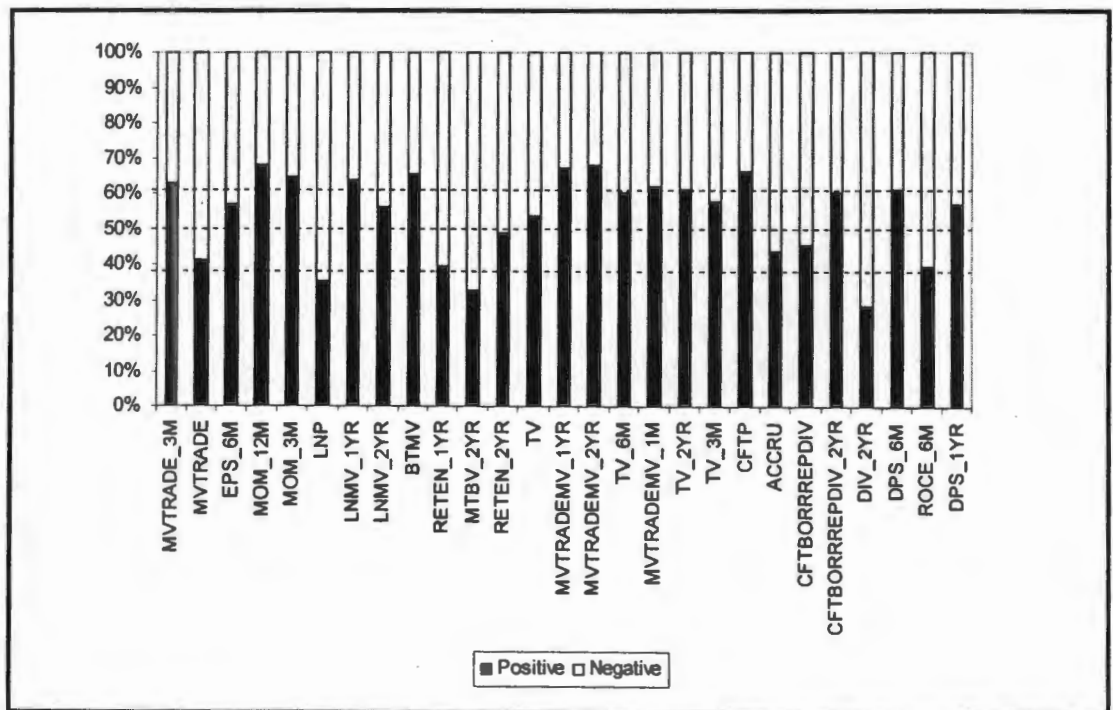
6.3.3. Style consistency assessment

Figure 6.18 gives an indication of the consistency of the styles' monthly payoff direction. The ratio of the number of times the payoff is positive is shown by the dark bars while the light bars show the ratio of the number of times the payoff is negative. The two outer dashed lines represent significance at the 5% level, and the middle dashed line displays a ratio of 50%. Characteristics with a higher consistent direction have ratios close to either 100% or 0%. The interpretation of ratios close to 50% is more ambiguous, as discussed in Section 6.2.6.

To be deemed inconsistent, a characteristic should have a high number of direction changes. Figure 6.19 displays the number of monthly payoff direction changes to total number of months (expressed as a percentage).

Figure 6.18. Consistency of the Direction of Monthly Payoffs

The dark bars on the graph display the ratio of the number of times the monthly payoffs are positive while the light bars show the ratio of the number of times the payoffs are negative. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The firm-specific attributes are standardised before the regressions are performed. The average payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. Characteristics with a higher consistent direction have ratios close to either 100% or 0%. Ratios close to 50% do not necessarily imply inconsistency. Dashed lines are displayed at the 50% level and at the 5% significance levels (Sign test). Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.



From Figure 6.18, it is clear that many characteristics are not highly consistent in monthly payoff direction. Twelve of the characteristics however show consistency ratios that are significance at the 5% level in the nonparametric binomial Sign test. The MVTRADEM_2YR characteristic has the highest positive (lowest negative) payoff consistency ratio of 68% (32%), and DIV_2YR has the highest negative (lowest positive) payoff consistency ratio of 71% (29%). The characteristics with the ratios closest to 50% all belong to the change in value interpretation group, and are

RETEN_2YR with 49% (51%), DPS_1YR with 57% (43%), and EPS_6M 57% (43%).

The DIV_2YR characteristic is still the most consistent in terms of the number of times the monthly payoff direction changes, as depicted in Figure 6.19. However, its payoff still changed direction 44 times (out of a possible 118). The most inconsistent characteristic here was TV_6M, which changed direction 66 times.

Figure 6.19. The Frequency of Changes in Monthly Payoff Direction

The graph displays the number of times the monthly payoffs to the standardised attributes changes direction expressed as a percentage on the total number of payoffs. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The firm-specific attributes are standardised before the regressions are performed. The average payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. Characteristics with lower ratios are more consistent in direction. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

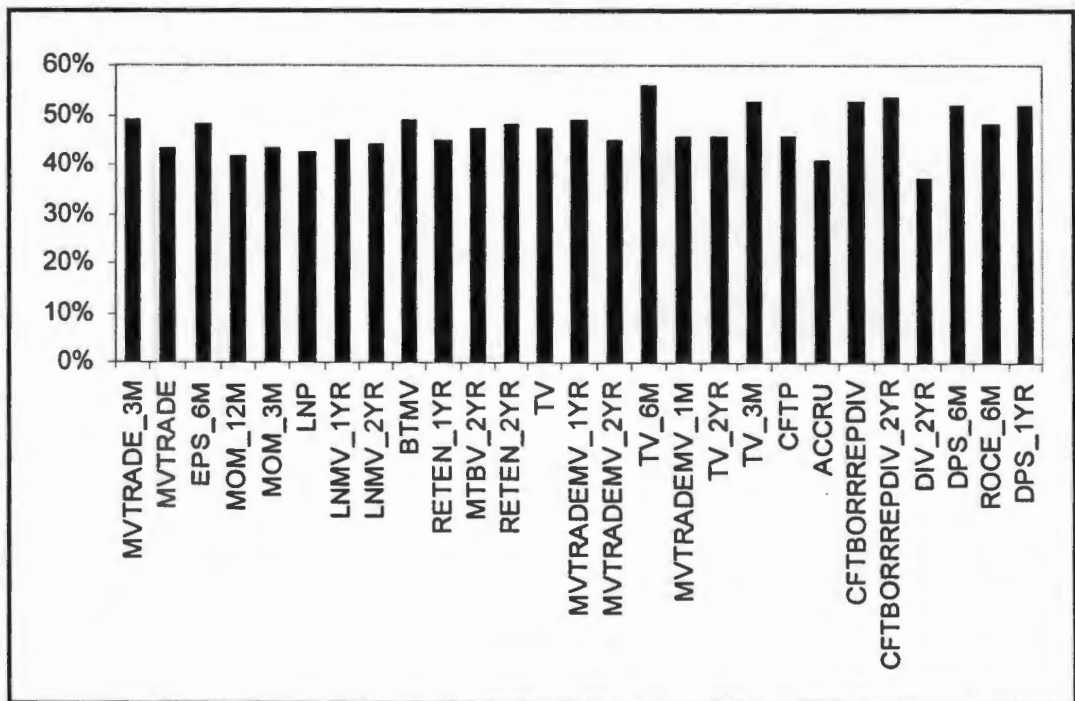
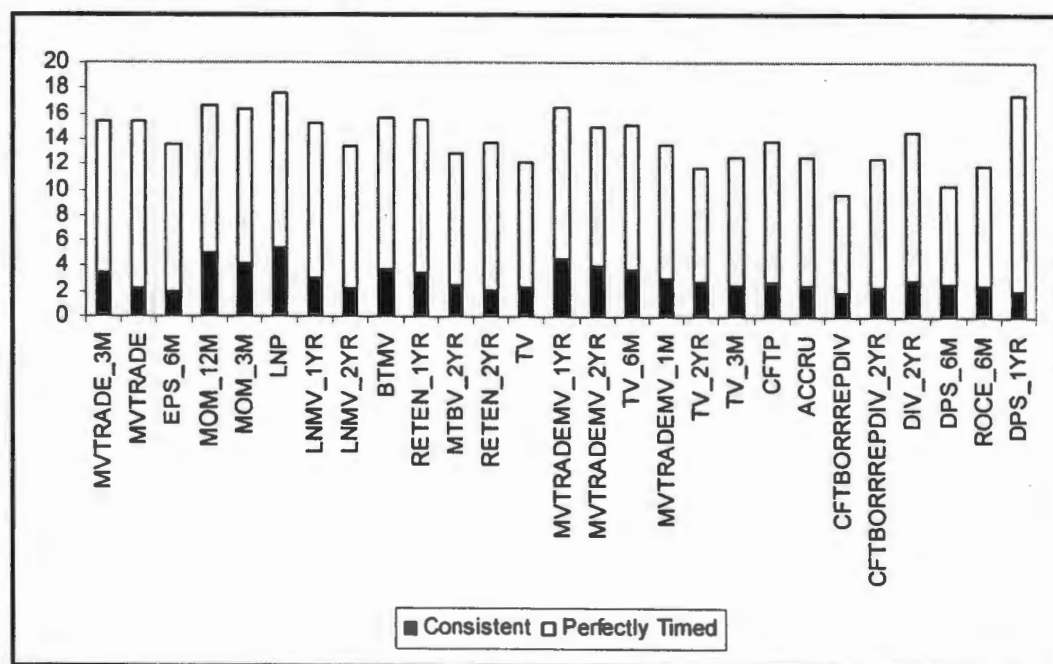


Figure 6.20 compares the t-statistics of the final 27 characteristics as calculated above to a t-statistic calculated on the assumption that the direction of the monthly payoff can be forecast perfectly. While the t-statistics should intuitively improve, the graph merely displays the magnitude of the change in significance.

Figure 6.20 shows that large improvements in significance are indeed possible for the final 27 characteristics if their monthly payoff direction can be perfectly forecast. The most significant characteristic using the initial t-statistic, LNP (5.48), remains the most significant after perfect direction timing and its new t-statistic becomes 12.113. This massive change is in fact the *smallest* improvement out of these 27 characteristics.

Figure 6.20. The t-statistics with and without Perfect Timing of Payoff Direction

The dark bars on the graph display the t-statistic relating to the time-series average of monthly payoffs to standardised attributes derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004 are performed. The average payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. The light bars represent t-statistics of the same average of the time-series of monthly payoffs to attributes, calculated using the absolute value of the monthly payoffs to simulate perfect directional timing. As the magnitude (and not direction) of the t-statistics is of concern, the t-statistics are displayed as absolute values thus enabling direct comparison. The greater the difference between the dark and light bars, the greater the benefits of the ability to predict the direction of the monthly payoff. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.



6.4. Summary and conclusion

This chapter investigates the ability of firm-specific attributes to explain the cross-sectional variation in share returns. In each month from July 1994 to May 2004, one-

month-forward stock returns on the final sample's 367 companies are univariately regressed on 207 firm-specific characteristics, most of which are financial ratios. The pooled time-series regression coefficients are assessed for significance using Student's (1908) t-test following the methodology of Fama and Macbeth (1973). Several characteristics are found to be significant when both unadjusted, CAPM risk-adjusted, and APT risk-adjusted returns are used.

Cluster analysis is then performed on the significant characteristics derived using the unadjusted, CAPM risk-adjusted, and APT risk-adjusted returns. Similar characteristics are found to be significant for each set of returns.

The list of significant characteristics derived using unadjusted returns is then further simplified through the use of a correlation matrix assessment. Where two characteristics are highly correlated, the one with the lower t-statistic is removed. The process gives rise to a set of 27 significant characteristics that are not highly correlated with each other. They can be classified into nine interpretation groups or combinations thereof, namely: (1) Liquidity; (2) Momentum; (3) Performance; (4) Size; (5) Value; (6) Change in Liquidity; (7) Change in Performance; (8) Change in Size; and (9) Change in Value. Many of the significant characteristics are the same as those found in prior research. The P/E characteristic does not however show significance. While this is in contrast to the US literature, the effect is not inconsistent with Australian literature, which continues to report mixed results. The size effect is virtually the same for both unadjusted and APT-risk adjusted returns, thus contradicting arguments suggesting that it is merely the manifestation of the differential pricing between resources (high capitalisation) and industrials shares as the APT model uses both an industrials (General Industrials index) and a resources (Steel & Other Metals index) factor.

An examination of the cumulative payoffs over the period shows that most characteristics display a fairly consistent monthly payoff, implying that profits could have been made over the period examined by consistently treating a characteristic as either a negative or positive payoff indicator. The behaviour, however, was not absolutely consistent, and in many months all the style characteristics returned

payoffs of the opposite direction to their general trend. Further, the large number of changes in direction payoff for all the characteristics indicates the considerable fluctuation in direction. As some characteristics may swing from positive to negative rather frequently (thus increasing the chance of being found to be insignificant), the ability to time payoffs, at least in terms of direction, may enable investors to exploit even the insignificant characteristics if the fluctuation in payoffs occurs in a predictable fashion.

The comparison of the initial t-statistics to those calculated assuming perfect monthly payoff direction forecasting indicates that the payoffs to style investing can be greatly improved if the payoffs can be timed in terms of direction. The timing of the style characteristics is examined in Chapter Seven.

A limitation of univariate analysis is that it provides a list of variables that are significant when they are used as the only explanatory variable. Such variables may in fact be rendered insignificant when other variables are simultaneously included in the regressions. The correlation matrix assessment somewhat deals with these multicollinearity issues in the context of two-factor models. There however still remains the strong possibility that the explanatory value of a characteristic may become dominated by the combination of other explanatory variables in multivariate regressions. The behaviour of the final 27 style characteristics is therefore examined in a multivariate framework in Chapter Nine.

Style Timing

7.1. Introduction

Chapter Six identifies a final list of 27 significant characteristics that are not highly correlated with each other. While most characteristics show an overall trend in terms of payoff direction, an examination of the consistency of monthly payoff direction reveals instability in the payoffs' direction. The magnitude of the benefit of perfect payoff direction forecasting ability was illustrated by the change in t-statistics.

It was also noted that as some characteristics may swing from positive to negative rather frequently (thus increasing the chance of being found to be insignificant), the ability to time payoffs, at least in terms of direction, may enable investors to exploit even the insignificant characteristics if the fluctuation in payoffs occurs in a predictable fashion. This aim of this chapter, however, is to assess whether the performance of the significant characteristics can be improved through the use of a style-timing model which predicts monthly payoffs. Thus only the final 27 significant characteristics are examined.

This chapter first examines the relationships between the monthly payoffs and their own lagged values by looking at autocorrelations and partial-autocorrelations. Then six style-timing models are constructed and compared for time-series forecasting ability using three measures: (1) the correlation between the forecast payoffs and the realised payoffs; (2) the ratio of the number of times the payoff direction is correctly forecast to total forecasts (tested for probability using the nonparametric Sign Test), and (3) Theil's (1958) Inequality Coefficient (referred to as "*U*-statistic" for the remainder of the chapter).

The remainder of the chapter is set out as follows: Section 7.2 provides an overview of the data and methodology used to construct and test the timing models that are used to forecast monthly payoffs to the attributes, Section 7.3 reports the results, and Section 7.4 summarises and concludes.

7.2. Data and methodology

The data set consists of the 119 monthly payoffs to the final 27 characteristics for the period July 1994 to May 2004 as calculated in Chapter Six.

A twelve lag correlogram is calculated for each style characteristic and shows the autocorrelations and partial-autocorrelations between style's monthly payoffs with the first twelve lags of those payoffs.

The autocorrelation T_k of each characteristic's monthly payoffs at lag k is estimated by the following equation:

$$T_k = \frac{\sum_{t=k+1}^N (Y_t - \bar{Y})(Y_{t-k} - \bar{Y})}{\sum_{t=1}^N (Y_t - \bar{Y})^2} \quad (7.1)$$

where Y_t is the observed payoff in month t , \bar{Y} is the sample mean, and N is the number of monthly payoffs. Note that this calculation is similar to Pearson's (1892) correlation coefficient (Chapter Five Section 5.2.1.2 Equation 5.1) and gives the correlation coefficient for values of the monthly payoff series that are k months apart. If T_1 is nonzero, it means that the series is first-order serially correlated.

The partial-autocorrelations for lag k is given by the regression coefficient on Y_{t-k} calculated when Y_t is regressed on a constant, Y_{t-1}, \dots, Y_{t-k} . This partial-correlation measures the correlation for values of the monthly payoff series that are k periods

apart after removing the correlation from the intervening lags. If the pattern of autocorrelation is one that can be captured by an autoregression of order less than k , the partial autocorrelation at lag k will be close to zero.

Both the calculated autocorrelations and partial-autocorrelations are tested for significance. The test statistic is calculated as²⁰:

$$T_{k,obs} = T_k \left(\sqrt{\frac{N-2}{1-T_k^2}} \right) \quad (7.2)$$

which has the t-distribution with $(N-2)$ degrees of freedom.

Ljung-Box (1978) Q -statistics (referred to as “LB” Q -statistics for the remainder of the chapter) testing for the null hypothesis that there is no autocorrelation up to order k are also calculated. The Q -statistic at lag k is given by the following formula:

$$Q_k = N(N+2) \sum_{j=1}^k \frac{T_j^2}{N-j} \quad (7.3)$$

where T_j is the j^{th} autocorrelation. If the null hypothesis holds, Q follows a χ^2 distribution with k degrees of freedom.

Six timing models are created. The first is an autoregressive model that uses twelve lags (AR12). The results of the correlogram (see Section 7.3) show that none of the lags particularly stands out across the characteristics, with some characteristics experiencing significant autocorrelation at even the tenth and eleventh lags (MTBV_2YR and CFTBORRREPDIV_2YR). The decision to use twelve lags is partly due to this inconsistency as well as the suspected seasonality in the characteristics’ payoffs. For each characteristic for each month, an intercept and lag coefficients for the lagged variables are calculated from running the autoregression only on the data before that month. This is known as an “expanding window” and is a

²⁰ See van den Honert 1999, p. 100

better method than using the entire sample to determine an overall intercept and set of lag coefficients as this would be subject to look-ahead bias. An autoregression is thus run for each month. However, given the regression's number of observations requirement, these lag coefficients and intercepts can only be calculated for the last 95 months. The expanding window results in 24 observations being used for the autoregression for month 25's payoff and 118 observations being used for the last month's payoff. Ordinary Least Squares (OLS) regressions were used for the autoregressions.

The average lag coefficients of the lagged variables and average intercept for each style are shown in Appendix D.1. Student's (1908) t-test (referred to as "t-test" for remainder of the chapter) is performed to assess whether the average lag coefficients and intercepts are significantly different from zero. The t-statistics of the average lag coefficients and intercepts are included in brackets and displayed in bold if significant. It is clear that most of these are significant for all styles, with the exception of the CFTP characteristic for which none of the average lag coefficients or the average intercept are significantly differently from zero.

The autoregressive model's lag coefficients and intercepts are then combined with the payoffs data set to give rise to a predicted payoffs data set consisting of 95 estimates. They are represented by the following equation, used for each characteristic:

$$y_{est,t} = \alpha_t + \sum_{k=1}^{12} \beta_{t,k} y_{t-k} \quad (7.4)$$

where:

$y_{est,t}$ = the estimated payoff in month t

α_t = the intercept from the autoregression on the sample unique to month t

$\beta_{t,k}$ = the slope of the lagged monthly payoff from the autoregression on the sample unique to month t

y_{t-k} = the actual payoff for month $t - k$

The next three models constructed use the non-inclusive trailing moving average as a forecast of monthly payoffs. The first uses the six-month moving average (6M), the second uses the twelve-month moving average (12M), and the third uses the eighteen-month moving average (18M). The forecast data sets thus have 113, 107, and 101 estimates respectively.

The fifth model (HIST M) uses the non-inclusive trailing historic mean as an estimate of future payoff. The mean is calculated using only payoffs prior to the month being forecast. The model's forecast data set contains 118 estimates.

The last model (1M) uses the previous-month's payoff as an estimate of this month's payoff. It can be viewed as a trailing one-month moving average model, but is treated separately due to its unique implication: if the model performs well, it indicates that the payoffs follow a random walk where the best estimate of a value is the last available value. This model can also be viewed as a special-case (one-lag) autoregressive model which does not include an intercept term or estimate of the slope coefficient. The model's forecast data set contains 118 estimates.

A summary of the six models is shown in Table 7.1 below.

Table 7.1. Summary of Monthly Payoff Style-timing Models

The table displays the models tested for the ability to forecast the monthly payoffs to standardised firm-specific attributes. The actual monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The number of forecasts is constrained by the number of observations needed for each model's forecast.

Code	Forecasts	Description
AR12	95	Forecast is made using the regression equations estimated when payoffs are autoregressed against 12 lags. Parameters of the model are estimated using an "expanding window" sample period.
6M	113	Forecast is equal to the six-month trailing moving average (not inclusive)
12M	107	Forecast is equal to the twelve-month trailing moving average (not inclusive)
18M	101	Forecast is equal to the eighteen-month trailing moving average (not inclusive)
Hist M	118	Forecast is equal to the trailing historic mean (not inclusive)
1M	118	Forecast is equal to the payoff in the previous month

The in-sample forecasting ability of the six timing models is evaluated using three main criteria: (1) the correlation between the forecast payoffs and the realised payoffs; (2) the ratio of the number times the payoff direction was correctly forecast to total forecasts, and (3) U -statistics.

The correlation coefficient is basically that of Pearson (1896) and is calculated using the following equation:

$$r = \frac{\sum_{t=1}^h (\hat{y}_t - \sum_{t=1}^h \hat{y}_t / h)(y_t - \bar{y})}{\sqrt{\sum_{t=1}^h (\hat{y}_t - \sum_{t=1}^h \hat{y}_t / h)^2 \sum_{t=1}^h (y_t - \bar{y})^2}} \quad (7.5)$$

where \hat{y}_t and y_t are the forecast and realised payoffs for month t , h is the number of forecasts, and $\sum_{t=1}^h \hat{y}_t / h$ and \bar{y} are the respective means of the forecast and realised payoffs. This is similar to the Information Coefficient (IC) of Grinold (1989) which compares forecast share returns to realised share returns. The significance of the correlations is assessed using the t-test displayed in Equation 7.2.

The correlation coefficient shows the relationship between the forecast and realised payoffs and lies between positive and negative one. A correlation of positive one indicates a perfect fit and a correlation of zero indicates that the two series are unrelated. Negative correlations imply the model's forecast payoffs are of the incorrect direction thus indicating a particularly bad model that will result in the loss of value. A correlation of negative one implies the model predicts the exact opposite of what is actually realised. This case can be considered the worst scenario. However, in a rather perverse way the model can be used for timing where the action taken is the exact opposite of that suggested by the model.

The models' ability to predict the correct direction of the payoff is further assessed using a ratio of the number of times the payoff direction was correctly forecast to total

forecasts (this ratio will be referred to as the “direction ratio”). The nonparametric Sign Test is used to test the null hypothesis that the models predict the correct sign less than 50% of the time. The probability mass function used is that stated in Chapter Six Section 6.2.6 Equation 6.10, except that here N is the total number of forecasts and c is the number of correct forecasts. The test is a one-tailed test as it is expected that the model forecasts better than a random process. The null is rejected if the cumulative probability associated with the number of correct forecasts is greater than $(1-p)$ where p is the level of significance.

While direction predictability may be critical, the measure does not consider the magnitudes of the payoffs when the direction predictions are correct and incorrect. Thus a model with a direction ratio of 50% (implying that the model does not add value in terms of sign prediction as this is the expected chance in a fair game model with two possible outcomes) may still be valuable if it is able to correctly predict the direction of the payoffs when the magnitudes of those payoffs are large relative to the magnitudes of the payoffs for the months in which the direction prediction was incorrect.

The Root Mean Squared Error (RMSE) and Mean Absolute Percentage Error (MAPE) statistics are also calculated and displayed. Although the RMSE depends on the scale of the dependent variable, it can be used as a relative measure to compare forecasts for the same series across different models. For both RMSE and MAPE, the smaller the error, the better the forecasting ability of the model.

The U -statistic is a scale-invariant error statistic and always lies between zero and one, where zero indicates a perfect fit (Pindyck and Rubinfeld, 1998). This enables comparisons between models to be more meaningful than the above error statistics and is thus used as the main error statistic.

The calculation of the RMSE, MAPE, and U statistics is displayed below:

$$RMSE = \sqrt{\sum_{i=1}^h (\hat{y}_i - y_i)^2 / h} \quad (7.6)$$

$$MAPE = 100 \sum_{i=1}^h \left| \frac{\hat{y}_i - y_i}{y_i} \right| / h \quad (7.7)$$

$$U = \frac{\sqrt{\sum_{i=1}^h (\hat{y}_i - y_i)^2 / h}}{\sqrt{\sum_{i=1}^h \hat{y}_i^2 / h + \sum_{i=1}^h y_i^2 / h}} \quad (7.8)$$

The mean and standard deviations of the above five measures are calculated across the characteristics to enable overall comparison between the models.

Additional informational content is contained in the U -statistic. The mean squared forecast error can be decomposed into three components: the bias (U^M), variance (U^S) and covariance (U^C) proportions of the second moment of prediction errors, as displayed below (Theil, 1958):

$$U^M = \frac{((\sum_{i=1}^h \hat{y}_i / h) - \bar{y})^2}{\sum_{i=1}^h (\hat{y}_i - y_i)^2 / h} \quad (7.9)$$

$$U^S = \frac{(s_{\hat{y}} - s_y)^2}{\sum_{i=1}^h (\hat{y}_i - y_i)^2 / h} \quad (7.10)$$

$$U^C = \frac{2(1-r)s_{\hat{y}}s_y}{\sum_{i=1}^h (\hat{y}_i - y_i)^2 / h} \quad (7.11)$$

where $\sum_{i=1}^h \hat{y}_i / h$, \bar{y} , $s_{\hat{y}}$ and s_y are the means and biased²¹ standard deviations of \hat{y}_i and y_i , and r is the absolute correlation between \hat{y}_i and y_i .

The bias proportion measures the extent to which the mean of the forecast deviates from the mean of the actual series and thus provides an indication of systematic error. The variance proportion indicates the ability of the model to replicate the degree of variation of the actual series. The covariance proportion measures the remaining unsystematic forecasting errors. The inequality proportions add up to one. Optimally, the bias and variation proportions should approach zero so that most of the bias is concentrated on the covariance proportion (Pindyck and Rubinfeld, 1998; Theil, 1958).

7.3. Results

The autocorrelations and partial-autocorrelations are displayed in Appendices D.2 and D.3, and the LB Q -statistics and related p-values are displayed in Appendices D.4 and D.5. Thirteen characteristics show significant autocorrelation with at least one lag, but these lags are not consistent across the characteristics. First order autocorrelation is only significant for TV_3M, CFTBORRREPDIV, CFTBORRREPDIV_2YR and DPS_6M. The partial autocorrelations, which show the explanatory power of each lag after controlling for the other eleven lags, show significant partial autocorrelation for fifteen of the characteristics, with most of the significant lags being within the first five lags. The LB Q -statistics however show significant autocorrelation for only five characteristics, two of which become significant after five lags, one becomes significant after nine lags and two only

²¹ The difference between biased and unbiased standard deviation depends on the denominator used in the variance calculation. Unbiased variance is calculated as $\frac{1}{n-1} \sum_{i=1}^n (y_i - \bar{y})^2$ while biased variation is calculated as $\frac{1}{n} \sum_{i=1}^n (y_i - \bar{y})^2$.

become significant after ten lags. These are BTMV(10), TV(9), CFTBORRREPDIV(5), CFTBORRREPDIV_2YR(10), and DPS_6M(5).

The correlations between the forecast and realised payoffs are calculated for each style characteristic for each model. The mean correlation for each model (calculated across the style characteristics) and related standard deviation are displayed in Figure 7.1 below. The full set of correlations is displayed in Table 7.2, and the correlations significant at the 5% level are displayed in bold.

Figure 7.1. Average Correlation between Forecast and Realised Payoffs

The correlations between the forecast and realised payoffs are calculated for each standardised style characteristic for each model. The dark bars represent the mean (across the attributes) correlations between the forecast and realised payoffs for each model, and the light bars display the related standard deviation. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The greater the correlation the better the style-timing model.

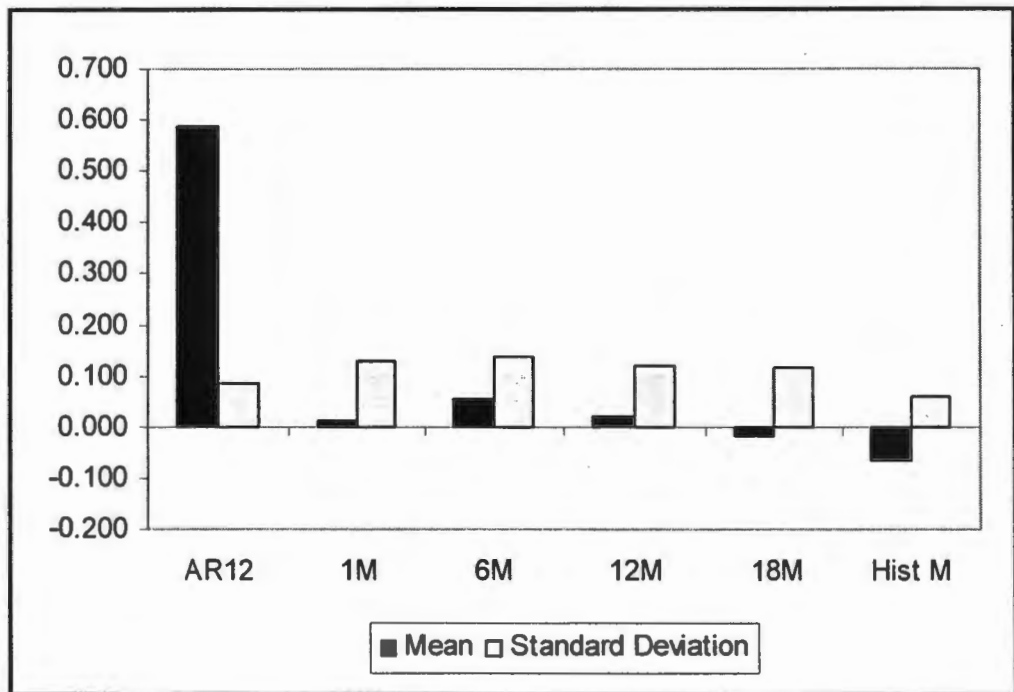


Table 7.2. Correlation between Forecast and Realised Payoffs

The correlations between the forecast and realised payoffs are calculated for each standardised style characteristic for each model. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. Correlations significant at the 5% level in a t-test are displayed in bold. The greater the correlation the better the style-timing model. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	AR12	1M	6M	12M	18M	Hist M
Liquidity						
TV	0.604	0.010	0.179	0.175	0.131	-0.118
Momentum						
MOM_12M	0.546	0.028	0.034	-0.050	-0.096	-0.091
MOM_3M	0.628	-0.070	0.072	0.044	-0.043	-0.086
Performance						
ACCRU	0.587	0.114	0.136	0.018	0.006	-0.136
CFTBORRREPDIV	0.416	0.192	0.198	0.106	0.020	0.013
Size						
LNP	0.622	-0.002	0.187	0.090	0.099	-0.046
Value						
BTMV	0.591	-0.106	0.241	0.243	0.241	-0.095
CFTP	0.511	-0.090	-0.123	-0.108	-0.181	-0.032
Change in Liquidity						
MVTRADEM_1YR	0.534	0.089	0.191	0.179	0.163	-0.094
MVTRADEM_2YR	0.598	0.142	0.092	0.113	-0.021	0.048
TV_6M	0.506	-0.141	-0.212	-0.185	-0.101	-0.145
MVTRADEM_1M	0.625	-0.095	-0.100	-0.145	-0.188	-0.059
TV_2YR	0.684	-0.116	-0.065	-0.069	-0.095	0.060
TV_3M	0.636	-0.257	-0.102	-0.190	-0.128	-0.137
Change in Performance						
DIV_2YR	0.534	0.107	0.073	-0.010	0.017	-0.085
DPS_6M	0.743	0.322	0.228	0.127	0.064	-0.066
ROCE_6M	0.340	-0.018	-0.149	0.024	0.016	-0.088
CFTBORRREPDIV_2YR	0.700	-0.232	-0.112	-0.049	-0.047	-0.042
DPS_1YR	0.583	0.081	0.177	0.137	-0.006	-0.053
Change in Size						
LNMV_1YR	0.566	0.114	-0.062	-0.179	-0.299	-0.149
LNMV_2YR	0.658	0.119	0.082	0.030	-0.088	-0.043
Change in Value						
RETEN_1YR	0.543	-0.092	0.098	0.123	0.094	-0.033
MTBV_2YR	0.525	-0.007	0.118	0.154	0.015	-0.076
RETEN_2YR	0.688	-0.047	-0.002	-0.085	0.003	-0.137
Liquidity/Size						
MVTRADE	0.622	0.174	0.254	0.075	0.068	0.038
Change in Liquidity / Change in Size						
MVTRADE_3M	0.590	-0.026	0.124	0.021	-0.004	-0.109
Change in Size / Change in Performance						
EPS_6M	0.648	-0.010	-0.080	-0.087	-0.111	-0.058
Mean	0.586	0.007	0.055	0.019	-0.017	-0.067
Standard Deviation	0.085	0.132	0.136	0.122	0.116	0.058

The AR12 model clearly shows the highest average correlation out of the six timing models, with a mean correlation of 0.586. The correlation is high despite the fact that an expanding window is used to determine the regression coefficients. The HIST M

model performs the worst and in fact displays a slightly negative correlation. The remaining mean models' performances are all fairly similar. It is interesting to note that the dispersions in the correlation coefficient across the styles, as measured by standard deviation, are rather similar across the models. The result of the high mean of the AR12 model is also strengthened somewhat by the model having the second lowest standard deviation in correlation. Table 7.2 shows that all of the correlations for the AR12 model are significant at the 5% level.

Figure 7.2 below displays the mean and standard deviation of the direction ratios calculated for the style characteristics for each model, and Table 7.3 displays the direction ratios for all the characteristics using each model. Appendix D.6 shows the p-values from the Sign Test testing whether or not the probability of correct direction forecast is greater than 50%, and Appendix D.7 graphically shows the mean and standard deviation of the Sign Test p-values for the style characteristics for each model.

Figure 7.2. Average Direction Ratios Comparing Forecast to Realised Payoffs

Direction ratios displaying the number of times the direction of the payoff to an attribute is correctly forecast to total forecasts are calculated for each standardised style characteristic for each model. The dark bars represent the mean (across the attributes) direction ratios for each model, and the light bars display the related standard deviation. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The greater the direction ratio the better the style-timing model.

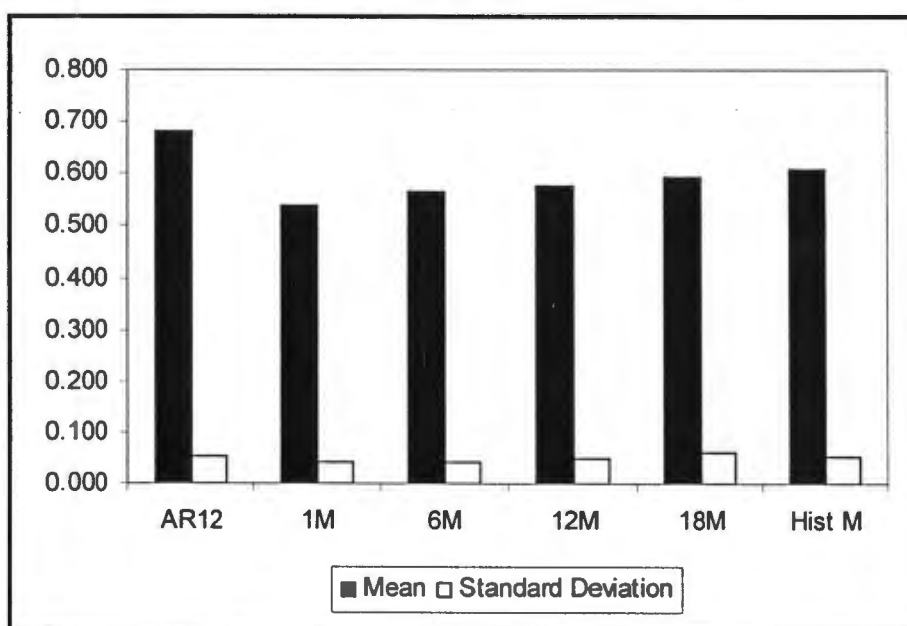


Table 7.3. Direction Ratios Comparing Forecast to Realised Payoffs

Direction ratios displaying the number of times the direction of the payoff to an attribute is correctly forecast to total forecasts are calculated for each standardised style characteristic for each model. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. Figures displayed in bold are significant at the 5% level in the nonparametric Sign Test which tests the null hypothesis that the models predict the correct sign less than 50% of the time. The greater the direction ratio the better the style-timing model. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

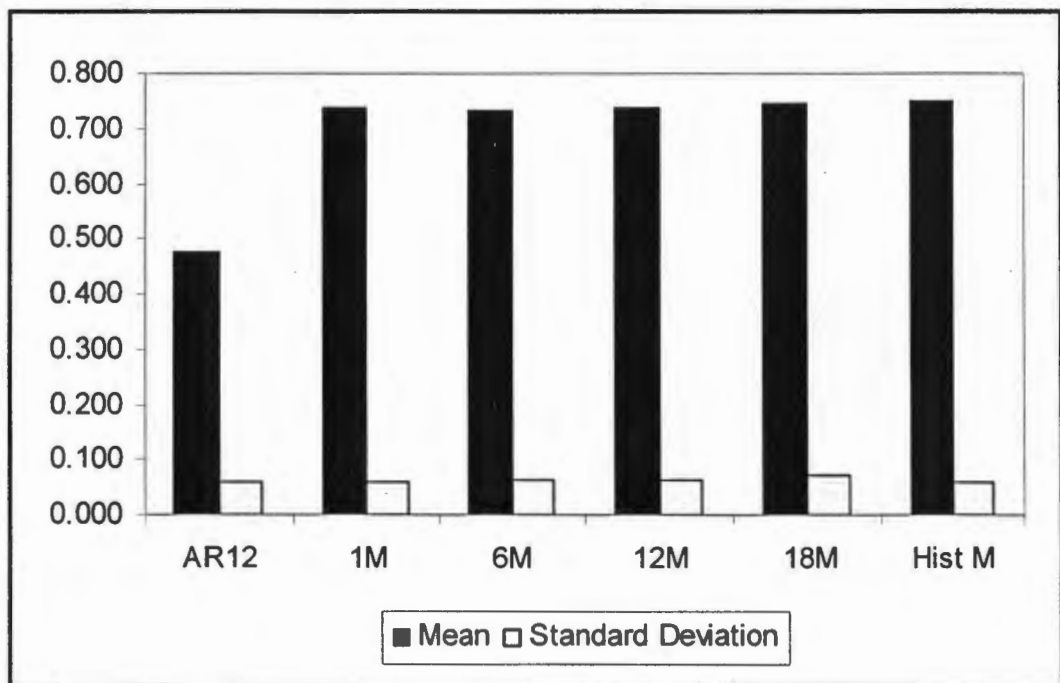
	AR12	1M	6M	12M	18M	Hist M
Liquidity						
TV	0.695	0.534	0.522	0.523	0.564	0.534
Momentum						
MOM_12M	0.716	0.593	0.593	0.692	0.703	0.678
MOM_3M	0.768	0.576	0.611	0.607	0.614	0.644
Performance						
ACCRU	0.611	0.602	0.566	0.533	0.564	0.551
CFTBORRREPDIV	0.600	0.483	0.522	0.505	0.495	0.542
Size						
LNP	0.800	0.585	0.611	0.636	0.653	0.644
Value						
BTMV	0.747	0.517	0.566	0.607	0.653	0.619
CFTP	0.642	0.551	0.593	0.589	0.604	0.653
Change in Liquidity						
MVTRADEM_1YR	0.716	0.517	0.602	0.664	0.673	0.669
MVTRADEM_2YR	0.674	0.559	0.584	0.607	0.634	0.678
TV_6M	0.621	0.449	0.566	0.579	0.604	0.593
MVTRADEM_1M	0.632	0.551	0.637	0.598	0.594	0.619
TV_2YR	0.705	0.551	0.575	0.533	0.505	0.610
TV_3M	0.621	0.483	0.566	0.542	0.574	0.576
Change in Performance						
DIV_2YR	0.695	0.636	0.619	0.636	0.733	0.712
DPS_6M	0.600	0.492	0.549	0.570	0.554	0.610
ROCE_6M	0.632	0.525	0.540	0.589	0.614	0.593
CFTBORRREPDIV_2YR	0.695	0.475	0.496	0.561	0.515	0.602
DPS_1YR	0.705	0.492	0.540	0.551	0.545	0.568
Change in Size						
LNMV_1YR	0.653	0.559	0.584	0.589	0.584	0.636
LNMV_2YR	0.695	0.568	0.513	0.467	0.485	0.559
Change in Value						
RETEN_1YR	0.705	0.559	0.566	0.598	0.584	0.551
MTBV_2YR	0.684	0.534	0.522	0.589	0.594	0.661
RETEN_2YR	0.632	0.525	0.478	0.514	0.535	0.492
Liquidity/Size						
MVTRADE	0.747	0.576	0.655	0.617	0.574	0.576
Change in Liquidity / Change in Size						
MVTRADE_3M	0.716	0.517	0.575	0.589	0.594	0.627
Change in Size / Change in Performance						
EPS_6M	0.726	0.525	0.549	0.561	0.624	0.619
Mean	0.683	0.538	0.567	0.579	0.591	0.608
Standard Deviation	0.053	0.043	0.042	0.050	0.060	0.052

All the models predict the correct direction more than 50% of the time, but only just. The worst predictor is the 1M model which is correct, on average, 53.8% of the time. The direction ratios gradually improve for the mean models, reaching 60.8% for the HIST M model. However, the AR12 model is again the best model, with a direction ratio of 68.3%. Even though it has the second highest standard deviation of 0.053%, the standard deviations are all low and fairly similar, ranging from 0.042% to 0.046%. Table 7.3 clearly shows the overall superiority of the AR12 model. However, the other models in fact display good direction forecasting ability for certain characteristics.

Finally, the mean and standard deviation across the styles of the U -statistic is displayed in Figure 7.3, with the full set of U -statistics displayed in Appendix D.8.

Figure 7.3. Average Theil Inequality Coefficient for Style-timing Models

Theil (1958) Inequality Coefficients are calculated for each standardised style characteristic for each style-timing model. The dark bars represent the mean (across the attributes) Theil Inequality Coefficients for each model, and the light bars display the related standard deviation. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The Theil Inequality Coefficient lies between zero and one, and the lower the coefficient, the better the style-timing model.



The results present a similar picture to that of the correlation and direction ratio assessments. The AR12 model performs the best with an average U -statistic of 0.476

while the other models display similar performance. The standard deviation of the statistic is again small and almost the same across the models. This means that for each model, the U -statistic calculated is rather similar all styles.

The RMSE and MAPE statistics are also calculated for the models and are displayed in Appendices D.9 and D.10. The bias, variance, and covariance of the models are shown for each style in Appendices D.11 to D.13. All of the timing models show almost no bias. However, while the AR12 model shows high covariance (average of 0.735) and low variance (average of 0.265), the other models in fact show high variance and low covariance, with the averages ranging from 0.777 to 0.856 (variance) and from 0.144 to 0.223 (covariance). This demonstrates the superiority of the AR12 model, as the optimal ratio of bias to variance to covariance is 0:0:1. The main problem with the mean models thus stems from their constant underestimation of the variance in actual payoffs.

Appendices D.14 to D.19 also display the statistics used to compare the models in this section, but instead display the statistics by model.

7.4. Summary and conclusion

The main aim of this chapter is to investigate the ability of six style-timing models to forecast the monthly payoffs to the final 27 significant characteristics as determined in Chapter Six. The six models are: (1) a twelve-lag autoregressive model; (2) a six-month moving average model; (3) a twelve-month moving average model; (4) an eighteen-month moving average model; (5) a trailing historic mean model; and (6) a one-month model which uses the previous-month's payoff as an estimate of this month's payoff.

The decision to use twelve lags for the autoregressive model stems from an analysis of a correlogram, which shows that none of the lags particularly stands out across the characteristics. From the correlogram, some characteristics display significant

autocorrelation even at late lags such as lag ten and lag eleven. The inconsistency, as well as the suspected seasonality in the characteristics' payoffs, leads to the decision to use an autoregressive model with twelve lags. Ljung-Box (1978) Q -statistics however show significant autocorrelation for only five characteristics, two of which become significant after five lags, one becomes significant after nine lags and two only become significant after ten lags. This is in contrast to the arguments of Barberis and Shleifer (2003) who predict that style returns exhibit a rich pattern of own- and cross-autocorrelations.

The autoregressive model's forecasts are calculated using an "expanding window" data set, thus the only data that are available at the time are used to forecast future payoffs. The average lag coefficients of the lagged variables and average intercept for each style are assessed for significance using Student's (1908) t -test. Most of these average lag coefficients and intercepts are significant for all styles with the exception of the cashflow-to-price characteristic for which none of the average lag coefficients or the average intercept are significantly differently from zero.

Using the correlation between the forecast and realised payoffs, the ratio of the number of times the payoff direction was correctly forecast to total forecasts, and Theil's (1958) Inequality Coefficient, it was found that the twelve-lag autoregressive model convincingly displays the best performance out of the timing models. The other five models do not show much forecasting ability and do not show any marked difference in performance from each other. The poor performance of the one-month model indicates that Wang's (2003) style momentum strategy, in which he ranks the style portfolios in each month according to their returns over the previous month and then buys the winner style and short-sells the loser style, should not work in the Australian market for the 27 style characteristics examined.

The autoregressive model used in this chapter produces superior results to those used by Lucas, van Dijk, and Kloek (2001) who find statistical techniques such as autoregression are not useful in predicting the future sign and magnitude of style payoffs.

The ability to time the payoffs to the style attributes enables the investor to improve the performance of a style-based strategy. In fact, characteristics found to be insignificant in cross-sectional tests may be exploitable through timing if the fluctuation in payoffs occurs in a predictable fashion. This chapter however simply focuses on improving the performance of characteristics that are already found to be significant in cross-sectional tests, and finds that their monthly payoffs can to some extent be forecast using a twelve-lag autoregressive model.

Seasonality in the Monthly Style Payoffs

8.1. Introduction

As previously discussed in Chapter Three, the style-based anomalies are often associated with the January and turn-of-the-year effects. The Australian evidence documents seasonal effects in the months of January, December, July, and August (see Chapter Three Section 3.6), but is fairly silent on the relation between the seasonal effects and the style-characteristics anomalies.

There are three main objectives of this chapter: (1) to test whether the 27 significant characteristics identified in Chapter Six retain their significance after the months of January, December, July, and August are removed from the sample; (2) to assess whether their monthly payoffs exhibit seasonality; and (3) to identify the months in which these characteristics have particularly high (low) payoffs.

The remainder of the chapter is set out as follows: Section 8.2 discusses the data and methodologies employed, Section 8.3 reports the results, and Section 8.4 summarises and concludes.

8.2. Data and methodology

The data set consists of the monthly payoffs to the final 27 significant characteristics as determined during the cross-sectional regressions in Chapter Six. During the cross-sectional regressions, the characteristics' observations were matched with the returns for the following month. This means that a calculated monthly payoff for month m is

actually the payoff related to month $(m + 1)$. For this chapter, the data set is therefore re-labelled to correctly match the payoff with the calendar month.

Appendices E.1 and E.2 display the mean and median payoff for each calendar month. The only month that partially stands out is that of July. However, conclusions from visual inspection are difficult to make as Australia has been found to have seasonality effects in four months.

Three sets of tests are conducted. The first follows the methodology of Michaud (1999) who assesses the January effect and aims to solve the first objective of this analysis. Basically, when each characteristic is tested for significance in Chapter Six, the average of the time-series of monthly payoffs from the cross-sectional regressions is subjected to Student's (1908) t-test (referred to as "t-test" for the remainder of the chapter). This t-test is again conducted for the final 27 characteristics, but the month of January is omitted from the data set. In the following three tests, the t-test is repeated but the months of December, July and August are excluded. Michaud's (1999) methodology is then extended and combinations of the four historically anomalous months are excluded and the tests repeated. The last t-test is performed on the data set that excludes all four months. The t-statistics are then assessed for significance. It should be noted that as the sample size changes through the exclusion of data, the t-statistics from the t-distribution tables change and thus comparisons between the magnitudes of the calculated t-statistics cannot readily be made. However, given the high number of observations in all the tests, the difference in the t-distributions is very small.²²

The widely used nonparametric test developed by Kruskal and Wallis (1952) (known as the "Kruskal-Wallis H test" and referred to as "KW" for the remainder of the chapter) to test the hypothesis that samples are drawn from the same population is conducted to assess whether the characteristics' monthly payoffs are seasonal²³. While the KW test has been specifically used to assess whether the mean of the

²² The test-t statistics from the distribution tables range between 1.9803 and 1.9904.

²³ The actual null hypothesis of the Kruskal-Wallis test is that the populations from which the samples are drawn have identical population distributions. However, as the test is sensitive to differences in population means, the null hypothesis of mean equality can also be used.

monthly returns differs across calendar months, it is applied here in a similar fashion to test whether the mean monthly payoffs for each characteristic differs across calendar months. Thus rejection of the null hypothesis implies that monthly payoffs to characteristics exhibit seasonality.

The test is similar to the Analysis of Variance (ANOVA) test, but is based on ranks instead of actual payoffs. The test requires the following assumptions (from Conover, 1971): (1) all samples are random samples from their respective populations; (2) there is mutual independence among the various samples; (3) all random variables are continuous; (4) the measurement scale is at least ordinal²⁴; and (5) the population distribution functions of the groups are identical, except for a possible difference in the population medians. The test however does not require the populations to be normally distributed nor have similar variances.

For each characteristic, all the monthly payoffs are first ranked and the observation then replaced by its rank. This data set is then divided into calendar months, and the KW H -statistic is calculated as:

$$H = \frac{12}{N(N+1)} \left[\sum_{m=1}^r \frac{R_m^2}{n_m} \right] - 3(N+1) \quad (8.1)$$

where

N = the total number of observations in the complete data set

R_m = the sum of the ranks in calendar month m

n_m = the number of observations in calendar month m

r = the number of groups (calendar months)

The null hypothesis is rejected if the calculated value of H is greater than or equal to the table value of H (thus only an upper tailed rejection region is used). When the null hypothesis is true, the H -statistic is approximately χ^2 -distributed with $(r-1)$ degrees of freedom (van den Honert, 1999).

²⁴ Values measured on an ordinal scale contain information about their relationship to other values only in terms of whether they are "greater than" or "less than" other values but not in terms of "how much greater" or "how much smaller." (Statsoft Inc. Electronic Textbook)

If the null hypothesis is rejected, the KW test cannot really be used to identify the months responsible for seasonality. Conover (1971) suggests that the KW test may be used to compare two or more groups until the differences between populations have been satisfactorily detected. However, he notes that “the level of significance in all but the first test is distorted and almost completely devoid of meaning, except possibly to aid in ordering the differences from smallest to largest”.

The parametric ANOVA test is also used to assess seasonality in the monthly payoffs, and the Scheffé (1953) parametric test is applied to identify the months causing this seasonality. ANOVA tests the null hypothesis that the population means of monthly payoffs for each calendar month are all equal across the calendar months and that the samples, represented here by calendar months, are drawn from the same population. The test is in fact conducted by comparing the variation within the groups to that between the groups.

The related F-statistic for a test using the calendar month groups shows the ratio of variation between groups to the variation within groups, and is computed as:

$$F = \frac{MSTR}{MSE} \tag{8.2}$$

$$\text{for } MSTR = \frac{\sum_{m=1}^{12} n_m (\bar{Y}_m - \bar{Y})^2}{12 - 1} \tag{8.3}$$

$$\text{and } MSE = \frac{\sum_{m=1}^r \sum_{i=1}^{n_m} (Y_{i,m} - \bar{Y}_m)^2}{N - r} \tag{8.4}$$

where

\bar{Y}_m = the mean of the observations in group m

\bar{Y} = the mean of all of the observations

- n_m = the number of observations in group m
 $Y_{i,m}$ = the i^{th} observation in group m
 N = the total number of observations
 r = the number of groups

The ratio of the variances follows the F-distribution with the numerator having $(r-1)$ degrees of freedom, and the denominator having $(N-r)$ degrees of freedom. If the two variance estimates are equal or similar, the F-statistic should be close to a value of one. Rejection of the null hypothesis occurs when the variation between the groups is significantly larger than the variation within the groups.

Scheffé's (1953) method of multiple comparisons is used to identify which pairs of group means differ from each other. The method sets up a critical range (CR) calculated as follows:

$$CR = \sigma \left[\sqrt{(r-1)F_{r-1;N-r}^{\alpha}} \right] \quad (8.5)$$

and

$$\sigma = \sqrt{\left[\frac{1}{n_p} + \frac{1}{n_q} \right] MSE} \quad (8.6)$$

Where $F_{r-1;N-r}^{\alpha}$ is the F-value at the α significance level with $(r-1)$ degrees of freedom in the numerator and $(N-r)$ degrees of freedom in the denominator, and n_p and n_q are the sample sizes for the two tested groups.

If the absolute difference between a pair of means (called "contrasts") is greater than the limit set by the critical range, the corresponding population means are said to be significantly different from each other.

ANOVA also makes the assumptions that the observations in each group are independent and that the groups are independent of each other. However, unlike the KW test, ANOVA also assumes that the dependent variable is measured on at least an interval²⁵ scale and is normally distributed within groups, and the variances in the different groups are identical.

Van den Honert (1999) calls the ANOVA tests “robust” and notes that the conclusions from the tests are approximately true for non-normal populations as well. Further, even if variances are not equal amongst populations, the conclusions are approximately true as long as the sample sizes are “about” equal. The Statsoft Inc. Electronic Textbook points out a special case of particular concern. If the means are correlated with variances across the cells of the design, the ANOVA F-statistic may be very misleading. If all of the groups have similar means but one of them has a very large mean, the F-statistic may suggest a statistically significant effect. However, if the group with the large mean also has a large variance (and thus the means and the variances are correlated across the groups – the higher the mean the larger the variance), the apparent effect may in fact be caused by outliers. These outliers can have a large effect on the group’s mean, and as the overall F-statistic is based on a pooled within-group variance estimate, the group with the high mean may be identified as significantly different from the others when in fact it is not significantly different if the test was based on the within-group variance of that group alone. The test is thus sensitive to outliers. (As the KW test uses rankings and not actual observations, it is of course not sensitive to outliers.) An examination of the mean-variance correlation across the groups is conducted to assess the effect of outliers. The correlation is calculated using the correlation formula (Equation 5.1) given in Section 5.2.1.2 of Chapter Five, except that here j , and k , are the mean and variance of the payoffs in calendar month group t , \bar{j} is the mean of all of the payoffs, \bar{k} is the mean of the calendar month groups’ variances, and n is the number of calendar month groups.

²⁵ This scale of measurement allows for the quantification and comparison of the sizes of differences between the measurements. It thus also allows for the ranking of the measurements. No absolute zero is required. (Statsoft Inc. Electronic Textbook)

It should be noted that both the ANOVA and KW tests assume that the groups are independent of each other and that there is independence within each group. The presence of autocorrelation would therefore violate this assumption of independence. Autocorrelation was examined in Chapter Seven Section 7.3, but not much autocorrelation was found to exist. From the LB Q -statistics, the only characteristics that display autocorrelation are BTMV, TV, CFTBORRREPDIV, CFTBORRREPDIV_2YR, and DPS_6M. Interpretations of their results must therefore bear this violation in mind.

8.3. Results

The results from the Michaud (1999) type t -tests are displayed in Appendix E.3. A summary of the losses in significance after month exclusion is displayed in Table 8.1 below. The months are listed in decreasing order of the change in t -statistic.

Most of the characteristics retain their significance after excluding the four months individually and in combination. The LNP (size) characteristic also retains its significance even when all four months are excluded. This is in contrast to that suggested by US evidence of the January- and turn-of-the-year effects' relations with the size effect. The LNP t -statistic does however suffer a large decrease in size when the months of January and July are individually and jointly excluded. This evidence somewhat echoes that of Gaunt, Gray, and McIvor (2000) who examine Australia and find the return-to-price relation is negative in July and positive in all other months except January where the relation does not exist. This is also in accordance with Faff, Brooks, and Josev's (1997) Australian tests that find stocks with significant January, July, and August effects have on average smaller market capitalisations.

Table 8.1. Summary of Changes in Significance when Excluding Seasonal Months

Univariate cross-sectional regressions of standardised firm-specific attributes on unadjusted total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of regression slope coefficients for each characteristic. The data were extracted from DataStream International. The average of the time-series of coefficients is subjected to Student's (1908) t-test before and after certain months (historically found to exhibit seasonality in share returns) are individually and jointly excluded, and the table provides a summary of the changes in significance when these seasonal months were excluded. Significance is measured at the 5% level. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Single Month Excluded	Only When Combination Excluded
MVTRADE	July January August	
EPS_6M	August December	
MTBV_2YR		January, December and July
RETEN_2YR	August July December	
TV	January	
TV_2YR		January and July combinations
TV_3M	January July	
ACCRU	July	January and August
CFTBORRREPDIV	July January August	
DPS_6M		January, December and August
DPS_1YR	August January December	

The EPS_6M characteristic loses significance with the individual exclusions of August and December, but interestingly remains significant when all four months are excluded.

The test thus shows that not all of the characteristics retain their significance after excluding the historically anomalous months.

The results of the KW and ANOVA tests are displayed in Table 8.2 below.

Table 8.2. Results of the Kruskal-Wallis and ANOVA Tests for Seasonality

Univariate cross-sectional regressions of standardised firm-specific attributes on unadjusted total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of regression slope coefficients for each characteristic. The data were extracted from DataStream International. The payoffs to attributes are divided into calendar months, and the calendar months are then subjected to the Kruskal and Wallis (1952) and ANOVA tests to assess whether the calendar months are different from each other. The Kruskal-Wallis test-statistic follows a chi-squared distribution, and the ANOVA test-statistic follows an F-distribution. The characteristics are ordered in descending order of seasonality significance for both tests, and characteristics displaying significant seasonality at the 5% level are displayed in bold. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Kruskal-Wallis		ANOVA	
Characteristic	χ^2 -stat	Characteristic	F-stat
TV_2YR	26.68	LNP	3.84
LNP	26.22	TV_2YR	2.80
EPS_6M	24.91	MVTRADE	2.57
MVTRADE	22.90	EPS_6M	2.10
MVTRADEMV_1M	21.04	MVTRADEMV_2YR	2.00
TV_3M	19.46	TV_3M	1.89
DIV_2YR	17.39	MVTRADEMV_1M	1.66
MVTRADEMV_2YR	16.60	MOM_3M	1.58
TV	15.54	ACCRU	1.58
ACCRU	15.03	DIV_2YR	1.54
DPS_6M	14.83	TV	1.46
MOM_3M	14.62	MOM_12M	1.25
MVTRADE_3M	14.39	MVTRADE_3M	1.19
CFTP	13.00	RETEN_2YR	1.12
CFTBORRREPDIV_2YR	12.53	DPS_1YR	1.07
CFTBORRREPDIV	12.44	MTBV_2YR	1.03
MOM_12M	12.06	CFTBORRREPDIV_2YR	0.96
RETEN_2YR	10.89	MVTRADEMV_1YR	0.93
DPS_1YR	10.87	LMNV_2YR	0.93
MVTRADEMV_1YR	10.48	TV_6M	0.91
TV_6M	8.73	CFTBORRREPDIV	0.91
LMNV_2YR	8.55	BTMV	0.91
LMNV_1YR	8.45	DPS_6M	0.85
BTMV	7.90	LMNV_1YR	0.78
MTBV_2YR	7.18	ROCE_6M	0.67
ROCE_6M	4.05	CFTP	0.65
RETEN_1YR	3.96	RETEN_1YR	0.28

Only five characteristics are found to have significant seasonal fluctuations in their monthly payoffs in the KW test. While the TV_2YR, EPS_6M and MVTRADE characteristics lose their significance when certain months are excluded, the LNP and MVTRADEMV_1M characteristics did not. It is interesting to note that the LNP characteristic does in fact display seasonality here.

Both tests display similar results and find significant seasonality in the TV_2YR, EPS_6M and MVTRADE characteristics. From the t-statistics comparison test, it can be concluded that they are at least related to the four historically anomalous months. ANOVA also finds significant seasonality in the LNP characteristic. While the KW test finds MVTRADEMV_1M seasonally significant, ANOVA does not. And while ANOVA finds MVTRADEMV_2YR and TV_3M seasonally significant, the KW test does not.

The parametric Scheffé (1953) test is unable to identify the months causing the seasonality. The only characteristic that has at least two calendar month's payoffs significantly different to each other is the LNP characteristic. The payoffs in the month of July are significantly different to those in June and March, with the absolute value of the differences being 0.0343 and 0.0298 respectively.

The correlations between the means and variances of the calendar months are displayed in Appendix E.4. The only characteristics showing high correlation are TV_2YR (seasonal in all three tests), LNP (seasonal in KW and ANOVA tests), and DPS_6M and ACCRU (which only stand out in the first test). As the characteristics displaying high mean-variance correlation and displaying seasonality in the ANOVA test also display seasonality in the KW test, the effect of outliers is not the main cause of the seasonality result. The autocorrelation of DPS_6M (see Chapter Seven Section 7.3) however violates the independence assumption. Its results in this section are thus highly suspicious.

8.4. Summary and conclusion

International literature has documented relations between the January effect and several of the anomalous style-based anomalies. While seasonality in share returns is well documented on the Australian market, the literature is fairly silent on the interaction between seasonality and the style characteristics in Australia. This chapter aims to identify whether these relations do in fact exist as well as document their interaction.

The first set of tests conducted is based on the test of Michaud (1999) where the average of the time-series of monthly payoffs to the style characteristics is assessed for significance after certain months are removed from the data set. While Michaud (1999) removes January from his data set as a January seasonal effect has been historically documented, tests on Australia require the removal of four months as January, December, July, and August seasonals have been found to exist in prior research. Most of the characteristics retain their significance after individually and jointly removing the historically anomalous months. The natural log of price (size) characteristic, which has been related to the January and turn-of-the-year effects (this would be July in Australia) in the US, also retains its significance. However, the magnitude of its t-statistic suffers a large decrease when the months of January and July are individually and jointly excluded. This is in accordance with the findings of Gaunt, Gray, and McIvor (2000) and Faff, Brooks, and Josev (1997).

The parametric ANOVA and nonparametric Kruskal and Wallis (1952) tests are performed to determine whether the monthly payoffs of the style characteristics exhibit seasonality. Both tests find seasonality in the payoffs of the same four factors, while the Kruskal-Wallis test finds seasonality in an additional factor and the ANOVA test finds seasonality in an additional two factors. The size effect is found to be significantly seasonal in both the ANOVA and Kruskal-Wallis tests, a finding that is in strong contrast with the evidence of Brown, Keim, Kleidon, and Marsh (1983) who report that the size effect is unaffected by the seasonal effect.

Both the ANOVA and Kruskal-Wallis tests assume that the groups are independent of each other and that there is independence within each group. While the presence of autocorrelation for five of the characteristics (see Chapter Seven Section 7.3) violates the assumption of independence, these characteristics were not found to exhibit seasonality in the ANOVA and Kruskal-Wallis tests.

A Scheffé (1953) test procedure is employed to identify the months responsible for the seasonality in the monthly payoffs, but is however unable to identify these months. The test was only able to show that the month July has significantly higher payoffs to the natural log of price characteristic than the months of June and March.

While seasonality in share returns may exist in Australia, this chapter does not present convincing evidence that the style payoffs are being driven by a seasonality effect. And even though the payoffs do exhibit some seasonality, the tests used are unable to identify the months responsible for this seasonality.

Multivariate Style Analysis, Timing, and Expected Return Models

9.1. Introduction

The univariate regressions in Chapter Six give rise to 51 significant variables (using unadjusted returns). As noted in the univariate analysis, the initial list of characteristics is meant to be a comprehensive list thus naturally resulting in similarity between various characteristics. The list of 51 variables is somewhat simplified by analysing a correlation matrix of their monthly payoffs (as discussed in Chapter Six) which yields a “final” list of 27 characteristics.

Michaud (1999) notes that: “...univariate analysis provides limited useful information for forecasting return in practice. One important reason for this limitation is that a variable with significant explanatory power in isolation from other variables may become dominated when combined with other factors. Issues of consequence include factor interrelationships and factor-return dynamics”. The correlation assessment performed in Chapter Six somewhat mitigates this multicollinearity for two-factor style-characteristics models. However, models containing more than two explanatory variables can result in a characteristic being dominated by the combination of other factors in the model to the point where it no longer remains significant. Thus the list of 27 variables does not imply that there are 27 factors for the market as there may be repetition in cross-sectional variance explanation.

The list of 27 variables cannot simply all be included in a multifactor model. Michaud (1999) explains that increasing the number of variable in a regression may increase in-sample explanatory power but may also reduce out-of-sample forecast power. He states that: “A parsimonious, but comprehensive, representation of the active-return-generating process with relatively uncorrelated factors that have intuitive investment

content may sacrifice in-sample fit for increased ability to effectively use exogenous information for forecasting return”.

This chapter first undertakes to simplify the list of 27 variables further and thus construct a multifactor model with K -factors in which all the factors remain significant in the multivariate framework. The chapter also examines the ability of a twelve-lag autoregressive model to predict the controlled payoffs of the factors that comprise the derived multifactor model.

The chapter then uses the six style-timing models examined in Chapter Seven in applying the methodology of Haugen and Baker (1996) and examines the share return forecasting ability of the derived K -factor model.

Finally, the chapter aims to construct multifactor expected return models by applying the methodology of Haugen and Baker (1996) in a stepwise framework. The six timing models examined in Chapter Seven are used to forecast the slopes of the attributes in the models and as such six expected return models are created and compared for share return forecasting ability. Attributes with a t -statistic greater than 1.00 in the univariate (unadjusted returns) tests of Chapter Six are used as candidate factors. While some may not have been significant in Student's (1908) t -test (referred to as “ t -test” for the remainder of the chapter), they may nevertheless be useful in a multifactor expected return model. This list of variables need not be simplified for high correlation as the stepwise multivariate procedure takes multicollinearity into account. All the regressions performed in the chapter are Ordinary Least Squares (OLS) regressions

The remainder of the chapter is set out as follows: Section 9.2 outlines the data and methodology, Section 9.3 presents the results, and Section 9.4 summarises and concludes.

9.2. Data and Methodology

9.2.1. Multivariate cross-sectional Regressions

The total monthly returns and attribute data were obtained from DataStream International and are sorted and manipulated as described in Chapter Four, leaving 367 companies for the sample period 1 July 1994 to 30 May 2004. As with the univariate tests in Chapter Six, the cross-sectional distribution of each style characteristic in each month is standardised to yield a mean of zero and a standard deviation of one, which enables comparison between the magnitudes of the cross-sectional regression slopes. The only attributes examined in these first tests are those of the “final list” of 27 variables as derived in Chapter Six. Only the unadjusted returns are used due to the similarity of the unadjusted and risk-adjusted results seen in Chapter Six. For each of the 27 attributes, the value of the attribute is taken to be the exposure of the stock to the attribute.

The creation of the multifactor model starts by cross-sectionally regressing the most significant characteristic of the 27 variables on the monthly forward returns (as performed in Chapter Six). Then, the second most significant characteristic is included in the regression thus resulting in a cross-sectional regression with two explanatory variables. The monthly regression is of the form:

$$r_{i,t+1} = \gamma_{0,t+1} + \gamma_{1,t+1}A_t + \gamma_{2,t+1}B_t + \varepsilon_{i,t+1} \quad (9.1)$$

where A_t and B_t represent the standardised candidate factors, $\gamma_{1,t+1}$ and $\gamma_{2,t+1}$ are the respective cross-sectional coefficients, and $r_{i,t+1}$, $\gamma_{0,t+1}$, and $\varepsilon_{i,t+1}$ are the same as in the univariate regressions and represent the realised return on share i for month $t+1$, the constant intercept term, and the residual error respectively. The mean values of the time-series of cross-sectional slope coefficients $\gamma_{1,t+1}$ and $\gamma_{2,t+1}$ are subjected to a t -test to identify which slopes are significantly different from zero. If both characteristics are significant, the next most significant characteristic is simultaneously regressed with the first two. Again, the means of the time-series of

monthly slopes are assessed for significance. If the mean slopes of all the characteristics are significant, the process continues.

At any stage, if the characteristic displaying the lowest t-statistic is found to be insignificant at the 5% level, it is removed from the regression. The regression is then repeated for the remaining variables. If there are still variables that are insignificant, they are removed one at a time until all the remaining variables are significant. The process of adding variables then continues until all the 27 variables have been included in the multifactor regressions.

9.2.2. Timing the multivariate factors

The multivariate analysis gives rise to a list of factors that remain significant when multivariate cross-sectional regressions are performed. The regressions produce controlled²⁶ monthly payoffs for each of the characteristics, the mean of which is significant.

The consistency of the direction of monthly controlled payoffs to the factors in the multivariate model is assessed using two measures: (1) the ratio of the number of times the payoff is positive (negative); and (2) the number of times the payoff direction changed expressed as a percentage over total number of months.

As noted in Chapter Six, the ratio of the number of times the payoff is positive (negative) lies between 0% and 100% and characteristics with a higher consistent direction have ratios close to either 100% or 0%. The interpretation of ratios close to 50% is little bit more ambiguous as the ratio does not consider the number of times the payoff direction changes. To be deemed inconsistent, a characteristic should more accurately have a high number of direction *changes*. The second measure accounts for this fluctuation. However, the above two measures do not consider the magnitude related to the direction changes. A more accurate picture of the direction-timing benefits is derived from the comparison between the t-statistics of the average

²⁶ The term “controlled” payoff refers to the slope related to the characteristic when cross-sectional regressions are performed that simultaneously include all the multivariate characteristics as explanatory variables in the regressions.

controlled monthly slopes and a t-statistic calculated on the assumption that the direction of the monthly payoff can be forecast perfectly. This second t-statistic is calculated using the absolute value of the monthly payoffs to each characteristic as the data set.

Twelve-lag autoregressive models (AR12M) are constructed for each characteristic in a similar way to the construction of the univariate AR12 models, except that here the payoffs used are the controlled payoffs of the characteristics. The “expanding window” is again applied, which means that for each characteristic for each month, an intercept and lag coefficients for the lagged variables are calculated from running the autoregression only on the data before that month. As noted earlier, this method is better than using the entire sample to determine an overall intercept and set of lag coefficients as this would be subject to look-ahead bias. An autoregression is thus run for each month. Lag coefficients and intercepts can only be calculated for the last 95 months given the number of observations required for regressions with twelve explanatory variables. OLS regressions are used for the autoregressions.

The autoregressive model’s lag coefficients and intercepts are then combined with the payoffs data set to give rise to a predicted payoffs data set consisting of 95 estimates. They are represented by the following equation, used for each characteristic:

$$y_{est,t} = \alpha_t + \sum_{k=1}^{12} \beta_{t,k} y_{c,t-k} \quad (9.2)$$

where:

$y_{est,t}$ = the estimated payoff in month t

α_t = the intercept from the autoregression on the sample unique to month t

$\beta_{t,k}$ = the slope of the lagged monthly payoff from the autoregression on the sample unique to month t

$y_{c,t-k}$ = the actual controlled payoff for month $t - k$

The in-sample forecasting ability of the AR12M model is evaluated using: (1) the correlation between the forecast payoffs and the realised payoffs; (2) the ratio of the number times the payoff direction is correctly forecast to total forecasts (tested for significance using the nonparametric Sign Test), and (3) Theil's (1958) Inequality Coefficient (referred to as "*U*-statistic" for the remainder of the chapter). For a discussion on the calculation of these statistics, see Chapter Seven Section 7.2.

The Root Mean Squared Error (RMSE) and Mean Absolute Percentage Error (MAPE) statistics are also calculated and displayed. However, as the *U*-statistic is a scale-invariant error statistic that always lies between zero and one, it enables more meaningful comparisons between models than the above error statistics and is thus used as the main error statistic. The *U*-statistic is further broken down into its three components of bias, variance, and covariance. Again, see Chapter Seven Section 7.2 for a discussion on the calculation of these statistics.

9.2.3. Multifactor expected return models

The same total monthly returns and attribute data examined above are used for these tests. However, the attribute data are not standardised for these tests as comparison between univariate slopes is not relevant here.

9.2.3.1. The Haugen and Baker (1996) methodology

This section applies the methodology of Haugen and Baker (1996) and examines the returns forecasting ability of the *K*-factor model derived using the procedure laid out in Section 9.2.1. Haugen and Baker's (1996) methodology aims to predict return using a three-stage procedure. First, multivariate cross-sectional regressions are performed not unlike those performed in this first part of this chapter, except that they include all the possible explanatory variables in the regressions:

$$r_{i,t+1} = \gamma_{0,t+1} + \sum_{k=1}^K \gamma_{k,t+1} F_{i,k,t} + \varepsilon_{i,t+1} \quad (9.3)$$

where

$r_{i,t+1}$ = return to stock i in month $t+1$,

$\gamma_{k,t+1}$ = estimated regression coefficient of factor k in month $t+1$

$F_{i,k,t}$ = exposure to factor k for stock i at the end of month t

Controlled monthly payoffs to the various attributes are derived ($\gamma_{k,t+1}$). In the second stage, Haugen and Baker (1996) use the non-inclusive twelve-month trailing moving average timing model (similar to that employed in Chapter Seven) which makes use of the controlled monthly payoffs dataset to predict the controlled monthly payoffs over the same period. In other words, the average of the previous twelve month's controlled payoffs to an attribute is used to estimate this month's controlled payoff.

The examination in this paper however uses the six timing models analysed in Chapter Seven for their ability to predict the controlled monthly slopes and thus examines six expected return models. The first timing model (1M) uses the previous-month's payoff as an estimate of this month's payoff. It can be viewed as a trailing one-month moving average model, but can also be viewed as a special-case (one-lag) autoregressive model which does not include an intercept term or estimate of the slope coefficient. The next three timing models use the non-inclusive trailing moving average as a forecast of monthly payoffs. The first uses the six-month moving average (6M), the second uses the twelve-month moving average (12M), and the third uses the eighteen-month moving average (18M). The fifth model (HIST M) uses the non-inclusive trailing historic mean as an estimate of future payoff. The mean is calculated using only payoffs prior to the month being forecast. The last timing model is that of the twelve-lag autoregressive model (AR12) described earlier in this chapter. These models are applied in their multifactor form, which basically means they are used to estimate controlled slopes as opposed to univariate slopes.

As noted above, the autoregressive model can only estimate slopes for the last 95 months as it requires a minimum number of observations of 24 for regressions with twelve explanatory variables. OLS regressions are used for the autoregressions. Given the nature of the estimate construction of the other five models, the number of slopes

estimated by these other models are 118 (1M and HIST M), 113 (6M), 107 (12M), and 101 (18M).

In the last stage, the attribute values for share i at the end of month t are combined with the estimated attribute payoffs for month $(t + 1)$ to produce a forecast return for share i :

$$E(r_{i,t+1}) = \gamma_{0,t+1} + \sum_{k=1}^K E(\gamma_{k,t+1})F_{i,k,t} \quad (9.4)$$

where:

$E(r_{i,t+1})$ = forecast return to share i in month $t + 1$

$E(\gamma_{k,t+1})$ = estimated payoff to attribute k in month $t + 1$

The ability of the model to forecast returns is assessed using the Information Coefficient (IC) of Grinold (1989), which is the monthly cross-sectional Pearson (1896) correlation between forecast and realised returns:

$$IC = \frac{\sum_{t=1}^h (\hat{y}_t - \sum_{t=1}^h \hat{y}_t / h)(y_t - \bar{y})}{\sqrt{\sum_{t=1}^h (\hat{y}_t - \sum_{t=1}^h \hat{y}_t / h)^2 \sum_{t=1}^h (y_t - \bar{y})^2}} \quad (9.5)$$

where \hat{y}_t and y_t are the forecast and realised returns for the shares for month t , h is the number of forecasts in month t , and $\sum_{t=1}^h \hat{y}_t / h$ and \bar{y} are the respective means of the forecast and realised returns. This is similar to the formula used in Section 7.2 of Chapter Seven (Equation 7.5) except that here the forecast and realised *returns* are being compared as opposed to forecast and realised *payoffs* (refer to Chapter Seven for comparison if further clarity is required).

Grinold and Kahn (1995) consider the IC statistic to be a measure of a manager's skill (model's accuracy). Banz (2004) states that an IC of 0.1 is considered "quite high" and is evidence of meaningful skill.

Another related measure of forecast accuracy discussed by Grinold and Kahn (1995) is the Information Ratio (IR):

$$IR = IC\sqrt{breadth} \quad (9.6)$$

Grinold and Kahn (1995) use the number of share returns forecast (N) in the month being measured as an indication of breadth and thus approximate the IR as:

$$IR \approx IC\sqrt{N} \quad (9.7)$$

The IR takes into account the breadth over which accuracy (IC) is exercised. Qian and Hua's (2004) IR adjusts the mean IC by the variation in the IC statistic:

$$IR \approx \frac{\overline{IC}}{stdev(IC)} \quad (9.8)$$

where \overline{IC} is the mean monthly IC and $stdev(IC)$ is the standard deviation of the monthly IC . The Qian and Hua (2004) IR approximation provides a measure of the statistical significance of the final mean IC by taking into account the volatility across the monthly IC statistics.

9.2.3.2. Constructing multifactor expected return models

The problem with the Haugen and Baker (1996) methodology is that it does not search for an optimal model, but instead just includes all variables in the expected return model. It may be possible to create better expected return models using a stepwise procedure and examining the forecasting accuracy of the model at each step.

This section aims to create a multifactor expected return model by applying the Haugen and Baker (1996) methodology in a stepwise procedure. Attributes with a t-statistic greater than 1.00 in the univariate (unadjusted returns) tests of Chapter Six are included in the analysis (105 variables). While some may not have been significant in the t-tests, they may nevertheless be useful in a multi-factor expected return model. This list of variables need not be simplified for high correlation as the stepwise multivariate procedure takes multicollinearity into account. For each of the 105 attributes, the value of the attribute is taken to be the exposure of the stock to the attribute.

The stepwise procedure is performed for each of the six timing models discussed above. Six multifactor models are thus constructed. The timing models are applied in their univariate form for the first step of the procedure (which means they are used to predict univariate slopes) after which they are applied in their multifactor form (which means they are used to estimate controlled slopes).

At each step K in the procedure, the aim is to create a model that has the best average monthly IC using independent variables V_1 to V_{k-1} (which are already in the model from previous steps) and an additional independent variable N .

At Step 1, a univariate expected return model is sought. First, univariate cross-sectional OLS regressions are performed. These are exactly the same as in Chapter Six except that here nonstandardised attribute data are used:

$$r_{i,t+1} = \gamma_{0,t+1} + \gamma_{N,t+1} N_{i,t} + \varepsilon_{i,t+1} \quad (9.9)$$

where $N_{i,t}$ represents the value of the attribute of share i at end of each month t , $\gamma_{N,t+1}$ is the cross-sectional coefficient, and $r_{i,t+1}$, $\gamma_{0,t+1}$, and $\varepsilon_{i,t+1}$ are the same as in the univariate regressions and represent the realised return on share i for month $(t+1)$, the constant intercept term, and the residual error respectively.

A set of monthly payoffs ($\gamma_{1,t+1}$) is thus calculated for each of the 105 attributes. These monthly payoffs are used as the dataset to predict the monthly slopes (for each attribute) in accordance with the timing model.

Given the attribute value for share i at the end of month t and the predicted monthly payoff to that attribute for month $(t + 1)$, a forecast monthly return can be calculated for each share:

$$E(r_{i,t+1}) = \gamma_{0,t+1} + E(\gamma_{N,t+1})N_{i,t} \quad (9.10)$$

where:

$$E(r_{i,t+1}) \quad = \text{forecast return to share } i \text{ in month } t + 1$$

$$E(\gamma_{N,t+1}) \quad = \text{predicted payoff to attribute } N \text{ in month } t + 1$$

The accuracy of the monthly forecast returns is then compared to the realised returns for the shares in each month. IC ratios are calculated each month, and the accuracy of the model is assessed by examining the average IC across the months. The attribute that displays the highest average IC takes the place of V_1 for the steps that follow and thus becomes the first attribute to remain in the model.

At Step 2, multivariate cross-sectional regressions using two independent variables are performed with variable V_1 being used as the first independent variable and each of the remaining attributes included as the second independent variable (N) to possibly take the place of V_2 .

$$r_{i,t+1} = \gamma_{0,t+1} + \gamma_{V_1,t+1}V_{1,t} + \gamma_{N,t+1}N_{i,t} + \varepsilon_{i,t+1} \quad (9.11)$$

If V_1 is also used as N , the regressions would in fact be using V_1 as both explanatory variables and thus adds no value from the univariate regressions. As such, only 104 sets of regressions are run at Step 2. These cross-sectional regressions give rise to a set of controlled monthly slopes (γ_{t+1}) for the independent variables. The set of

controlled slopes for V_1 of course varies for each attribute's inclusion as N . The timing model is then employed to predict the monthly controlled slopes for each pair of V_1 and N .

Given the attribute values for share i at the end of month t and the predicted monthly payoffs to the attributes for month $(t + 1)$, a forecast monthly return can be calculated for each share:

$$E(r_{i,t+1}) = \gamma_{0,t+1} + \sum_{k=1}^{K-1} E(\gamma_{1k,t+1})V_{k,t,t} + E(\gamma_{N,t+1})N_{i,t} \quad (9.12)$$

As this is the second step, $K = 2$. Again, monthly forecast returns for each share are then compared to the realised returns to assess model performance.

The attribute N that combines with V_1 to display the highest average IC in this step takes the place of V_2 in the regressions that follow and thus becomes the second attribute to remain in the model.

However, if this two-variable model does not give rise to an average IC greater than that achieved by the model in the previous step, the procedure ends and only the attribute V_1 is used in the model. If the two-variable model does have a greater average IC than the previous step's model, attribute V_2 remains in the model and the procedure continues. At Step 3, the method in Step 2 is repeated, except that here attributes V_1 and V_2 are used as the first two independent variables in all the three-variable regressions and the remaining attributes (103) are tried as the possible third variable V_3 .

The procedure continues until the average IC achieved by the model at a step is not greater than that achieved by the previous step's model, at which point the most recently added variable is removed (thus reverting to the previous step's model).

From Equation 9.7, Grinold's (1989) Information Ratio decreases when fewer share returns forecasts are made. The number of forecasts is dependent on the availability of attribute data. Thus, once the six models are derived via the stepwise procedure, attributes with less than 100 average observations (refer to Appendix A.8) are removed from the model and the model retested.

While the stepwise procedure should give rise to better expected return models than the initial K -factor model derived in the multivariate tests, it technically does not necessarily produce the *optimal* model. A major shortcoming of the stepwise procedure is that it only looks to add one variable at each step. At the last step, no additional variables add value to the model when considered alone with the already included variables and thus the procedure stops. However, if say two additional variables were added instead of just one, the mean monthly IC of the model may in fact improve. This problem is not only a feature of the final step, but instead implies that all the steps, which only add one variable at a time, may benefit from the addition of more than one variable and thus a very different model may end up being derived.

What this means is that in order for the optimal model to be derived using the available variables, all combinations of the variables need to be examined as possible expected return models. As this procedure is far more complicated given the large number of possible models, the stepwise procedure described above is used instead.

9.3. Results

9.3.1. Multivariate cross-sectional regressions

The average slope and related t-statistic of each explanatory variable is shown in Appendix F.1 for each regression. If the least significant variable in a regression is in fact insignificant, it is displayed in bold with a grey background. Regressions that are repeated after these variables are removed are indicated as "repeat" (note that some repeats are not necessary as the remaining variables had already been jointly tested in

an earlier multivariate regression). The t-statistics of the significant average slopes are displayed in bold.

The series of steps eventually leaves five factors remaining. They are displayed in Table 9.1 below along with the name of the interpretation group they were classified under (in Chapter Six), and their average monthly slopes and related t-statistics. The directions of the controlled payoffs of all five characteristics are the same as their univariate payoffs as calculated in Chapter Six.

Table 9.1. Results of Multivariate Cross-Sectional Regressions

Multivariate cross-sectional regressions of univariately significant standardised firm-specific attributes on unadjusted total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of controlled slope coefficients for each characteristic. The sets of multivariate regressions start with the most univariately significant characteristic, and thereafter characteristics are included in the regressions one at a time (in order of univariate significance) until the least significant variable displays an insignificant mean (using Student's (1908) t-test at the 5% level) of the time-series of controlled slopes. The variable is then removed and then the process of incorporating more variables in the regressions continues until all variables have been tested. The procedure results in a multifactor model in which all the characteristics are univariately and multivariately significant. The average controlled slope and related t-statistic of the remaining variables in the last set of cross-sectional regressions is shown. Significant t-statistics are displayed in bold. The data were extracted from DataStream International. Also shown are the logical interpretations of the attributes. * The interpretation assumes the size of the dividends represents performance. This may also be interpreted as change in growth prospects, where a higher dividend may indicate lower growth opportunities. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Characteristic	Nature	Average Slope	t-stat
MOM_12M	Momentum	0.023	4.205
BTMV	Value	0.012	3.124
DIV_2YR*	Change in Performance	-0.003	-2.415
CFTP	Value	0.005	3.018
MTBV_2YR	Change in Value	-0.007	-2.452

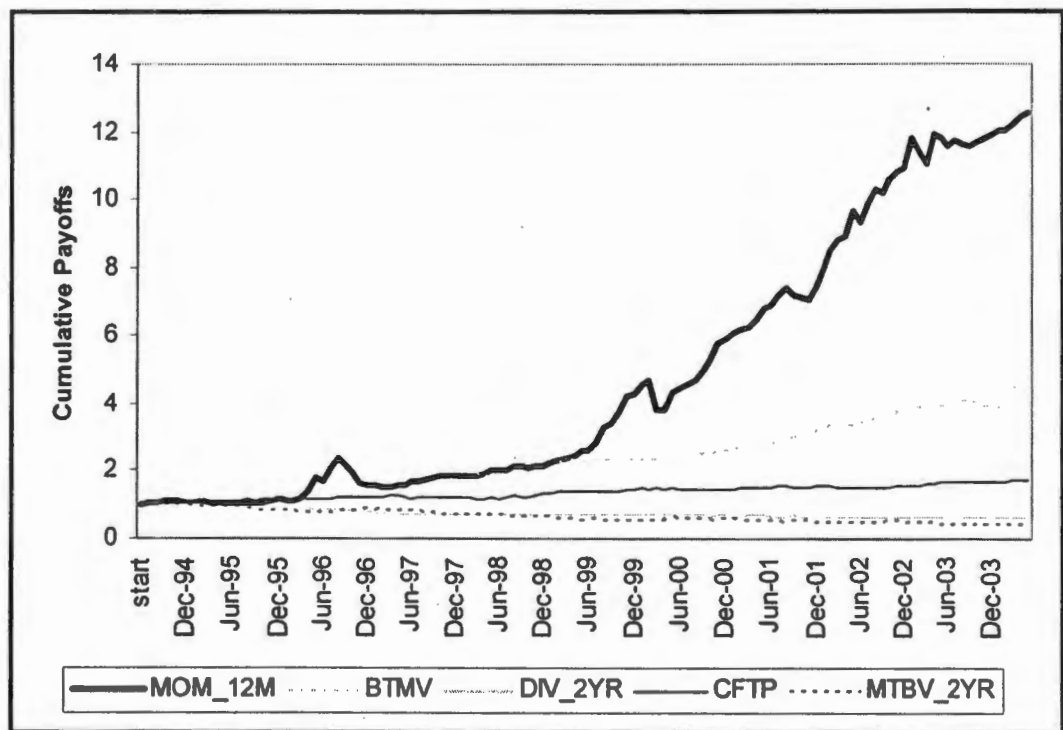
Figure 9.1 graphically shows the cumulative monthly payoffs to each of the five characteristics as calculated from the multivariate monthly payoffs. As noted in Chapter Six, the cumulative payoff graph represents payoffs to an equally-weighted portfolio rather than a market-weighted portfolio.

It is clear from Figure 9.1 that MOM_12M has the largest cumulative monthly payoff by far. It is also the most (univariately and multivariately) significant variable out of these five variables.

The DIV_2YR and MTBV_2YR both show negative cumulative payoffs. However, it is clear that these payoffs are the smallest in magnitude when compared to the other three factors.

Figure 9.1. Cumulative Monthly Payoffs to Multivariately Significant Attributes

The cumulative monthly payoffs (controlled) of the final list of multivariately significant standardised attributes. The monthly payoffs are derived from multivariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The average controlled payoffs to the attributes displayed are significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. The graphs start at the value 1. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.



9.3.2. Timing the multivariate factors

Table 9.2 below displays a summary of the style consistency statistics for each of the five characteristics.

Characteristics with a higher consistent direction have ratios close to either 100% or 0% (the interpretation of ratios close to 50% is more ambiguous). The characteristics display a fair amount of direction consistency, with the worst ratio being that of

MTBV_2YR (61%). However, it is the DIV_2YR characteristic that displays the most inconsistency as it has the most number of direction changes (65 out of a possible 118). The MOM_12M characteristic shows the most consistent performance with the direction of its controlled payoff changing only 36 times out of the possible 118. While the t-statistics should intuitively increase if the direction of the payoffs could be perfectly timed, Table 9.2 just displays the absolute values of the initial and improved t-statistics to demonstrate the magnitude of the change in t-statistic.

Table 9.2. Consistency of the Direction of Controlled Payoffs to Multivariate Factors

The table displays the statistics assessing the consistency of the direction of controlled monthly payoffs of the multivariately significant standardised firm-specific attributes. The first set of statistics displays the ratio of the number of times the monthly payoffs are positive (and negative) as a percentage. Characteristics with a higher consistent direction have ratios close to either 100% or 0%. Ratios close to 50% do not necessarily imply inconsistency. The second set of statistics displays the number of times the payoffs changed direction, expressed as a percentage on total number of payoffs. Characteristics with lower ratios are more consistent in direction. The third set of statistics displays the t-statistic relating to the time-series average of controlled monthly payoffs, and the t-statistics calculated using the absolute value of payoffs to simulate perfect directional timing. All the t-statistics are significant at the 5% level. The monthly payoffs are derived from multivariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	MOM_12M	BTMV	DIV_2YR	CFTP	MTBV_2YR
Positive	73%	63%	37%	64%	39%
Negative	27%	37%	63%	36%	61%
Frequency of direction changes	36	56	65	51	55
Frequency of direction changes (%)	31%	47%	55%	43%	47%
Absolute t-statistic (original)	4.21	3.12	2.42	3.02	2.45
Absolute t-statistic (assuming perfect direction timing)	9.12	6.29	9.20	10.43	10.83

The average lag coefficients of the lagged variables and average intercept for each style are shown in Table 9.3. Student's (1908) t-test (referred to as "t-test" for the remainder of the chapter) is performed to assess whether the average lag coefficients and intercepts are significantly different from zero. The t-statistics of the average lag coefficients and intercepts are included in brackets and displayed in bold if significant.

Most of the average lag coefficients of the characteristics are significant at the 5% level. The least number of significant lag coefficients for a characteristic is five

(DIV_2YR), which is also the only characteristic without a significant intercept term. The only characteristic that shows significance for all the average lag coefficients as well as the average intercept is the CFTP characteristic. This result is very interesting in that it was the only characteristic found to have none of its average lag coefficients nor average intercept term significant in the univariate style timing tests.

Table 9.3. Average Intercept Term and Average Lag Coefficients for Twelve-lag Autoregressions on Controlled Monthly Payoffs to Multivariate Factors

For each attribute for each month, an intercept term and lag coefficients for the lagged variables are calculated from running an Ordinary Least Squares twelve-lag autoregression only on the controlled monthly payoffs data before that month. This is known as an “expanding window”. The monthly payoffs to standardised firm-specific attributes are derived from multivariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. Given the autoregression’s number of observations requirement, these lag coefficients and intercepts can only be calculated for the last 95 months. The expanding window results in 24 observations being used for the autoregression for month 25’s payoff, and 118 observations being used for the last month’s payoff. The average lag coefficient of the lagged variables and average intercept for each attribute are displayed, and the related t-statistics of the averages are displayed in brackets. The average lag coefficients and intercepts significant at the 5% level in a Student’s (1908) test are displayed in bold. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Intercept	Lag Coefficients											
		t-1	t-2	t-3	t-4	t-5	t-6	t-7	t-8	t-9	t-10	t-11	t-12
MOM_12M	0.04 15.77	0.08 3.73	0.10 6.29	0.17 4.31	-0.25 -21.85	0.03 1.52	-0.36 -15.31	-0.04 -0.95	0.17 2.38	0.53 4.23	-0.02 -0.41	-0.24 -5.87	-0.26 -3.66
BTMV	0.01 28.29	0.11 4.75	0.19 8.50	0.02 0.84	-0.16 -3.64	0.17 4.92	-0.19 -9.11	0.12 5.90	0.08 3.27	0.09 5.38	-0.13 -4.59	-0.14 -5.40	-0.07 -4.63
DIV_2YR	0.00 0.27	0.10 0.89	-0.01 -0.32	0.04 0.37	0.00 -0.05	0.33 2.50	0.33 4.83	0.31 2.46	0.15 4.45	-0.12 -6.03	0.42 2.34	-0.07 -1.55	0.11 0.59
CFTP	0.01 22.72	0.11 6.50	-0.18 -11.82	0.05 2.90	-0.11 -5.98	-0.15 -12.21	0.04 2.36	0.08 6.72	-0.19 -14.95	0.15 14.48	-0.19 -21.53	0.19 14.84	-0.14 -14.51
MTBV_2YR	-0.02 -13.12	-0.17 -19.37	0.12 5.06	0.02 1.17	-0.01 -0.77	-0.01 -0.81	0.02 1.06	-0.05 -2.10	-0.07 -2.72	-0.05 -3.09	-0.12 -9.07	-0.17 -11.78	-0.41 -9.92

Table 9.4 below summarises the statistics calculated for the AR12M model of each characteristic.

All characteristics show fairly high correlation between the actual and forecast controlled payoffs – particularly the BTMV characteristic, which shows a correlation of 0.885. The direction ratios also indicate strong performance of the AR12M models with all displaying p-values less than 0.001. This means that the null hypothesis of the AR12M models incorrectly forecasting the direction of the payoff is strongly rejected.

The *U*-statistic displays values between 0.24 and 0.49, which means that the models are fairly accurate.

Table 9.4. Multivariate Forecasting Statistics for the Twelve-lag Auto-regressive Model (AR12M)

The statistics calculated in assessing the ability of a twelve-lag auto-regressive model to forecast controlled monthly payoffs to standardised attributes are displayed. The parameters of each style characteristic's autoregressive model are calculated each month by running Ordinary Least Squares regressions only on the controlled monthly payoffs data before that month. This is known as an "expanding window". The actual monthly payoffs are derived from multivariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. Given the autoregression's number of observations requirement, the lag coefficients and intercepts can only be calculated for the last 95 months. The expanding window results in 24 observations being used for the autoregression for month 25's payoff, and 118 observations being used for the last month's payoff. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Correlation	Direction Ratio	Direction Ratio: (p-value)	Thiel's Inequality Coefficient	BIAS	VAR	COV	RMSE	MAPE
MOM_12M	0.655	0.747	0.00000	0.408	0.000	0.209	0.791	0.042	255
BTMV	0.885	0.695	0.00004	0.236	0.000	0.061	0.939	0.022	564
DIV_2YR	0.725	0.674	0.00021	0.392	0.000	0.159	0.841	0.011	158
CFTP	0.673	0.737	0.00000	0.423	0.000	0.196	0.804	0.013	617
MTBV_2YR	0.594	0.768	0.00000	0.492	0.000	0.255	0.745	0.027	618

The *U*-statistic can be broken down into three proportions. As noted in Chapter Seven Section 7.2, the bias proportion measures the extent to which the mean of the forecast deviates from the mean of the actual series (indication of systematic error), the variance proportion indicates the ability of the model to replicate the degree of variation of the actual series, and the covariance proportion measures the remaining unsystematic forecasting errors. Optimally, the bias and variation proportions should approach zero so that most of the bias is concentrated on the covariance proportion (Pindyck and Rubinfeld, 1998; Theil, 1958).

The breakdown shows that the bias and variance proportions are low for all models, while the covariance proportion is very high, thus again showing that all AR12M

models display significant forecasting ability with regards to the controlled payoffs of the multifactor characteristics.

9.3.3. The Haugen and Baker (1996) methodology

Table 9.5 below shows the mean monthly *IC* and Grinold (1989) *IR* statistics for the five-factor model consisting of the variables MOM_12M, BTMV, DIV_2YR, CFTP, and MTBV_2YR. The statistics are shown for each of the timing models used to forecast controlled slopes. Also displayed are the Qian and Hua (2004) *IR* statistics for each model. The models are displayed in ascending order of mean *IC*.

Table 9.5. Forecasting Ability of Five-factor Style-characteristics Expected Return Models

Multivariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004 are performed using the nonstandardised independent variables prior twelve-month momentum, book-to-market value, two-year percentage change in dividends, cashflow-to-price, and two-year change in market-to-book value. The regressions give rise to a time-series of controlled slope coefficients for each characteristic. The one-month, six-month, twelve-month, and eighteen month trailing moving average of the slope coefficients are used to give rise to four sets of predicted slope coefficients over the sample period. The historic trailing mean is used to give rise to a fifth set of predicted slope coefficients. A sixth set of forecasts is calculated using a twelve-lag autoregressive model, which calculates an intercept and lag coefficients for the lagged variables by running Ordinary Least Squares twelve-lag autoregressions only on the controlled monthly payoffs data before that month. This is known as an “expanding window”, which results in 24 observations being used for the autoregression for month 25’s payoff, and 118 observations being used for the last month’s payoff. The six sets of forecast slopes are combined with the share attribute data for each month to give rise to forecast share returns over the sample period. For each model in each month, the Pearson (1896) correlation between the forecast and actual returns is calculated. This is the Information Coefficient (IC) of Grinold (1989). The Information Ratio’s (IR) calculated are those of Qian and Hua (2004), which is the mean monthly IC divided by the standard deviation of the IC over the months, and Grinold (1989), which is the monthly IC multiplied by the standard deviation of the number of forecasts made that month. The data were extracted from DataStream International.

Forecasting Model	Mean Monthly IC	IR (Qian and Hua, 2004)	IR (Grinold, 1989)
AR12M	0.074	0.387	0.898
1M	0.078	0.379	0.864
18M	0.096	0.575	1.151
12M	0.100	0.556	1.153
Hist M	0.105	0.599	1.150
6M	0.113	0.611	1.298

The expected return model created using the 6M style-timing model to estimate controlled slopes displays the best performance for all three statistics, with a mean *IC* of 0.113, a Grinold (1989) *IR* of 1.298 and a Qian and Hua (2004) *IR* of 0.611. The worst performer is surprisingly the twelve-lag autoregressive model (AR12M),

which is in conflict with its relatively strong univariate slope forecasting ability displayed in Chapter Seven. Overall, most of the models display good returns forecasting ability with four of the *IC* statistics being close to or greater than 0.1. The performance of these models may however appear to be below expectations given the fact that the five attributes are found to be multivariately significant in cross-sectional tests. However, the multivariate cross-sectional tests assess the significance of the *average* payoff which is calculated from the entire sample of payoffs. The tests conducted here estimate a payoff each month based only on information on historic payoffs.

9.3.4. Constructing multifactor expected return models

The mean of the monthly *IC* and Grinold's (1989) *IR* statistics as well as Qian and Hua's (2004) *IR* statistics of the expected return models created at each step of the stepwise procedure are displayed in Table 9.6 below for each of the six timing models. The attributes added as explanatory factors are shown for each model. The timing models are displayed in ascending order of the mean *IC* of the final expected return model that they give rise to.

Appendix F.2 displays the mean *IC* as well as the Qian and Hua (2004) *IR* for each of the multifactor models tested at each step in the procedure when the 1M timing model is used to predict controlled slopes. The statistics refer to the multifactor model consisting of the variables that remain in the expected return model from previous steps and the variable next to which the statistic is displayed. Variables that remain in the model are displayed in white on a black background, and the mean *IC* and Qian and Hua (2004) *IR* of the model with that variable's addition are similarly displayed. In the last step of the procedure, the variable that combines with those that remain in the model from previous steps to give the highest mean *IC* is displayed in bold on a grey background, as this model is inferior to that created at the previous step. Similar results for the other timing models are displayed in Appendices F.3 to F.7. The variables are listed in descending order of the univariately calculated mean *IC* statistic (in other words, the mean *IC* statistic calculated at Step 1 in the stepwise procedure).

Table 9.6. Derived Expected Return Models

The Haugen and Baker (1996) forecasting methodology is applied in a stepwise procedure to derive expected return models. The procedure starts by applying the Haugen and Baker (1996) methodology using one nonstandardised explanatory variable. Instead of only using the twelve-month trailing moving average to predict slopes of the variables as in Haugen and Baker (1996), six timing models are used for slope prediction, namely one-month, six-month, twelve-month, and eighteen month trailing moving average models, an historic trailing mean model, and a twelve-lag autoregressive model, which calculates an intercept and lag coefficients for the lagged variables by running Ordinary Least Squares twelve-lag autoregressions only on the controlled monthly payoffs data before that month. (This is known as an “expanding window”, which results in 24 observations being used for the autoregression for month 25’s payoff, and 118 observations being used for the last month’s payoff.) The forecasting ability of the variable under each model is tested using the Information Coefficient (IC) of Grinold (1989). The variable for each timing model that displays the highest IC is taken to the next step where the above procedure is repeated using two variables, the first being that from the first step. The second attribute to remain in the model is that which combines with the first attribute to produce the highest IC. The stepwise procedure continues until the multifactor expected return model derived at a stage displays an IC lower than that of the previous stage’s model. The Information Ratio’s (IR) calculated are those of Qian and Hua (2004), which is the mean monthly IC divided by the standard deviation of the IC over the months, and Grinold (1989), which is the monthly IC multiplied by the standard deviation of the number of forecasts made that month. The mean IC and IR statistic of the expected return models created at each step of the stepwise procedure are displayed for each of the six timing models. The attributes added as explanatory factors are shown for each model. The timing models are displayed in ascending order of the mean IC statistic of the final expected return model that they give rise to. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Style-timing Model	Mean Monthly IC	IR (Qian and Hua, 2004)	IR (Grinold, 1989)	Variables			
AR12	0.108	0.768	1.526	LNP CFTP	BTMV BORROW_1YR	LNMV_1YR TLTTA	TV_6M MOM_6M
Hist M	0.109	0.821	1.059	MOM_12M	ECANDRES	P_1M	
1M	0.113	0.659	1.373	MOM_12M	RETEN	DY_6M	CFTP
6M	0.149	0.837	1.552	LNMV LNMV_3M CFTBORRRREPDIV_6M TV	MOM_12M MVTRADÉMV_1YR CFTP ACCRU	ECANDRES_1YR P RETEN TV_1M	A_TURN
12M	0.166	0.670	1.257	MOM_12M EPSCH_P_6M	BTMV ACCRU	CFTP	SALEPEMPLY_1YR
18M	0.193	0.847	1.236	MOM_12M LNMV_2YR	MOM_18M SALEPEMPLY_2YR	CFTP EPSCH_P_12M	ACCRU CFTBORRRREPDIV_1YR

As displayed in Table 9.6, the six timing models give rise to expected return models that have between two and thirteen factors. All the models display good forecasting ability as the mean *IC* statistics are above 0.1. The worst performing model is that of the AR12M, a result which is again in contrast with the twelve-lag autoregressive model’s relatively strong performance in Chapter Seven. However, it displays the second highest average monthly Grinold (1989) *IR* value. This most probably results from the AR12M model only examining the last 95 months, which have more observations than the earlier months. The other models all examine some of the earlier months and thus suffer from the lower number of data observations.

The dynamic expected return models (created using the 6M, 12M, and 18M timing models) have progressively higher *IC* statistics which are all rather high, and are all higher than the *IC* statistics of the static expected return model (created from the HIST M timing model). The statistics are also higher than those of the five-factor models tested earlier in the chapter. The stepwise procedure is thus able to build stronger models than the simple procedure used previously, and the expected return model requires a dynamic rather than static procedure. The 6M timing model gives rise to an expected return model with the most number of explanatory factors (thirteen), but the 18M model, with only eight factors, shows the best *IC* of 0.193.

The 12M and 18M models have somewhat lower Grinold (1989) *IR* statistics, which may be caused by the inclusion of factors with a low number of observations thus resulting in a low number of share returns forecasts. Characteristics with fewer average monthly observations than 100 are excluded from the models and the results displayed in Appendix F.8. This procedure basically results in the exclusion of the SALEPEMPLOY_1YR characteristic in the 12M model, and the SALEPEMPLOY_2YR characteristic in the 18M model. While both model's mean *IC* statistics expectantly decrease, the 12M model's Grinold (1989) *IR* value improves as opposed to the 18M's *IR* value worsening.

9.4. Summary and conclusion

This chapter picks up from where Chapter Six left off and first attempts to construct a multifactor style-characteristic model. The entire final list of 27 variables derived in Chapter Six cannot simply be included in a multifactor model. Increasing the number of variables may increase in-sample explanatory power, however out-of-sample forecast power is lost along with a degree of freedom for each additional variable included (thus decreasing the value of the model). Michaud (1999) puts forward a challenge of finding a set of uncorrelated factors that collectively provide a parsimonious yet comprehensive representation of the return generating process.

The creation of the multifactor model starts by cross-sectionally regressing the most significant standardised characteristic of the 27 variables on the monthly forward returns. Thereafter, variables are included in the regressions one at a time (in order of univariate significance) until the least significant variable displays an insignificant mean of the time-series of its controlled slopes. This variable is then removed, and the process of incorporating more variables in the regression continues until the 27th characteristic is included in the regression.

The multifactor tests give rise to a five-factor style model comprising: (1) prior twelve-month momentum (Momentum); (2) book-to-market value (Value); (3) two-year percentage change in dividends (Change in Performance); (4) cashflow-to-price (Value); and (5) two-year percentage change in market-to-book ratio (Change in Value). The prior twelve-month momentum factor displays the largest cumulative monthly payoff by far, and is the most significant variable out of these five variables in both the univariate and multivariate tests. All the characteristics display a fair amount of direction consistency, and the prior twelve-month momentum characteristic shows the most consistent performance.

Twelve-lag autoregressive models are constructed for each characteristic in a similar way to the construction of the univariate autoregressive models, except that here the payoffs used are the controlled payoffs of the characteristics. Most of the average lag coefficients of the characteristics are significant at the 5% level. The only characteristic displaying significance for all the average lag coefficients as well as the average intercept term is the cashflow-to-price characteristic. It was noted that this result is rather interesting in that cashflow-to-price is the only characteristic found to have none of its average lag coefficients nor average intercept term significant in the univariate style timing tests.

The ability of the autoregressive models to forecast the monthly controlled payoffs to the style characteristics is assessed using the correlation between actual and forecast payoffs, direction ratios representing the number of times the model correctly predicts the direction of the payoff, and Theil's (1958) Inequality Coefficient. The statistics indicate that the autoregressive model does indeed have forecasting ability. The Sign

Test's null hypothesis of the autoregressive models incorrectly forecasting the direction of the payoff is strongly rejected for all five characteristics. The proportions of Theil's Inequality Coefficient illustrate low bias and variance proportions and high covariance proportions for all the characteristics, thus again showing that all twelve-month autoregressive models have significant forecasting ability.

The chapter thus creates a multifactor style-characteristics model consisting of uncorrelated firm-specific attributes that are both univariately and multivariately significant, and whose controlled payoffs can be forecast using a twelve-lag autoregressive model.

The methodology of Haugen and Baker (1996) is then applied to this five-factor style model to test the ability of the model to forecast share returns. Nonstandardised attribute data are used for this analysis. While Haugen and Baker (1996) use the twelve-month trailing moving average of attribute payoffs to forecast future payoffs, this chapter also applies the Haugen and Baker (1996) methodology using the other five timing models examined in Chapter Seven and thus tests six expected return models. Most of the models display good share return forecasting ability, with the six-month trailing moving average model showing the best performance.

Finally, the methodology of Haugen and Baker (1996) is applied in a stepwise framework with the aim of creating better expected share return models. A stepwise procedure is performed for each of the six timing models of Chapter Seven that are used to forecast attribute payoffs and thus gives rise to six expected return models. Attributes with a t-statistic greater than 1.00 in the univariate (unadjusted returns) tests of Chapter Six are used as candidate factors. Again, nonstandardised attribute data are used for the analysis.

The six timing models give rise to expected return models that have between three and thirteen factors. While the static expected return model (created using the historic mean timing model) displays good forecasting ability, the dynamic expected return models (created using the six-, twelve-, and eighteen-month trailing moving average timing models) display rather high forecasting ability, with the eighteen-month model

being the best of the three. The attributes that are used as factors in the expected return model derived by the eighteen-month timing model are: (1) prior twelve-month momentum; (2) prior eighteen-month momentum; (3) cashflow-to-price; (4) accruals; (5) two-year percentage change in the natural log of market capitalisation; (6) two-year percentage change in sales-per-employee; (7) one-year change in earnings expressed over price; and (8) one-year percentage change in the ratio of cashflow to borrowings repayable (including dividends).

While this thesis has provided strong evidence relating to the existence of anomalous factors in the Australian market, it does not attempt to determine the true meaning behind these anomalies. There are various arguments that have been developed to explain the effects, yet they remain passionately contested without any movement towards a consensus. It thus remains to be seen what these effects really are.

Summary, Conclusion, and Suggested Extensions

10.1. Introduction

Chapter One sets out the six objectives of this thesis relating to share returns on the Australian Stock Exchange (ASX): (1) to determine whether a Multi-index model is better than the Single-index model in explaining the return generating process; (2) to investigate the cross-sectional relationships between an extensive set of firm-specific attributes and stock returns on the ASX both before and after CAPM- and APT-risk adjustment; (3) to assess the behaviour of the payoffs to the significant characteristics and examine the predictability of the payoffs; (4) to examine whether the anomalous characteristics are related to seasonality; (5) to derive a multi-attribute cross-sectional model for the ASX and examine whether the controlled payoffs of the constituent characteristics can be predicted; and (6) to create a multifactor style-characteristics expected return model that is able to forecast share return.

The remainder of this chapter is set out as follows: Section 10.2 provides a summary of the main findings regarding each of the objectives above, and Section 10.3 concludes the thesis and suggests areas of further research on the ASX.

10.2. Summary of results

A data set of 207 firm-specific attributes is created using monthly data extracted from DataStream International for all ASX listed stocks on 1 September 2004, and covers the period July 1994 to May 2004. After preference shares and shares with insufficient returns data are removed from the data set, non-traded and thinly traded shares are removed from the sample. However, due to the large number of thinly

traded shares on the ASX, the adjustment does not completely remove thin trading and many shares are still thinly traded in numerous months. The decision to retain these shares in the sample is based on the need to preserve a sufficiently large sample size. The influence of outliers in both the attribute and returns data sets is reduced by applying a fairly new winsorisation procedure in each month, and monthly share returns are further limited to 100%. The final sample of 367 companies represents the sectoral structure of the market well in terms of market capitalisation over the period examined. As DataStream International only updates information once it becomes known to the public, the study is free from look-ahead bias. However, the DataStream International database suffers from survivorship bias.

An examination of the structure of the Australian market over the five-year period 1 January 1999 to 31 December 2003 reveals that the share indexes and subindexes are influenced by five underlying factors. The cluster analysis describes the nature of these five clusters (based on the constituents thereof) as Gold Mining, Pharmaceuticals, Entertainment, General, and Utilities and Cyclical clusters. The principal components analytic procedure and subsequent varimax (orthogonal) and promax (oblique) rotations give rise to a set of factors similar in nature. The five factors together explain just over 90% of the common variation of the sample. In accordance with the methodology of van Rensburg and Slaney (1997), a five-factor APT model is constructed using the share indexes that have the highest loadings on the factors as proxies for those factors.

The ability of the Single- and Multi-index models to explain the time-series variation in share returns is examined in accordance with the first objective of the thesis. The explanatory variables of the Multi-index model are the factor proxies of the derived APT model. The average (across the companies) R^2 -adjusted statistics are calculated for each model, and while the Multi-index model displays a higher average R^2 -adjusted as well as higher R^2 -adjusted values for more companies than the Single-index model, 60% of the Single-index model's regressions are significant at the 5% level as opposed to 26% of the Multi-index model's. The models are also tested for the ability to explain the variation in share returns not explained by the alternative model, and neither model shows evidence of this ability. While the Australian market

has shown evidence of a multifactorial structure, the evidence is not clear as to whether the examined Multi-index model is in fact better than the Single-index model, and both models exhibit poor explanatory power.

For the second objective, the cross-sectional relationships of the extensive set of standardised firm-specific attributes are assessed for the ability to explain the cross-sectional variation in share returns both before and after CAPM- and APT-risk adjustment. Cluster analysis of the significant characteristics' payoffs derived using the three sets of share returns indicates that similar significant characteristics are found for each returns set. The list of significant characteristics derived from the unadjusted returns test is then simplified using a correlation matrix analysis and results in a list of 27 variables that do not display Pearson (1896) correlation coefficients higher than 0.7 (and less than -0.7) with each other. The 27 characteristics can be divided into nine interpretation groups or combinations thereof, namely: (1) Liquidity; (2) Momentum; (3) Performance; (4) Size; (5) Value; (6) Change in Liquidity; (7) Change in Performance; (8) Change in Size; and (9) Change in Value.

The existence of the anomalies found in prior Australian literature (size, price-per-share, M/B, P/E, cashflow-to-price, and short- to medium-term momentum) has for the most part been confirmed. However, the P/E characteristic does not show significance. While it is well documented in the US, the characteristic is controversial in the Australian context. And in contrast to prior research indicating separate size and price-per-share effects, the monthly payoffs to the attributes are found to be highly correlated in this study. The size effect is virtually the same for both unadjusted and APT-risk adjusted returns, thus contradicting arguments suggesting that it is merely the manifestation of the differential pricing between resources (high capitalisation) and industrials shares as the APT model uses both an industrials (General Industrials index) and a resources (Steel & Other Metals index) factor.

As the previously identified anomalies only cover five of the final 27 characteristics, the evidence indicates the existence of a multitude of uncorrelated anomalies.

The third objective requires an assessment of the behaviour of the payoffs to the significant characteristics and an examination of the predictability of the payoffs. While most of the characteristics display a fairly consistent monthly payoff, their behaviour is not absolutely consistent and in many months the direction of the payoffs reverses. Six style-timing models are evaluated for the ability to forecast the monthly payoffs: (1) a twelve-lag autoregressive model; (2) a six-month moving average model; (3) a twelve-month moving average model; (4) an eighteen-month moving average model; (5) a trailing historic mean model; and (6) a one-month model which uses the previous-month's payoff as an estimate of this month's payoff. Using the correlation between the forecast and realised payoffs, the ratio of the number of times the payoff direction is correctly forecast to total forecasts, and Theil's (1958) Inequality Coefficient, it was found that the twelve-lag autoregressive model convincingly displays the best performance out of the timing models. The other five models do not show much forecasting ability and do not show any marked difference in performance from each other.

With regards to the fourth objective of seasonality assessment, the average of the time-series of monthly payoffs to the style characteristics is assessed for significance after the historically seasonal months of January, December, July, and August are individually and jointly removed from the data set. Most of the characteristics retained their significance after removing the historically anomalous months. The size effect, which has been related to the January and turn-of-the-year (July in Australia) effects in the US, also retains its significance. However, the magnitude of its t-statistic suffers a large decrease when the months of January and July are individually and jointly excluded. The parametric ANOVA and nonparametric Kruskal and Wallis (1952) tests only find seasonality in a few characteristics including the size effect. The Scheffé (1953) test is however unable to identify the months responsible for the seasonality in monthly payoffs.

The fifth objective is achieved by cross-sectionally regressing the most significant characteristic of the 27 variables on the monthly forward returns and thereafter including variables in the regression one at a time (in order of univariate significance) until the least significant variable displays an insignificant mean of the time-series of

its controlled slopes. This variable is then removed, and the process of incorporating more variables in the regression continues until the 27th characteristic is included in the regression. The method yields a five-factor style model for the ASX and comprises: (1) prior twelve-month momentum (Momentum); (2) book-to-market value (Value); (3) two-year percentage change in dividends paid (Change in Performance); (4) cashflow-to-price (Value); and (5) two-year percentage change in market-to-book value (Change in Value). The prior twelve-month momentum factor displays the largest cumulative monthly payoff by far, and is the most significant variable out of these five variables in both the univariate and multivariate tests. All the characteristics display a fair amount of direction consistency and the prior twelve-month momentum characteristic shows the most consistent performance. A twelve-lag autoregressive model is found to be able to forecast the controlled monthly payoffs to these five characteristics.

For the final objective, the methodology of Haugen and Baker (1996) is first applied to the derived five-factor style model using nonstandardised attribute data, and the resultant expected return model is tested for its ability to forecast share returns. While Haugen and Baker (1996) use the twelve-month trailing moving average of attribute payoffs to forecast future payoffs, this chapter also applies the Haugen and Baker (1996) methodology using the other five style-timing models examined earlier in the thesis and thus tests six expected return models. Most of the models display good share return forecasting ability, with the six-month trailing moving average model showing the best performance.

The methodology of Haugen and Baker (1996) is then applied in a stepwise framework with the aim of creating better expected share return models. Nonstandardised attribute data are again employed. A stepwise procedure is performed for each of the previously examined six style-timing models that are used to forecast attribute payoffs and thus six expected return models are created. Attributes with a t-statistic greater than 1.00 in the univariate (unadjusted returns) tests are used as candidate factors. The six timing models give rise to expected return models that have between three and thirteen factors. While all the models display good forecasting ability, the dynamic (trailing moving average) models all perform

the better than the static model (historic mean). The eighteen-month trailing moving average timing model gives rise to the expected return model that has the best forecasting ability, which comprises: (1) prior twelve-month momentum; (2) prior eighteen-month momentum; (3) cashflow-to-price; (4) accruals; (5) two-year percentage change in the natural log of market capitalisation; (6) two-year percentage change in sales-per-employee; (7) one-year change in earnings expressed over price; and (8) one-year percentage change in the ratio of cashflow to borrowings repayable (including dividends).

10.3. Final conclusion and suggested extensions

This thesis has set out to identify firm-specific attributes that display a significant relationship with the cross-sectional variation of share returns on the ASX. The study identifies a number of such anomalies and shows that their univariate monthly payoffs can be timed using an autoregressive model. A five-factor style-characteristic model is constructed which comprises factors that are univariately and multivariately significant. Finally, an eight-factor style-characteristics dynamic expected return model is derived which displays meaningful skill in forecasting share returns. As the dynamic expected return models all outperformed the static (historic mean) multifactor expected return model, the evidence convincingly indicates that the asset pricing relationship follows a dynamic model.

The literature review discusses in detail the various explanations that have developed in attempting to explain the existence of these anomalous factors. The explanations roughly fall into the three categories of investor irrationality, investor rationality and methodological bias. This thesis makes no attempt to ascertain the interpretation of the anomalies, but merely focuses on identifying them and examining their behaviour. While measures are taken to deal with some of the methodological biases documented in the literature such as look-ahead bias, the use of incorrect proxies, thin trading, the effect of outliers, and errors in the data sets, some of the biases could not be removed. These include survivorship bias and thin-trading effects.

The methodological bias argument of data-snooping often appears in the anomaly related literature and argues that intensive study of a database will inevitably lead to some variables exhibiting a sample-specific spurious relationship with the variation in share returns. This study somewhat adds to CAPM anomaly evidence of US studies, indicating that the anomalies are also found to exist in other markets around the world and thus implying the effects are not sample-specific. However, if these variables are not found in other markets, it does not per se imply that the US evidence stems from data snooping, as Becker and Ochman (2004) point out that a style-characteristics model developed for one country cannot simply be applied to another market due to differences between the two markets in capital structure, accounting systems, reporting policies, and homogeneity of the universe.

This study's testing of an extensive set of characteristics may in fact be subject to criticism on the basis of data-snooping bias as this procedure amounts to intensive study of the Australian data. As noted in Chapter One, Kennedy (2003) suggests that economic theorising should take place before variables are tested for explanatory value so that there are valid economic arguments for their inclusion. This rule is difficult to adhere to as no consensus exists as to the interpretation of the historically documented anomalies. Some explanations contradict each other in terms of predicting the direction of the payoff to the anomalous factor, which results in the payoff direction predictions of some theories being incorrect. Further, some of the anomalies have reversed in direction for extended periods of time. Merely testing anomalous factors that have been found to be significant in prior research only adds to evidence on those factors and thus does not consider the possibility of other attributes also having explanatory value. Thus it seems that in order to identify the anomalies on the ASX, an extensive set of characteristics should be examined. The remedy for the data-snooping issue lies in the ongoing observation of the characteristics' relationships with share returns. The anomalies identified in this study cannot be tested on the same sample. Instead, they should be tested on different samples and sample periods to that examined in this thesis, and it would be interesting to see if the payoffs to the style characteristics maintain their significance, magnitude, and direction. Further, the derived expected return model should also be tested in out-of-sample periods to see if it maintains its forecasting ability.

The main challenge that lies ahead is finding the true interpretation of these anomalies. If they are indeed proxies for as yet unobservable risk factors, they are to be included in asset-pricing models. Fama and French (1993) note that the application of this new risk model has several applications including the selection of portfolios, evaluating portfolio performance, measuring abnormal returns in event studies, and estimating the cost of capital. However, some academics may disagree and quote the arguments of Banz (1981) relating to the size effect: "There is no theoretical foundation for such an effect". Another danger should also be considered: Faff's (2001a) finding of a reversal in the direction of the size effect in Australia and the suggestion that style effects are not stable over time serves as a caveat in blindly assuming these effects are proxies for risk.

The finding of significant explanatory variables after CAPM risk-adjustment is of course in direct conflict with predictions of the CAPM in an efficient market. The joint-hypothesis problem however prevents further interpretation. Fama (1991) notes that when anomalous evidence on the behaviour of returns is found, the way it should be split between market inefficiency and a bad asset-pricing model is ambiguous. Thus it can be concluded that either the CAPM is misspecified, or the Australian capital market is inefficient, or both. While Friedman (1953) argues that theories should be judged on the validity of their predictions and not on the basis of their assumptions, perhaps a critical re-examination of the CAPM assumptions is required. And the assumption of rationality that underpins much of economics and modern finance may not be as steadfast as initially believed.

As information is not costless, investors are only prepared to collect information until the marginal cost of acquiring it equals the marginal benefit (Grossman and Stiglitz, 1980). The implication is that asset prices would not reflect all available information, but instead reflect all information up to the point where no gains can be made from the acquisition of additional information. Aitken and Ferris (1991) in fact find that the Australian small firm effect disappears when transaction costs are considered. Robertson (2002) notes that the implications of the anomalies for practitioners is unclear since transaction costs, liquidity constraints, and market impact costs are not

accounted for in the test methodologies. Application is thus limited as trading costs erode abnormal profits.

The stepwise procedure used in this thesis to derive expected return models does not necessarily give rise to the *optimal* model given the available attributes. In order to derive the optimal model, all combinations of the variables need to be examined as possible expected return models. While this procedure was not used in this thesis due to the large number of possible models that require testing, it is an area for further research that could very well result in even better expected return models being derived.

A possible expansion is to incorporate trading costs into the anomalies studies and see whether the variables are still able to explain variation in returns. The impact of survivorship bias in this study is also not known, and tests using a sample free of this bias may reveal evidence contrary to that found here. Lastly, Robertson (2002) contends that financial information need not be comparable across different sectors and there may well be differences in their economic interpretation. An examination of the explanatory value of characteristics can be conducted after first segmenting the sample into the broad economic sectors, thus providing greater insight into the behaviour of the relationships of these variables with the variation in share returns.

"In the end, I think we can hope for a coherent story that (1) relates the cross-section properties of expected returns to the variation of expected returns through time, and (2) relates the behavior of expected returns to the real economy in a rather detailed way. Or we can hope to convince ourselves that no such story is possible."

- Fama (1991)

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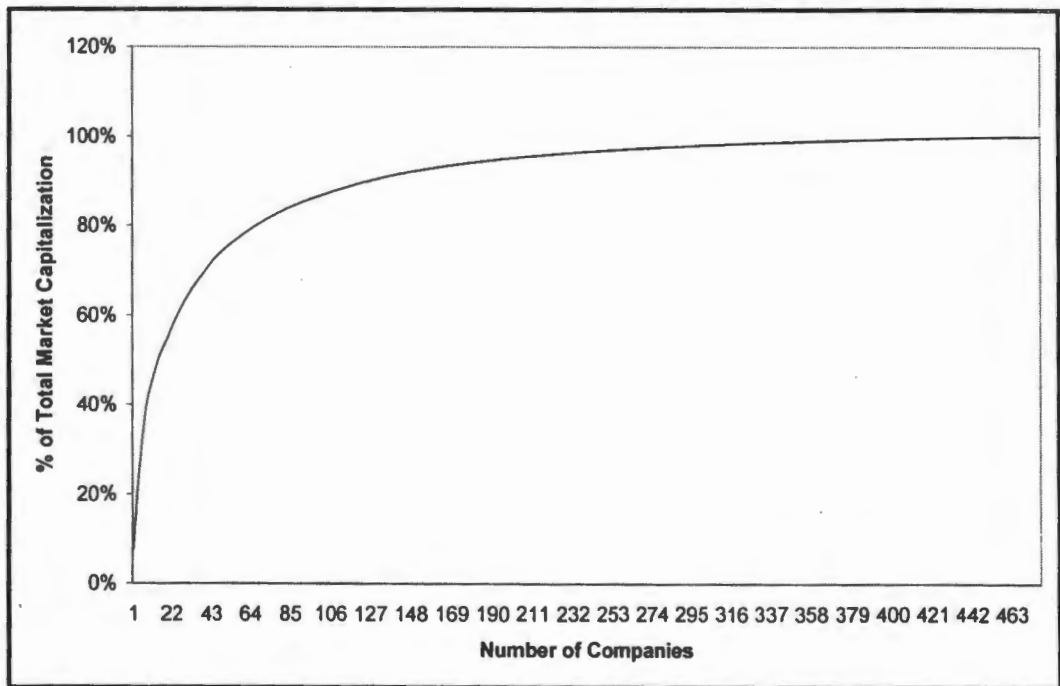
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Appendix A

A.1. Cumulative Size of ASX Companies as a Percentage of Total Market Capitalisation

The graph above shows the cumulative market capitalisation of the ASX All Ordinaries constituents as a percentage of the total market capitalisation of the share sample as at 31 May 2004. Preference shares and shares with no total returns data are excluded. The shares are ordered from highest to lowest market capitalisation displayed from left to right. The data were extracted from DataStream International. The largest 50 shares constitute 75% of the total market capitalisation of the share sample. On 31 May 2004, the market capitalisation of these 478 shares totals AUS\$ 797 867 million.



A.2. Attribute Availability for the First Month of Each Twelve-month Period

The table displays the number of observations for each firm-specific attribute in the data set for the first month (July) of each twelve-month period in the sample July 1994 to May 2004. The data relate to the constituent shares of the ASX All Ordinaries Index as at 31 May 2004. Preference shares and shares with no total returns data are excluded. The share sample has been filtered to exclude firms that had turnover ratios of less than 0.01% in more than 60% of the months they were listed. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Jul-94	Jul-95	Jul-96	Jul-97	Jul-98	Jul-99	Jul-00	Jul-01	Jul-02	Jul-03
Companies with Returns	152	168	189	212	229	247	287	326	342	364
EPS	134	152	169	197	212	233	260	297	331	341
EPS_6m	110	118	138	155	163	184	190	236	236	250
EPS_1yr	98	110	125	143	160	161	178	202	232	239
EPS_2yr	86	98	110	125	143	160	161	178	202	232
DY	146	163	179	208	224	246	286	326	340	362
DY_6m	100	112	133	146	158	173	181	209	233	247
DY_1yr	92	101	115	135	156	163	176	187	215	241
DY_2yr	80	92	101	115	135	156	163	176	187	215
LnMV	152	168	189	212	229	247	287	326	342	364
LnMV_1m	151	166	186	207	227	241	285	324	340	363
LnMV_3m	145	165	184	203	223	236	280	320	339	358
LnMV_6m	143	165	183	199	219	235	275	313	336	357
LnMV_1yr	132	152	168	189	212	229	247	287	326	342
LnMV_2yr	127	132	152	168	189	212	229	247	287	326
MTBV	96	123	147	175	201	223	261	326	342	364
MTBV_6m	90	122	144	169	194	215	254	313	336	357
MTBV_1yr	83	96	123	147	175	201	223	261	326	342
MTBV_2yr	81	84	96	123	147	175	201	223	261	326
BTMV	96	123	147	175	201	223	261	326	342	364
BTMV_6m	90	122	144	169	194	215	254	313	336	357
BTMV_1yr	83	96	123	147	175	201	223	261	326	342
BTMV_2yr	81	84	96	123	147	175	201	223	261	326
EY	134	152	169	197	212	233	260	297	331	341
EY_6m	110	118	138	155	163	184	190	236	236	250
EY_1yr	98	110	125	143	160	161	178	202	232	239
EY_2yr	86	98	110	125	143	160	161	178	202	232
P	152	168	189	212	229	247	287	326	342	364
P_1m	151	166	186	207	227	241	285	324	340	363
P_3m	145	165	184	203	223	236	280	320	339	358
P_6m	143	165	183	199	219	235	275	313	336	357
P_1yr	132	152	168	189	212	229	247	287	326	342
P_2yr	127	132	152	168	189	212	229	247	287	326
LnP	152	168	189	212	229	247	287	326	342	364
LnP_1m	151	165	185	206	225	241	284	323	339	362
LnP_3m	144	163	184	203	222	236	278	319	339	356
LnP_6m	143	165	182	199	219	234	275	312	334	357
LnP_1yr	132	152	168	187	211	227	246	285	326	342
LnP_2yr	126	132	152	168	187	211	227	246	285	326
Reten	100	124	147	171	194	228	278	333	352	357
Reten_1yr	87	98	124	146	169	193	225	272	329	344
Reten_2yr	85	87	98	124	146	169	193	225	272	329
CFtP	98	123	146	173	200	223	261	326	342	364
CFtP_6m	93	122	143	168	190	214	254	312	336	357
CFtP_1yr	86	98	123	146	173	200	223	261	326	342
CFtP_2yr	84	86	98	123	146	173	200	223	261	326
Borrow	99	125	153	177	207	232	268	334	351	364
Borrow_6m	78	88	113	134	157	191	207	252	290	313
Borrow_1yr	77	89	110	131	154	186	205	237	283	308
Borrow_2yr	79	77	89	110	130	155	186	205	237	283
Gear	99	124	153	177	207	231	268	334	350	364
Gear_6m	78	88	113	134	157	190	207	252	289	312
Gear_1yr	77	89	110	131	154	185	204	237	283	307
Gear_2yr	79	77	89	110	130	154	186	204	237	283
ROEpub	88	98	124	151	179	205	231	270	336	347

A.2. Attribute Availability for the First Month of Each Twelve-month Period

- continued

	Jul-94	Jul-95	Jul-96	Jul-97	Jul-98	Jul-99	Jul-00	Jul-05	Jul-05	Jul-05
ROEpub_6m	86	87	99	128	151	184	210	236	287	337
ROEpub_1yr	86	86	97	122	149	179	205	229	270	333
ROEpub_2yr	80	85	87	97	122	150	179	203	231	267
WC	77	93	115	132	156	177	207	264	281	288
WC_6m	69	76	97	115	134	160	183	225	269	283
WC_1yr	68	77	93	115	131	156	176	207	264	279
WC_2yr	67	68	77	93	114	131	156	176	207	262
VO	148	167	188	210	224	244	281	322	341	363
MVtrade	148	167	188	210	224	244	281	322	341	363
MVtrade_1m	147	165	185	205	221	234	279	320	338	362
MVtrade_3m	141	163	183	201	218	231	274	313	337	357
MVtrade_6m	139	162	182	197	213	230	269	306	334	355
MVtrade_1yr	128	148	167	187	207	223	241	280	321	341
MVtrade_2yr	122	129	148	166	184	209	223	242	280	321
MVtradeMV	148	167	188	210	224	244	281	322	341	363
MVtradeMV_1m	147	165	185	205	221	234	279	320	338	362
MVtradeMV_3m	141	163	183	201	218	231	274	313	337	357
MVtradeMV_6m	139	162	182	197	213	230	269	306	334	355
MVtradeMV_1yr	128	148	167	187	207	223	241	280	321	341
MVtradeMV_2yr	122	129	148	166	184	209	223	242	280	321
TV	95	117	143	167	189	215	250	317	339	360
TV_1m	95	117	142	165	189	213	250	315	337	360
TV_3m	84	94	125	144	171	196	223	263	326	347
TV_6m	84	95	122	143	170	193	222	263	326	345
TV_1yr	82	94	117	143	166	189	214	250	316	339
TV_2yr	81	81	94	117	142	167	189	215	249	316
Av6m_TV	83	94	123	143	169	192	222	262	326	346
Quick	77	93	115	132	154	171	207	264	279	288
Quick_6m	69	76	97	115	134	155	179	225	267	282
Quick_1yr	68	77	93	115	131	153	170	207	263	278
Quick_2yr	67	68	77	93	114	130	154	170	206	262
NS	96	119	145	169	192	216	251	322	340	362
CEpS	96	117	142	167	191	214	250	320	340	362
CEpS_6m	85	94	121	142	170	193	222	263	324	347
CEpS_1yr	83	94	117	142	167	188	214	249	318	340
CEpS_2yr	82	81	94	117	142	166	189	214	250	318
IntanMV	96	120	147	171	194	214	247	322	341	361
IntanMV_6m	64	70	86	96	109	125	143	190	226	243
IntanMV_1yr	62	71	84	95	105	121	132	171	222	233
IntanMV_2yr	58	62	71	84	95	105	121	132	171	222
NPMtP	95	117	140	164	191	211	243	309	323	349
NPMtP_6m	87	95	122	142	166	193	223	261	315	332
NPMtP_1yr	84	95	116	140	162	190	210	243	308	322
NPMtP_2yr	82	84	94	116	139	162	189	210	242	309
OPMtP	93	114	137	161	189	209	241	308	323	348
OPMtP_6m	85	93	119	139	163	191	221	260	313	330
OPMtP_1yr	82	93	113	137	159	188	208	241	307	321
OPMtP_2yr	80	82	92	113	136	159	187	208	240	307
CFMtP	95	117	140	164	190	210	243	306	323	349
CFMtP_6m	87	95	122	142	166	192	223	261	313	332
CFMtP_1yr	84	95	116	140	162	188	209	242	305	322
CFMtP_2yr	82	84	94	116	139	161	188	209	242	306
Div	99	124	153	177	204	228	264	334	349	364
Div_6m	77	84	111	128	149	164	189	211	251	260
Div_1yr	74	84	106	128	145	166	182	203	249	258
Div_2yr	72	74	84	106	127	146	166	182	203	248
DPS	146	163	179	208	224	246	286	326	340	362

A.2. Attribute Availability for the First Month of Each Twelve-month Period

- continued

	Jul-94	Jul-95	Jul-96	Jul-97	Jul-98	Jul-99	Jul-00	Jul-05	Jul-05	Jul-05
DPS_6m	100	112	133	145	158	173	181	212	233	247
DPS_1yr	91	101	115	135	155	163	176	187	217	241
DPS_2yr	79	91	101	115	135	155	163	176	187	217
BVpS	96	120	146	170	193	217	251	322	340	362
BVpS_6m	85	96	125	146	173	197	224	264	329	347
BVpS_1yr	83	96	120	146	170	193	217	251	322	340
BVpS_2yr	82	83	96	120	146	170	193	217	251	322
CF	96	117	144	169	192	216	251	321	340	361
CF_6m	85	95	122	143	172	196	223	264	328	347
CF_1yr	83	95	117	143	168	192	216	251	321	340
CF_2yr	82	82	95	117	143	168	192	216	251	321
TDtTA	99	125	153	177	207	232	268	334	351	364
TDtTA_6m	79	89	114	134	157	191	207	252	290	313
TDtTA_1yr	78	90	111	131	154	186	205	237	283	308
TDtTA_2yr	80	78	90	111	130	155	186	205	237	283
TLtTA	99	125	153	177	207	232	268	334	351	364
TLtTA_6m	75	85	107	130	148	181	195	233	264	292
TLtTA_1yr	74	86	103	127	146	178	194	219	260	285
TLtTA_2yr	75	74	86	103	126	147	178	194	219	260
CFtTL	83	95	119	140	167	182	210	251	275	299
CFtTL_6m	68	77	98	117	142	163	182	213	249	275
CFtTL_1yr	66	78	92	115	138	161	177	203	243	265
CFtTL_2yr	65	63	78	92	115	134	162	174	203	240
CFtTD	87	103	123	148	173	193	225	273	298	318
CFtTD_6m	74	84	102	123	150	174	196	232	278	298
CFtTD_1yr	72	85	96	121	146	170	192	222	269	291
CFtTD_2yr	71	70	82	98	121	144	171	189	221	266
ROCE	85	94	118	150	175	200	227	264	321	339
ROCE_6m	84	85	96	124	148	179	207	230	275	324
ROCE_1yr	84	84	94	118	146	174	199	224	260	317
ROCE_2yr	77	83	85	94	118	146	174	197	223	260
ECandRes	99	125	153	177	208	232	269	336	352	365
ECandRes_6m	89	98	130	152	180	211	237	288	341	357
ECandRes_1yr	88	98	124	152	176	207	231	268	335	352
ECandRes_2yr	87	88	98	124	152	176	207	231	268	335
ICBT	98	124	152	179	209	238	288	336	356	364
ICBT_1yr	77	87	107	132	156	189	213	259	309	330
ICBT_2yr	74	77	87	107	132	156	189	213	259	309
CFtBorrRep	81	95	114	126	151	174	202	248	262	286
CFtBorrRep_6m	68	77	94	107	125	150	171	202	241	258
CFtBorrRep_1yr	67	78	88	106	121	143	167	192	232	250
CFtBorrRep_2yr	65	64	76	82	105	118	143	162	187	231
CFtBorrRepDiv	91	109	136	155	180	199	230	282	307	327
CFtBorrRepDiv_6m	82	88	115	132	156	183	200	233	284	307
CFtBorrRepDiv_1yr	80	89	109	132	152	179	194	223	277	297
CFtBorrRepDiv_2yr	76	78	89	106	132	152	176	192	225	272
Grow	87	96	120	147	172	196	228	265	329	340
Grow_6m	84	86	97	124	146	176	198	228	278	322
Grow_1yr	84	84	96	119	144	171	194	220	261	318
Grow_2yr	78	83	85	96	119	144	171	192	222	258
MOM_1m	151	166	186	207	227	241	285	324	340	363
MOM_3m	145	165	184	203	223	236	280	320	339	358
MOM_6m	143	165	183	199	219	235	275	313	336	357
MOM_12m	132	152	168	189	212	229	247	287	326	342
MOM_18m	127	143	165	183	199	219	235	275	313	336
MOM_24m	127	132	152	168	189	212	229	247	287	326
Cross1_Mom1m	140	152	175	194	217	227	269	311	329	349

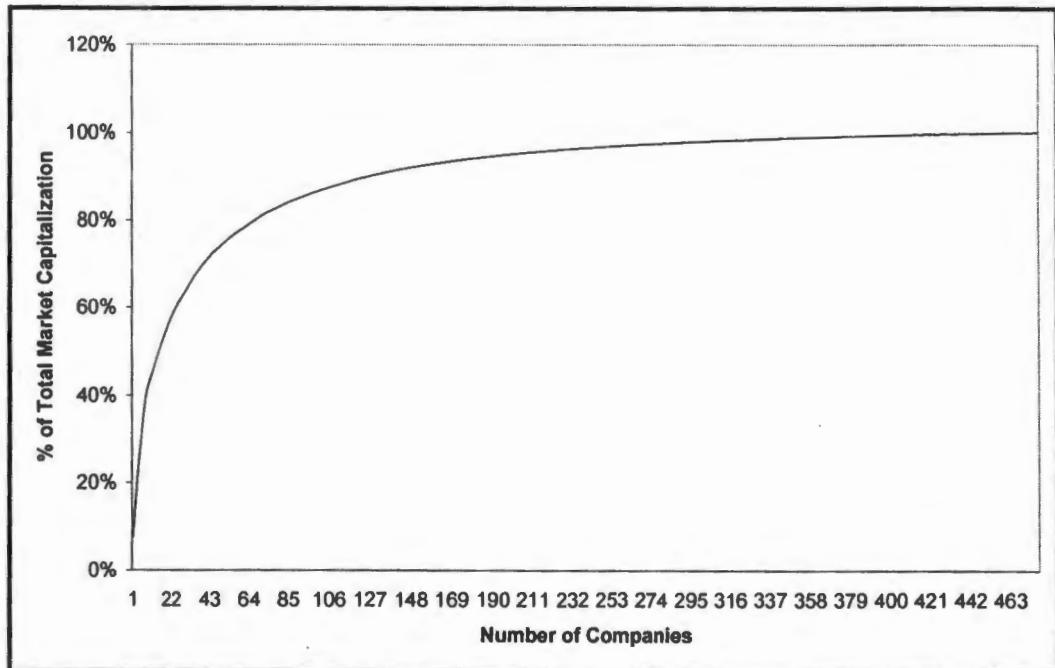
A.2. Attribute Availability for the First Month of Each Twelve-month Period

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	Jul-94	Jul-95	Jul-96	Jul-97	Jul-98	Jul-99	Jul-00	Jul-05	Jul-05	Jul-05
Cross3_Mom1m	136	154	180	192	216	226	274	309	323	343
Cross1_Mom3m	139	161	173	198	218	232	273	316	335	350
Cross3_Mom12m	128	142	163	183	200	221	236	278	320	338
Cross6_Mom12m	125	142	164	182	197	216	233	273	312	335
Cross1_Mom18m	124	141	161	171	196	217	235	273	311	335
Cross3_Mom18m	126	135	156	168	192	215	232	260	304	328
OBOS_3mMA	148	165	185	204	225	239	280	323	340	360
OBOS_6mMA	143	165	183	202	220	236	277	316	336	357
Inv_6m_ch	69	74	90	106	126	147	165	198	218	234
Inv_1yr_ch	68	75	89	107	120	147	161	185	215	230
Inv_2yr_ch	67	68	75	89	107	120	147	160	185	214
AccRec_6m_ch	69	76	97	115	134	154	178	213	253	277
AccRec_1yr_ch	68	77	93	115	131	152	169	196	248	272
AccRec_2yr_ch	67	68	77	93	114	131	151	167	196	249
chSale_les_chIn	67	74	88	105	118	146	160	180	213	227
chSale_les_chAcRe	67	75	90	109	125	147	162	185	233	251
SalestP	96	117	141	166	191	216	251	321	340	361
SalestP_6m	84	93	119	138	165	190	214	252	311	329
SalestP_1yr	82	93	114	138	162	186	209	242	304	321
SalestP_2yr	80	81	92	114	138	162	186	209	242	304
EPS_2yrAv	128	134	152	169	197	212	233	260	297	331
EPS_2yrAv_6m	105	114	133	148	167	180	196	211	248	254
EPS_2yrAv_1yr	96	110	120	137	151	171	183	197	223	253
EPS_2yrAv_2yr	87	96	110	120	137	151	171	183	197	223
SalepEmploy	64	64	67	57	61	56	89	236	285	292
SalepEmploy_1yr	43	53	52	55	50	48	56	82	221	262
SalepEmploy_2yr	40	41	45	46	49	42	49	54	83	216
A_Turn	99	125	151	174	205	231	264	334	350	365
A_Turn_6m	89	97	126	145	172	203	227	270	322	336
A_Turn_1yr	88	97	121	145	169	199	224	254	317	330
A_Turn_2yr	86	88	96	121	145	169	199	224	254	317
Accru	67	73	86	102	111	136	147	153	206	218
Accru_6m	66	66	71	88	96	113	127	119	162	205
Accru_1yr	65	66	72	84	96	108	119	115	143	194
Four_yrEarnGrowG	66	65	64	71	82	97	122	142	146	168
Four_yrEarnGrowA	48	52	57	66	73	78	93	109	119	131
EPSch_P_6m	132	150	165	188	208	228	242	290	326	335
EPSch_P_12m	128	134	152	169	197	212	233	260	297	331
EPSch_P_24m	116	128	134	152	169	197	212	233	260	297

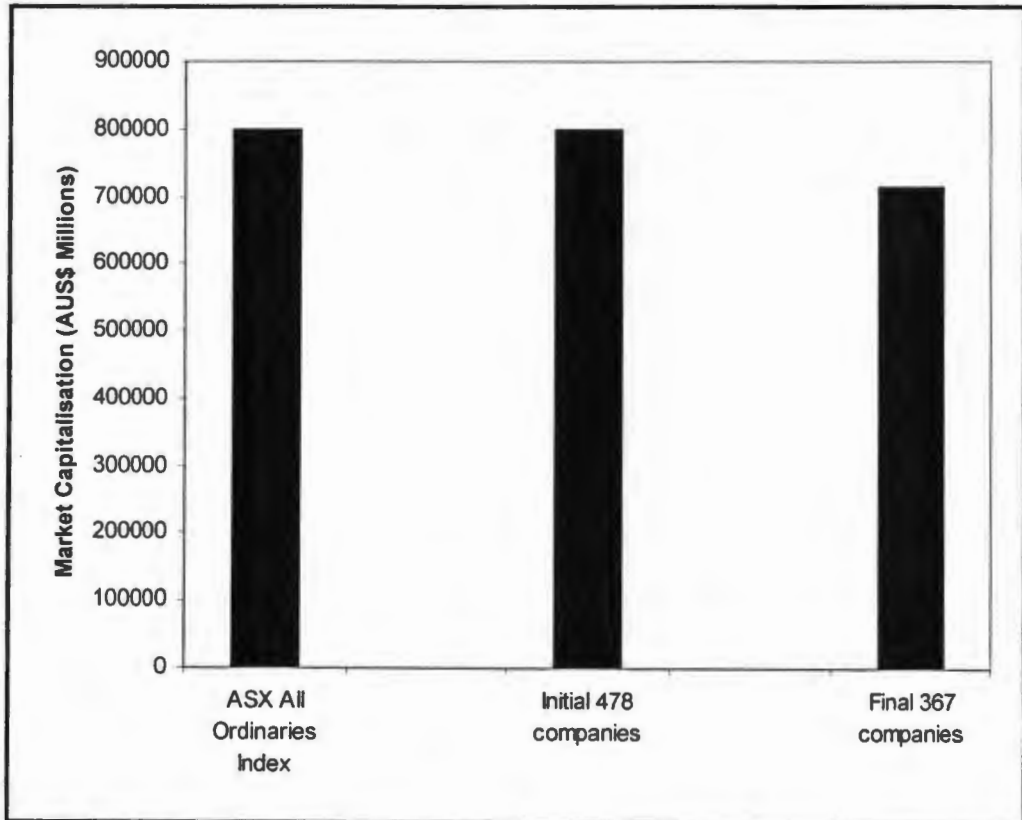
A.4. Cumulative Size of Filtered ASX Companies on Total Market Capitalisation

The graph above shows the cumulative market capitalisation of the ASX All Ordinaries constituents as a percentage of the total market capitalisation of the share sample as at 31 May 2004. Preference shares and shares with no total returns data are excluded. The share sample has been filtered to exclude firms that had turnover ratios of less than 0.01% in more than 60% of the months they were listed. The shares are ordered from highest to lowest market capitalisation displayed from left to right. The data were extracted from DataStream International. The largest 50 shares constitute 78% of the total market capitalisation of the share sample. On 31 May 2004, the market capitalisation of these 367 shares totals AUS\$ 713 768 million.



A.5. Market Capitalisation of the All Ordinaries Index and Initial and Filtered Samples

The graph compares the ending market capitalisations of the ASX All Ordinaries Index, the initial sample of 478 shares (excluding preference shares and shares with no total monthly returns data), and the filtered sample of 367 shares as at 31 May 2004. The filtered share sample excludes firms that had turnover ratios of less than 0.01% in more than 60% of the months they were listed. The data were extracted from DataStream International.



A.6. Definitions of DataStream International Items

Definitions of DataStream International items used to construct the firm-specific attributes tested in this paper. The DataStream International code is listed in brackets after the item. The definitions are based on the DataStream International Online Definitions.

Amortisation of Intangibles (975)

The non-movement of funds as shown in the Cashflow / Sources and Uses Statement and relating to the intangible assets.

Book Value per Share (1308)

Calculated on an issue basis, using that portion of share capital and reserves (excluding preference capital) minus intangibles attributable to the issue, divided by the year-end number of shares in that issue. It is adjusted for subsequent rights and scrip issues.

Borrowing Ratio (733)

Total debt divided by equity capital and reserves minus total intangibles.

Borrowings Repayable Within 1 Year (309)

Bank overdrafts, loans and other short-term borrowing. The current portion of long-term loans is included.

Capital Gearing (731)

Preference capital plus total debt, divided by total capital employed plus short term borrowings minus total intangibles minus future income tax benefits.

Cash Earnings per Share (792)

Earned for ordinary plus deferred tax and operating provisions, divided by the number of shares in issue.

Cash Flow Margin (719)

Cash earnings as a percentage of sales.

Depreciation (136)

This includes provisions for amounts written off, and depreciation of tangible fixed assets. Amortisation of intangible assets is included only if a separate breakdown is not disclosed in the annual report.

Dividend Yield (DY)

The dividend per share as a percentage of the share price. The underlying dividend is based on an anticipated annual dividend over the following twelve months and for that reason may be calculated on a rolling twelve-month basis, or as the "indicated" annual amount, or it may be a forecast. The dividend yield is based on gross dividends (including tax credits) where available. Special or once-off dividends are generally excluded.

Dividends Paid (434)

Ordinary and preference dividends paid during the period, often representing the previous year's final and current year's interim dividends.

Dividends per Share (DPS)

Dividend per share on a twelve-month rolling basis, taking interim dividends into account.

Earnings per Share (EPS)

The latest annualised rate that may reflect the last financial year or be derived from an aggregation of interim period earnings. Where the interim announcements are irregular or lacking in detail, the current earnings per share (EPS) may be a forecast provided by local sources.

Equity Capital and Reserves (305)

The equity share capital and reserves of the company. Preference capital is not included.

Standard adjustments include:

- goodwill shown against reserves is transferred to total intangibles

- capital and other grants shown as deferred liabilities are transferred to reserves
- proposed dividends are deducted if the balance sheet is shown before appropriations
- hybrid capital and other non-equity capital may have been excluded

Interest Cover Before Tax (ICBT)

Earnings before interest and tax (adjusted operating profit plus total non-operating income) divided by interest paid.

Market Value (MV)

The share price multiplied by the number of ordinary shares in issue. The amount in issue is updated whenever new tranches of stock are issued or after a capital change. For companies with more than one class of equity capital, the market value is expressed according to the individual issue. Market value is displayed in millions of units of local currency.

Market Value to Book Value (MTBV)

Market value divided by the net tangible assets.

Net Profit Margin (717)

Profits after tax (adjusted) divided by total sales.

Number of Shares (NS)

The number of shares used in the calculation of earnings per share. The year-end number of shares is used.

Operating Profit Margin (713)

Operating profit (adjusted for exceptional items) divided by total sales.

Payout Ratio (POUT)

The ratio of dividends per share to the net earnings per share (adjusted) for the last financial period.

Price (P)

The latest price available to DataStream International from the appropriate market in primary units of currency. It is the previous day's closing price from the default exchange. The 'current' prices taken at the close of market are stored each day. These stored prices are adjusted for subsequent capital actions, and this adjusted figure then becomes the default price. Prices are generally based on 'last trade' or an official price fixing. For stocks which are listed on more than one exchange within the country, default prices are taken from the primary exchange of that country (note that this is not necessarily the 'home' exchange of the stock).

Price/Cashflow Ratio (PC)

Current price divided by cash earnings per share for the appropriate financial year, adjusted for capital changes.

Quick Assets Ratio (742)

Total current assets minus total stock and work in progress, divided by total current liabilities.

Return on Capital Employed (707)

Pre-tax profit (excluding associates) adjusted for exceptional items plus total interest charges, divided by total capital employed plus borrowings repayable within one year minus total intangibles.

Return on Equity (Published) (1506)

Earned for ordinary, divided by equity capital and reserves minus total intangibles.

Total Assets (392)

The sum of tangible fixed assets, intangible assets, investments (including associates), other assets, total stocks & work in progress, total debtors & equivalent and cash & cash equivalents.

Common adjustments:

- deferred tax, if shown as an asset, is offset against deferred tax liability

- goodwill carried in reserves is transferred to intangible assets
- advances on work in progress, if disclosed as a liability by the company, has been offset against stocks and work in progress

Total Cash and Equivalent (375)

For industrials, this includes cash, bank balances, short-term loans and deposits, and investments shown under current assets. For banks and finance companies, it includes cash and balances with other banks, money at call and short notice, treasury bills and term deposits maturing under one month. Placements with banks are excluded.

Total Current Assets (376)

Includes stocks, work in progress, trade and other debtors, cash and equivalent, and any other current assets. Trade accounts receivable after one year are included.

Total Current Liabilities (389)

Includes current provisions, trade and other creditors, borrowings repayable within one year, and any other current liabilities. Trade accounts payable after one year are included. Where the balance sheet is stated before profit appropriation, the as reported figure for current liabilities is increased by the amount of proposed dividends outstanding at balance sheet date.

Total Debt (1301)

The total of all long and short term borrowings, including any subordinate debt and 'debt-like' hybrid finance instruments.

Total Debtors and Equivalent (370)

The total of balances outstanding which are due to the organisation in the normal course of trading. Accounts receivable after one year are included in this item.

Total Intangibles (344)

This includes research and development, goodwill, patents, trade marks, deferred charges, formation expenses and concessions. The figure may differ from that reported due to the fact that deferred charges may have been shown as part of 'other

assets' and goodwill on acquisition may have been deducted from share capital and reserves.

Total Loan Capital (321)

The total loan capital repayable after one year. It includes debentures, bonds, convertibles, notes, leasing finance, and 'debt-like' hybrid financial instruments.

Total Number of Employees (219)

The average number of employees as disclosed by the company. The year end number is used if the average number is not disclosed

Total Return (RI)

Theoretical growth in value of a share holding over a specified period, assuming that dividends are re-invested to purchase additional units of an equity at the closing price applicable on the ex-dividend date.

Total Sales (104)

The amount of sales of goods and services to third parties relating to the normal industrial activities of the company. It is net of sales related taxes and excludes any royalty income, rental income, and other operating income.

Total Stock and Work In Progress (364)

This includes finished goods, raw materials, work in progress less any advances paid, and any other stocks. It is stated net of any provisions for obsolete stocks. The most common adjustment applied to the as disclosed figure is the inclusion of advances on work in progress if shown as a liability.

Trading Days (not a DataStream International item)

Number of trading days in a month. This was derived from DataStream International data on the daily prices of shares.

Turnover by Volume (VO)

The number of shares traded for a stock for a particular month. The figure is always expressed in thousands. For stocks which are traded on more than one exchange within the country, default volumes are taken from the primary exchange of that country (note that this is not necessarily the 'home' exchange of the stock).

Working Capital Ratio (741)

Total current assets divided by total current liabilities.

A.7. Attribute Availability in the First Month of the Sample (July 1994)

The number of observations for each firm-specific attribute in the data set for July 1994, the first month of the sample. This month contains the fewest number of observations for both total returns and attribute data, as the sample suffers from survivorship bias. The data relate to the constituent shares of the ASX All Ordinaries Index as at 31 May 2004. Preference shares and shares with no total returns data are excluded. The share sample has been filtered to exclude firms that had turnover ratios of less than 0.01% in more than 60% of the months they were listed. The data were extracted from DataStream International. The table is sorted in ascending order of number of observations. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Characteristic	obs	Characteristic	obs	Characteristic	obs
SalepEmploy_2yr	40	CFtBorrRepDiv_2yr	76	CF_1yr	83
SalepEmploy_1yr	43	Borrow_1yr	77	CFtTL	83
Four_yrEarnGrowA	48	Gear_1yr	77	CFtP_2yr	84
IntanMV_2yr	58	WC	77	TV_3m	84
IntanMV_1yr	62	Quick	77	TV_6m	84
IntanMV_6m	64	Div_6m	77	NPMtP_1yr	84
SalepEmploy	64	ROCE_2yr	77	CFMtP_1yr	84
CFtTL_2yr	65	ICBT_1yr	77	ROCE_6m	84
CFtBorrRep_2yr	65	Borrow_6m	78	ROCE_1yr	84
Accru_1yr	65	Gear_6m	78	Grow_6m	84
CFtTL_1yr	66	TDtTA_1yr	78	Grow_1yr	84
Accru_6m	66	Grow_2yr	78	SalestP_6m	84
Four_yrEarnGrowG	66	Borrow_2yr	79	Reten_2yr	85
WC_2yr	67	Gear_2yr	79	CEpS_6m	85
Quick_2yr	67	DPS_2yr	79	OPMtP_6m	85
CFtBorrRep_1yr	67	TDtTA_6m	79	BVpS_6m	85
Inv_2yr_ch	67	DY_2yr	80	CF_6m	85
AccRec_2yr_ch	67	ROEpub_2yr	80	ROCE	85
chSale_les_chln	67	OPMtP_2yr	80	EPS_2yr	86
chSale_les_chAcRe	67	TDtTA_2yr	80	EY_2yr	86
Accru	67	CFtBorrRepDiv_1yr	80	CFtP_1yr	86
WC_1yr	68	SalestP_2yr	80	ROEpub_6m	86
Quick_1yr	68	MTBV_2yr	81	ROEpub_1yr	86
CFtTL_6m	68	BTMV_2yr	81	A_Turn_2yr	86
CFtBorrRep_6m	68	TV_2yr	81	Reten_1yr	87
Inv_1yr_ch	68	CFtBorrRep	81	NPMtP_6m	87
AccRec_1yr_ch	68	TV_1yr	82	CFMtP_6m	87
WC_6m	69	CEpS_2yr	82	CFtTD	87
Quick_6m	69	NPMtP_2yr	82	ECandRes_2yr	87
Inv_6m_ch	69	OPMtP_1yr	82	Grow	87
AccRec_6m_ch	69	CFMtP_2yr	82	EPS_2yrAv_2yr	87
CFtTD_2yr	71	BVpS_2yr	82	ROEpub	88
Div_2yr	72	CF_2yr	82	ECandRes_1yr	88
CFtTD_1yr	72	CFtBorrRepDiv_6m	82	A_Turn_1yr	88
Div_1yr	74	SalestP_1yr	82	ECandRes_6m	89
TLtTA_1yr	74	MTBV_1yr	83	A_Turn_6m	89
CFtTD_6m	74	BTMV_1yr	83	MTBV_6m	90
ICBT_2yr	74	Av6m_TV	83	BTMV_6m	90
TLtTA_6m	75	CEpS_1yr	83	DPS_1yr	91
TLtTA_2yr	75	BVpS_1yr	83	CFtBorrRepDiv	91

A.7. Attribute Availability in the First Month of the Sample (July 1994)

- continued

Characteristic	obs	Characteristic	obs	Characteristic	obs
DY_1yr	92	LnMV_2yr	127	LnMV_1m	151
CFtP_6m	93	P_2yr	127	P_1m	151
OPMtP	93	MOM_18m	127	LnP_1m	151
TV	95	MOM_24m	127	MOM_1m	151
TV_1m	95	MVtrade_1yr	128	LnMV	152
NPMtP	95	MVtradeMV_1yr	128	P	152
CFMtP	95	Cross3_Mom12m	128	LnP	152
MTBV	96	EPS_2yrAv	128		
BTMV	96	EPSch_P_12m	128		
NS	96	LnMV_1yr	132		
CEpS	96	P_1yr	132		
IntanMV	96	LnP_1yr	132		
BVpS	96	MOM_12m	132		
CF	96	EPSch_P_6m	132		
SalestP	96	EPS	134		
EPS_2yrAv_1yr	96	EY	134		
EPS_1yr	98	Cross3_Mom1m	136		
EY_1yr	98	MVtrade_6m	139		
CFtP	98	MVtradeMV_6m	139		
ICBT	98	Cross1_Mom3m	139		
Borrow	99	Cross1_Mom1m	140		
Gear	99	MVtrade_3m	141		
Div	99	MVtradeMV_3m	141		
TDtTA	99	LnMV_6m	143		
TLtTA	99	P_6m	143		
ECandRes	99	LnP_6m	143		
A_Turn	99	MOM_6m	143		
DY_6m	100	OBOS_6mMA	143		
Reten	100	LnP_3m	144		
DPS_6m	100	LnMV_3m	145		
EPS_2yrAv_6m	105	P_3m	145		
EPS_6m	110	MOM_3m	145		
EY_6m	110	DY	146		
EPSch_P_24m	116	DPS	146		
MVtrade_2yr	122	MVtrade_1m	147		
MVtradeMV_2yr	122	MVtradeMV_1m	147		
Cross1_Mom18m	124	VO	148		
Cross6_Mom12m	125	MVtrade	148		
LnP_2yr	126	MVtradeMV	148		
Cross3_Mom18m	126	OBOS_3mMA	148		

A.8. Average Attribute Availability across the Months of Sample

The average number of observations for each firm-specific attribute in the data set for each month over the entire sample July 1994 to May 2004. The data relate to the constituent shares of the ASX All Ordinaries Index as at 31 May 2004. Preference shares and shares with no total returns data are excluded. The share sample has been filtered to exclude firms that had turnover ratios of less than 0.01% in more than 60% of the months they were listed. The data were extracted from DataStream International. The table is sorted in ascending order of number of observations. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Characteristic	obs	Characteristic	obs	Characteristic	obs
SalepEmploy_2yr	68	EY_2yr	160	CFtP_2yr	182
Four_yrEarnGrowA	88	Div_1yr	162	MTBV_2yr	183
SalepEmploy_1yr	94	CFtBorrRep_6m	162	BTMV_2yr	183
Four_yrEarnGrowG	107	SalestP_2yr	163	EPS_2yrAv_6m	183
Accru_1yr	108	OPMtP_2yr	164	CFtTD_6m	183
IntanMV_2yr	115	CFMtP_2yr	166	EPS_6m	184
Accru_6m	119	AccRec_6m_ch	166	EY_6m	184
Inv_2yr_ch	125	NPMtP_2yr	166	CFtTL	185
CFtBorrRep_2yr	125	DY_1yr	168	Grow_6m	185
SalepEmploy	130	CEpS_2yr	168	ROCE_6m	187
Accru	132	DPS_1yr	168	SalestP_1yr	188
IntanMV_1yr	133	TV_2yr	169	OPMtP_1yr	189
AccRec_2yr_ch	134	CFtTD_1yr	169	CFtBorrRepDiv_6m	190
CFtTL_2yr	134	ICBT_2yr	169	CFMtP_1yr	191
Quick_2yr	136	Quick_6m	170	NPMtP_1yr	191
WC_2yr	137	TLtTA_1yr	170	ROEpub_6m	192
chSale_les_chln	140	CF_2yr	170	Gear_6m	193
Inv_1yr_ch	142	CFtTL_6m	170	Borrow_6m	193
Div_2yr	143	BVpS_2yr	171	TDtTA_6m	193
IntanMV_6m	143	WC_6m	171	CEpS_1yr	194
CFtTD_2yr	146	Div_6m	172	TV_1yr	195
chSale_les_chAcRe	147	Grow_1yr	172	ICBT_1yr	195
CFtBorrRep_1yr	147	A_Turn_2yr	172	CF_1yr	196
Grow_2yr	147	ROCE_1yr	173	BVpS_1yr	197
TLtTA_2yr	148	EPS_2yrAv_1yr	174	A_Turn_1yr	197
ROCE_2yr	148	CFtBorrRepDiv_1yr	176	CFtTD	197
Inv_6m_ch	151	EPS_1yr	176	ROCE	201
DY_2yr	152	EY_1yr	176	SalestP_6m	201
DPS_2yr	152	DY_6m	176	Grow	202
CFtBorrRepDiv_2yr	152	DPS_6m	176	OPMtP_6m	203
ROEpub_2yr	153	CFtBorrRep	177	EPSch_P_24m	203
AccRec_1yr_ch	155	ROEpub_1yr	179	CFMtP_6m	205
CFtTL_1yr	156	ECandRes_2yr	179	CFtBorrRepDiv	205
Gear_2yr	157	Gear_1yr	180	NPMtP_6m	205
Borrow_2yr	157	Borrow_1yr	181	ECandRes_1yr	206
EPS_2yrAv_2yr	158	Quick	181	ROEpub	207
TDtTA_2yr	158	TDtTA_1yr	181	CEpS_6m	208
Quick_1yr	158	TLtTA_6m	181	Reten_1yr	209
WC_1yr	159	WC	182	TV_6m	209
EPS_2yr	160	Reten_2yr	182	CFtP_1yr	209

A.8. Average Attribute Availability across the Months of Sample

- continued

Characteristic	obs	Characteristic	obs	Characteristic	obs
MTBV_1yr	210	TLtTA	234	LnP_1m	259
BTMV_1yr	210	MVtrade_1yr	235	LnMV_1m	260
CF_6m	210	MVtradeMV_1yr	235	P_1m	260
A_Turn_6m	211	ECandRes	235	MOM_1m	260
BVpS_6m	211	EPSch_P_6m	236	LnMV	261
Av6m_TV	211	CFtP	237	P	261
MVtrade_2yr	212	MTBV	238	LnP	261
MVtradeMV_2yr	212	BTMV	238		
LnP_2yr	215	Reten	238		
LnMV_2yr	216	LnP_1yr	238		
P_2yr	216	LnMV_1yr	239		
MOM_24m	216	P_1yr	239		
TV_3m	216	MOM_12m	239		
OPMtP	217	Cross3_Mom1m	244		
CFMtP	219	ICBT	245		
NPMtP	219	MVtrade_6m	247		
ECandRes_6m	220	MVtradeMV_6m	247		
Cross3_Mom18m	220	EPS	247		
TV_1m	221	EY	247		
CEpS	223	Cross1_Mom1m	248		
CFtP_6m	223	Cross1_Mom3m	249		
SalestP	224	LnP_6m	249		
MTBV_6m	224	LnMV_6m	250		
BTMV_6m	224	P_6m	250		
TV	224	MOM_6m	250		
Cross1_Mom18m	224	OBOS_6mMA	252		
EPS_2yrAv	224	MVtrade_3m	252		
EPSch_P_12m	224	MVtradeMV_3m	252		
CF	225	LnP_3m	255		
BVpS	225	LnMV_3m	256		
NS	225	P_3m	256		
Cross6_Mom12m	226	MOM_3m	256		
IntanMV	227	MVtrade_1m	256		
MOM_18m	227	MVtradeMV_1m	256		
Cross3_Mom12m	231	OBOS_3mMA	258		
Div	233	DY	258		
A_Turn	233	DPS	258		
Gear	234	VO	259		
Borrow	234	MVtrade	259		
TDtTA	234	MVtradeMV	259		

Appendix B

B.1. Australian Stock Exchange Sector and Subsector Indexes

The table displays the Australian Stock Exchange (ASX) sector and subsector indexes as listed by DataStream International. DataStream International uses the FTSE Actuaries classification structure for levels one to five. Level six is based on DataStream International customised indexes. Also included are the ASX All Ordinary Index, and the S&P300 and S&P200 indexes of Standard and Poor's. The shortened names of the indexes used in this paper are also included. The necessary data were obtained from DataStream International. * Excluded from the analysis due to insufficient data.

ANALYSIS NAME	FULL INDEX NAME	ANALYSIS NAME	FULL INDEX NAME
AIRLINES&APORTS	Airlines & Airports	MED. EQUIP&SUP.	Medical Equipment & Supplies
ASX ALL ORD	ASX All Ordinaries	MEDIA AGENCIES	Media Agencies
AUTO & PARTS	Automobiles & Parts	MEDIA, ENTERTAIN	Media & Entertainment
AUTO PARTS	Auto Parts	MINING	Mining
BANKS	Banks	MKT EX TMT	Market excluding Telecom, Media, Technology
BASIC INDUSTRIES	Basic Industries	NON CYC CONS GDS	Non-Cyclical Consumer goods
BEVERAGES	Beverages	NON CYC.SERVICES	Non-Cyclical Services
BLDNG&CONS. MATS	Building & Construction Materials	NON-FIN. EX RESOR	Non-financials,excluding resources
BREWERS	Brewers	NON-FINANCIAL	Non-financials
BUSINESS SUPPORT	Business Support Services	OIL & GAS	Oil & Gas
CHEMICALS	Chemicals	OIL&GAS EXP&PROD	Oil & Gas Exploration & Production
CHEMS. COMMODITY	Chemicals,Commodity	OTHER CONSTRUCTN	Other Construction
CONS.&BLDG MAT.	Construction & Building Materials	OTHER FINANCIAL	Other Financial
CYC. CONS. GOODS	Cyclical Consumer goods	OTHER MINING	Other Mineral Extractors
CYCLICAL SERVICE	Cyclical Services	OTHER UTILITIES	Utilities, Other
DISTIL.&VINTNERS	Distillers & Vintners	PAPER	Paper*
DIVERSIFIED INDS	Diversified Industrials	PHARM. & BIOTECH	Pharmaceuticals & Biotechnology
DSCT.&SPR.STORES	Discount & Super Stores & Warehouses	PHARMACEUTICALS	Pharmaceuticals
ENG. FABRICATORS	Engineering Fabricators	PROPERTY AGENCY	Property Agencies*
ENG.&MACHINERY	Engineering & Machinery	PUBLISH.&PRINT.	Publishing & Printing
FARMING&FISHING	Farming & Fishing	RAIL,RD,FREIGHT	Rail, Road & Freight
FINANCIALS	Financials	REAL ESTATE	Real Estate
FOOD PRDR./PRCR.	Food Producers & Processors	REAL ESTATE DEV.	Real Estate Development
FOOD PROCESSORS	Food Processors	RESOURCES	Resources
FOOD&DRUG RETLRS	Food & Drug Retailers	RETAIL, GENERAL	Retailers, General
FORESTRY AND PAPER	Forestry & Paper*	RETAILERS-DEPT	Retailers, Multi Department
GAMBLING	Gambling	S&P ASX 200	S&P ASX 200
GAS DISTRIBUTION	Gas Distribution	S&P ASX 300	S&P ASX 300
GEN. INDUSTRIALS	General industrials	SHIPPING & PORTS	Shipping & Ports
GOLD MINING	Gold Mining	SOFT DRINKS	Soft Drinks
HEALTH	Health	SPC&OTH. FINANCE	Speciality & Other Finance
HOSPITAL MNGMNT.	Hospital Management	STEEL	Steel
INSURANCE	Insurance	STEEL&OTH.METALS	Steel & Other Metals
INSURANCE BROKERS	Insurance Brokers*	SUBSCR. ENTERTAIN	Subscription Entertainment Netwks
INSURANCE,NON-LF	Insurance Non-Life	SUPPORT SERVICES	Support Services
INVEST. COS.(6)	Level 6: Investment Companies	TELECOM FXD.LINE	Telecom Fixed Line
INVESTMENT BANKS	Investment Banks	TELECOM SERVICES	Telecom Services
INVESTMENT COS.	Investment Companies	TELECOM,MEDIA,IT	Telecom, Media, Technology (TMT)
LEISURE + HOTELS	Leisure & Hotels	TRANS. + PAYROLL	Transaction & Payroll Services
LEISURE FACILITY	Leisure Facilities	TRANSPORT	Transport
LIFE ASSURANCE	Life Assurance	TV, RADIO, FILM	Television, Radio & Filmed Entertainment
MARKET	Market	UTILITIES	Utilities

B.2. Australian Stock Exchange Sector Indexes: Levels One to Three

The table displays the Australian Stock Exchange (ASX) sector and subsector indexes for classification levels one to three as listed by DataStream International. DataStream International uses the FTSE Actuaries classification structure for levels one to five. Also included are the ASX All Ordinary Index, and the S&P300 and S&P200 indexes of Standard and Poor's. The necessary data were obtained from DataStream International.

LEVEL	INDEX	DATASTREAM CODE
1	Market	TOTMK
OTHER	ASX All Ordinaries	ASXAORD
	S&P ASX 300	ASX300I
	S&P ASX 200	ASX200I
2	Non-financials	TOTLI
	Non-financials,excluding resources	TOTLX
	Resources	RESOR
	Financials	TOTLF
3	Resources	RESOR
	Basic Industries	BASIC
	General industrials	GENIN
	Cyclical Consumer goods	CYCGD
	Non-Cyclical Consumer goods	NCYCG
	Cyclical Services	CYSER
	Non-Cyclical Services	NCYSR
	Utilities	UTILS
	Financials	TOTLF
OTHER	Telecom, Media, Technology (TMT)	TLMIT
	Market excluding Telecom, Media,Technology	TOTXT

B.3. Australian Stock Exchange Sector and Subsector Indexes: Levels Three to Six

The table displays the Australian Stock Exchange (ASX) sector and subsector indexes for classification levels three to six as listed by DataStream International. DataStream International uses the FTSE Actuaries classification structure for levels one to five. Level six is based on DataStream International customised indexes. Level three indexes are displayed on a black background, and their subindexes are displayed directly below them. The necessary data were obtained from DataStream International. * Excluded from the analysis due to insufficient data.

Resources (RESOR)			
Level 4		Level 5	
Mining	MNING	Gold Mining	GOLDS
		Other Mineral Extractors	MINES
Oil & Gas	OILGS	Oil & Gas Exploration & Production	OILEP
Basic Industries (BASIC)			
Level 4		Level 5	
Chemicals	CHMCL	Chemicals, Commodity	CHEMS
Construction & Building Materials	CNSBM	Building & Construction Materials	BMATS
		Other Construction	OTHCN
Forestry & Paper*	FSTPA	Paper*	PAPER
Steel & Other Metals	STLOM	Steel	STEEL
General industrials (GENIN)			
Level 4		Level 5	
Diversified Industrials	DIVIN		
Engineering & Machinery	ENGEN	Engineering Fabricators	ENGFA
Cyclical Consumer goods (CYCGD)			
Level 4		Level 5	
Automobiles & Parts	AUTMB	Auto Parts	AUPRT
Non-Cyclical Consumer goods (NCYCG)			
Level 4		Level 5	
Beverages	BEVES	Brewers	BREWS
		Distillers & Vintners	DISTV
		Soft Drinks	SOFTD
Food Producers & Processors	FOODS	Farming & Fishing	FMFSH
		Food Processors	FDPRD
Health	HLTHC	Hospital Management	HOSPM
		Medical Equipment & Supplies	MEDEQ
Pharmaceuticals & Biotechnology	PHARM	Pharmaceuticals	PHRMC

B.3. Australian Stock Exchange Sector and Subsector Indexes: Levels Three to Six

- continued

Cyclical Services (CYSER)			
Level 4		Level 5	
Leisure & Hotels	LESUR	Gambling	GAMNG
		Leisure Facilities	LEISR
Media & Entertainment	MEDIA	Television, Radio & Filmed Entertainment	TVRFE
		Subscription Entertainment Netwks	SUBEN
		Media Agencies	MEDAG
		Publishing & Printing	PUBLS
Retailers, General	RTAIL	Discount & Super Stores & Warehouses	DSCST
		Retailers, Multi Department	MULTI
Support Services	SUPSV	Business Support Services	BUSUP
		Transaction & Payroll Services	TRPAY
Transport	TRNSP	Airlines & Airports	AIRLN
		Rail, Road & Freight	RROAD
		Shipping & Ports	SHPNG
Non-Cyclical Services (NCYSR)			
Level 4		Level 5	
Food & Drug Retailers	FDRET		
Telecom Services	TELCM	Telecom Fixed Line	TEFL
Utilities (UTILS)			
Level 4		Level 5	
Utilities, Other	UTILO	Gas Distribution	GASDS
Financials (TOTLF)			
Level 4		Level 5	
Banks	BANKS		
Insurance	INSUR	Insurance Brokers*	INSBR
		Insurance Non-Life	INSNL
Life Assurance	LIFEA		
Real Estate	RLEST	Real Estate Development	RLDEV
		Property Agencies*	PRPAG
Speciality & Other Finance	SPFIN	Investment Banks	INVBK
		Other Financial	MISFI
Investment Companies	INVSC	Level 6: Investment Companies	INVNK

B.4. Constituents of Clusters: Three-Cluster Breakdown

The table shows the results of the cluster analysis performed on total monthly returns of 77 Australian Stock Exchange (ASX) sector and subsector indexes over the period 1 January 1999 to 31 December 2003. Also included are the ASX All Ordinary Index, and the S&P300 and S&P200 indexes of Standard and Poor's. A subjective cut-off line is used to determine number of clusters extracted, which in this case is three clusters. The data concerning the sector and subsector indexes were extracted from DataStream International. Four indexes are excluded from the analysis due to insufficient data. Clusters are extracted based on the complete linkage distance between the individual sector and subsector indexes (the smaller the linkage distance, the more "similar" the indexes/clusters are in nature). Refer to Appendix B.1 for the full names of the indexes.

CLUSTER 1	CLUSTER 2	CLUSTER 3	
GOLD MINING	PHARMACEUTICALS	DIVERSIFIED INDS	BASIC INDUSTRIES
	TELECOM, MEDIA, IT	BREWERS	HOSPITAL MNGMNT.
	SUBSCR. ENTERTAIN	REAL ESTATE DEV.	GAMBLING
	MEDIA, ENTERTAIN	REAL ESTATE	INVESTMENT BANKS
		BANKS	FOOD&DRUG RETLRS
		SOFT DRINKS	MEDIA AGENCIES
		RETAIL, GENERAL	LEISURE FACILITY
		INSURANCE, NON-LF	SUPPORT SERVICES
		FINANCIALS	BUSINESS SUPPORT
		TRANS. + PAYROLL	ENG.&MACHINERY
		PHARM. & BIOTECH	PUBLISH.&PRINT.
		NON CYC CONS GDS	TELECOM SERVICES
		MARKET	NON CYC SERVICES
		MKT EX TMT	AUTO PARTS
		NON-FINANCIAL	AUTO & PARTS
		BEVERAGES	TV, RADIO, FILM
		OTHER FINANCIAL	LIFE ASSURANCE
		DSCT.&SPR.STORES	TELECOM FXD.LINE
		CHEMS. COMMODITY	ENG. FABRICATORS
		CHEMICALS	STEEL
			AIRLINES&PORTS
			INVEST. COS.(6)
			TRANSPORT
			RAIL, RD, FREIGHT
			MED. EQUIP&SUP.
			HEALTH
			UTILITIES
			CYCLICAL SERVICE
			CYC. CONS. GOODS
			OTHER UTILITIES
			GAS DISTRIBUTION
			ASX ALL ORD
			S&P ASX 300
			S&P ASX 200

B.6. Constituents of Clusters: Five-Cluster Breakdown

The table shows the results of the cluster analysis performed on total monthly returns of 77 Australian Stock Exchange (ASX) sector and subsector indexes over the period 1 January 1999 to 31 December 2003. Also included are the ASX All Ordinary Index, and the S&P300 and S&P200 indexes of Standard and Poor's. A subjective cut-off line is used to determine number of clusters extracted, which in this case is five clusters. The data concerning the sector and subsector indexes were extracted from DataStream International. Four indexes are excluded from the analysis due to insufficient data. Clusters are extracted based on the complete linkage distance between the individual sector and subsector indexes (the smaller the linkage distance, the more "similar" the indexes/clusters are in nature). Refer to Appendix B.1 for the full names of the indexes.

CLUSTER 1	CLUSTER 2	CLUSTER 3	CLUSTER 4	CLUSTER 5
GOLD MINING	PHARMACEUTICALS	TELECOM, MEDIA, IT	DIVERSIFIED INDS	BASIC INDUSTRIES
		SUBSCR. ENTERTAIN	BREWERS	HOSPITAL MNGMNT.
		MEDIA, ENTERTAIN	REAL ESTATE DEV.	GAMBLING
			INSURANCE	INVESTMENT BANKS
			FOOD PRDR./PRCR.	FOOD&DRUG RETLRS
			SOFT DRINKS	MEDIA AGENCIES
			RETAIL, GENERAL	LEISURE FACILITY
			INSURANCE, NON-LF	SUPPORT SERVICES
			FINANCIALS	OTHER CONSTRUCTN BUSINESS SUPPORT
			TRANS. + PAYROLL	OIL&GAS EXP&PROD
			PHARM. & BIOTECH	OIL & GAS
			NON CYC CONS GDS	LEISURE + HOTELS
			MARKET	DISTIL.&VINTNRS
			MKT EX TMT	CONS.&BLDG MAT.
			NON-FINANCIAL	BLDNG&CONS. MATS
			BEVERAGES	FOOD PROCESSORS
			OTHER FINANCIAL	STEEL&OTH.METALS
			DSCT.&SPR.STORES	RESOURCES
			CHEMS. COMMODITY	OTHER MINING
			CHEMICALS	MINING
				STEEL
				AIRLINES&APORTS
				INVESTMENT COS.
				INVEST. COS.(6)
				TRANSPORT
				RAIL, RD, FREIGHT
				MED. EQUIP&SUP.
				HEALTH
				UTILITIES
				CYCLICAL SERVICE
				CYC. CONS. GOODS
				OTHER UTILITIES
				GAS DISTRIBUTION
				ASX ALL ORD
				S&P ASX 300
				S&P ASX 200

B.7. Correlation Matrix of Total Monthly Returns of ASX Indexes

Correlation matrix of Pearson (1896) correlation coefficients between 77 Australian Stock Exchange (ASX) sector and subsector indexes over the period 1 January 1999 to 31 December 2003. Also included are the ASX All Ordinary Index and the Standard and Poor's S&P300 and S&P200 indexes. The data were extracted from DataStream International. Four indexes are excluded due to insufficient data. Correlations greater than 0.875 (less than -0.875) are shown in white on a black background. Refer to Appendix B.1 for the full names of the indexes.

	S&P ASX 200	S&P ASX 300	ASX ALL ORD	AIRLINES&PORTS	AUTO & PARTS	AUTO PARTS	BANKS	BASIC INDUSTRIES	BEVERAGES	BLDNG&CONS. MATS	BREWERS	BUSINESS SUPPORT	CHEMICALS	CHEMS. COMMODITY	CONS.&BLDG MAT.	CYC. CONS. GOODS	CYCLICAL SERVICE	DISTL.&VINTNRS	DIVERSIFIED INDS	MKT EX TMT	
S&P ASX 200	1.00																				
S&P ASX 300	1.00	1.00																			
ASX ALL ORD	1.00	1.00	1.00																		
AIRLINES&PORTS	0.17	0.17	0.18	1.00																	
AUTO & PARTS	-0.77	-0.77	-0.74	0.00	1.00																
AUTO PARTS	-0.77	-0.77	-0.74	0.00	1.00	1.00															
BANKS	0.84	0.84	0.83	0.35	-0.87	-0.87	1.00														
BASIC INDUSTRIES	0.73	0.73	0.75	0.43	-0.87	-0.87	0.68	1.00													
BEVERAGES	0.28	0.25	0.23	0.25	-0.37	-0.37	0.43	0.28	1.00												
BLDNG&CONS. MATS	0.75	0.75	0.78	0.39	-0.72	-0.72	0.91	0.99	0.31	1.00											
BREWERS	0.84	0.83	0.81	-0.09	-0.88	-0.88	0.61	0.46	0.65	0.54	1.00										
BUSINESS SUPPORT	-0.29	-0.30	-0.32	-0.48	0.42	0.42	-0.62	-0.81	-0.14	-0.80	-0.21	1.00									
CHEMICALS	0.33	0.34	0.38	0.52	-0.24	-0.24	0.55	0.83	0.00	0.77	-0.03	-0.83	1.00								
CHEMS. COMMODITY	0.34	0.35	0.39	0.51	-0.25	-0.25	0.56	0.83	0.01	0.77	-0.02	-0.83	1.00	1.00							
CONS.&BLDG MAT.	0.77	0.77	0.78	0.39	-0.73	-0.73	0.92	0.99	0.35	1.00	0.56	-0.77	0.75	0.75	1.00						
CYC. CONS. GOODS	-0.47	-0.48	-0.49	-0.09	0.68	0.68	-0.71	-0.81	0.00	-0.81	-0.27	0.78	-0.72	-0.72	-0.79	1.00					
CYCLICAL SERVICE	0.20	0.19	0.19	-0.48	0.12	0.12	-0.31	-0.41	-0.44	-0.41	-0.08	0.64	-0.53	-0.52	-0.40	0.40	1.00				
DISTL.&VINTNRS	0.49	0.48	0.44	-0.03	-0.54	-0.54	0.37	0.05	0.80	0.13	0.73	0.19	-0.45	-0.45	0.16	0.18	0.17	1.00			
DIVERSIFIED INDS	0.69	0.69	0.69	0.46	-0.70	-0.70	0.87	0.66	0.84	0.89	0.73	-0.67	0.55	0.55	0.90	-0.58	-0.49	0.42	1.00		
MKT EX TMT	0.90	0.90	0.90	0.35	-0.84	-0.84	0.97	0.88	0.48	0.90	0.70	-0.54	0.50	0.51	0.92	-0.62	-0.23	0.48	0.90	1.00	
DSCT.&SPR.STORES	0.41	0.40	0.38	-0.31	-0.17	-0.17	0.02	-0.22	0.10	-0.18	0.37	0.64	-0.54	-0.53	-0.14	0.40	0.71	0.55	-0.07	0.15	
ENG. FABRICATORS	0.49	0.50	0.53	0.43	-0.43	-0.43	0.70	0.92	0.07	0.88	0.17	-0.84	0.93	0.93	0.87	-0.82	-0.48	-0.30	0.67	0.66	
ENG.&MACHINERY	-0.81	-0.81	-0.79	-0.17	0.94	0.94	-0.92	-0.79	-0.40	-0.83	-0.72	0.55	-0.36	-0.37	-0.85	0.68	0.21	-0.53	-0.82	-0.91	
FARMING&FISHING	0.51	0.52	0.54	0.66	-0.43	-0.43	0.72	0.82	0.37	0.79	0.28	-0.77	0.81	0.81	0.79	-0.53	-0.52	0.01	0.75	0.70	
FINANCIALS	0.88	0.88	0.87	0.30	-0.89	-0.89	0.99	0.85	0.47	0.89	0.68	-0.55	0.48	0.48	0.90	-0.85	-0.23	0.48	0.68	0.99	
FOOD PRDR./PRCR.	0.50	0.51	0.53	0.55	-0.50	-0.50	0.77	0.93	0.28	0.90	0.22	-0.87	0.92	0.92	0.89	-0.77	-0.80	-0.18	0.76	0.73	
FOOD PROCESSORS	0.47	0.48	0.49	0.54	-0.50	-0.50	0.77	0.92	0.24	0.89	0.20	-0.88	0.92	0.92	0.88	-0.80	-0.84	-0.18	0.75	0.70	
FOOD&DRUG RETLRS	0.77	0.77	0.78	0.35	-0.88	-0.88	0.97	0.91	0.42	0.94	0.84	-0.71	0.57	0.57	0.94	-0.78	-0.40	0.35	0.90	0.94	
GAMBLING	0.45	0.46	0.48	0.60	-0.42	-0.42	0.72	0.83	0.27	0.79	0.10	-0.74	0.88	0.88	0.79	-0.87	-0.59	-0.20	0.68	0.67	
GAS DISTRIBUTION	0.54	0.55	0.56	0.20	-0.58	-0.58	0.88	0.73	0.79	0.14	0.78	0.19	-0.57	0.73	0.73	0.77	-0.80	-0.36	-0.21	0.58	0.88
GEN. INDUSTRIALS	-0.04	-0.05	-0.02	0.54	0.20	0.20	0.10	0.24	0.53	0.24	0.19	-0.29	0.34	0.34	0.24	0.08	-0.51	0.01	0.49	0.17	
GOLD MINING	0.64	0.65	0.67	0.57	-0.54	-0.54	0.81	0.95	0.29	0.92	0.34	-0.79	0.87	0.87	0.92	-0.71	-0.47	0.00	0.82	0.81	
HEALTH	0.71	0.70	0.68	-0.18	-0.66	-0.66	0.49	0.26	0.41	0.32	0.80	0.18	-0.28	-0.27	0.35	-0.09	0.32	0.83	0.45	0.60	
HOSPITAL MNGMNT.	0.75	0.75	0.78	0.49	-0.73	-0.73	0.93	0.96	0.39	0.96	0.50	-0.78	0.78	0.78	0.97	-0.74	-0.44	0.18	0.89	0.91	
INSURANCE	0.84	0.85	0.87	0.12	-0.48	-0.48	0.68	0.79	0.27	0.79	0.45	-0.47	0.85	0.86	0.79	-0.63	-0.21	-0.05	0.67	0.71	
INSURANCE, NON-LF	0.75	0.75	0.77	0.11	-0.63	-0.63	0.79	0.84	0.30	0.85	0.54	-0.48	0.81	0.82	0.86	-0.89	-0.17	0.08	0.73	0.81	
INVEST. COS.(6)	0.72	0.73	0.73	0.37	-0.78	-0.78	0.93	0.94	0.47	0.97	0.66	-0.75	0.66	0.66	0.97	-0.78	-0.48	0.27	0.95	0.92	
INVESTMENT BANKS	0.89	0.89	0.89	0.07	-0.70	-0.70	0.72	0.66	0.33	0.69	0.78	-0.24	0.23	0.24	0.72	-0.40	0.18	0.54	0.70	0.82	
INVESTMENT COS.	0.72	0.73	0.73	0.37	-0.78	-0.78	0.93	0.94	0.47	0.97	0.66	-0.75	0.66	0.66	0.97	-0.78	-0.48	0.27	0.95	0.92	
LEISURE + HOTELS	0.86	0.86	0.84	0.23	-0.80	-0.80	0.85	0.67	0.48	0.71	0.69	-0.28	0.24	0.25	0.74	-0.43	-0.07	0.82	0.78	0.90	
LEISURE FACILITY	0.86	0.87	0.84	0.05	-0.63	-0.63	0.53	0.23	0.42	0.29	0.61	0.14	-0.25	-0.24	0.32	0.01	0.24	0.84	0.46	0.81	
LIFE ASSURANCE	0.17	0.15	0.12	-0.28	-0.14	-0.14	-0.08	-0.44	0.35	-0.38	0.37	0.87	-0.78	-0.78	-0.34	0.58	0.47	0.79	-0.09	0.02	
MARKET	0.98	0.98	0.98	0.15	-0.67	-0.67	0.87	0.75	0.64	0.26	0.66	0.81	-0.17	0.27	0.28	0.67	-0.34	0.29	0.50	0.82	0.84
MED. EQUIP&SUP.	0.72	0.72	0.69	-0.14	-0.69	-0.69	0.53	0.30	0.43	0.37	0.83	0.10	-0.25	-0.24	0.40	-0.13	0.27	0.84	0.51	0.63	
MEDIA AGENCIES	0.90	0.89	0.87	0.12	-0.87	-0.87	0.85	0.83	0.52	0.89	0.79	-0.23	0.13	0.14	0.72	-0.41	0.03	0.71	0.75	0.90	
MEDIA, ENTERTAIN	0.02	0.02	0.02	-0.54	0.25	0.25	-0.45	-0.51	-0.56	-0.51	-0.21	0.84	-0.54	-0.53	-0.52	0.42	0.98	0.03	-0.63	-0.39	
MINING	0.88	0.88	0.89	0.41	-0.88	-0.88	0.88	0.88	0.31	0.89	0.55	-0.57	0.61	0.61	0.89	-0.81	-0.17	0.31	0.82	0.92	
NON CYC CONS GDS	0.61	0.60	0.57	0.18	-0.61	-0.61	0.58	0.34	0.82	0.41	0.85	-0.03	-0.13	-0.12	0.45	-0.02	-0.10	0.87	0.70	0.82	
NON CYC. SERVICES	-0.88	-0.88	-0.86	-0.19	0.88	0.88	-0.88	-0.77	-0.35	-0.81	-0.82	0.61	-0.39	-0.40	-0.82	0.70	0.30	-0.38	-0.77	-0.84	
NON-FIN. EX RESOR	-0.11	-0.12	-0.11	-0.37	0.51	0.51	-0.61	-0.61	-0.39	-0.62	-0.26	0.75	-0.52	-0.52	-0.62	0.65	0.86	0.00	-0.64	-0.50	
NON-FINANCIAL	0.41	0.41	0.43	-0.18	0.12	0.12	-0.12	-0.12	-0.23	-0.13	0.06	0.47	-0.21	-0.20	-0.13	0.33	0.81	0.20	-0.19	0.03	
OIL & GAS	0.86	0.86	0.86	0.19	-0.84	-0.84	0.77	0.69	0.26	0.71	0.53	-0.22	0.38	0.37	0.73	-0.45	0.05	0.32	0.84	0.84	
OIL&GAS EXP&PROD	0.86	0.86	0.86	0.19	-0.84	-0.84	0.78	0.70	0.26	0.71	0.53	-0.23	0.37	0.38	0.74	-0.46	0.04	0.31	0.64	0.84	
OTHER CONSTRUCTN	0.77	0.77	0.77	0.41	-0.75	-0.75	0.92	0.92	0.51	0.93	0.85	-0.85	0.83	0.83	0.96	-0.67	-0.41	0.30	0.93	0.94	
OTHER FINANCIAL	0.25	0.24	0.23	-0.35	0.03	0.03	-0.18	-0.40	0.14	-0.37	0.27	0.78	-0.84	-0.84	-0.33	0.58	0.71	0.56	-0.21	-0.04	
OTHER MINING	0.90	0.90	0.91	0.35	-0.88	-0.88	0.83	0.84	0.28	0.85	0.57	-0.50	0.54	0.55	0.86	-0.57	-0.09	0.34	0.78	0.91	
OTHER UTILITIES	0.54	0.55	0.56	0.20	-0.58	-0.58	0.73	0.79	0.14	0.78	0.19	-0.57	0.73	0.73	0.77	-0.80	-0.36	-0.21	0.58	0.68	
PHARM. & BIOTECH	0.57	0.56	0.52	-0.13	-0.52	-0.52	0.33	0.02	0.43	0.08	0.70	0.34	-0.49	-0.48	0.13	0.20	0.40	0.92	0.31	0.45	
PHARMACEUTICALS	0.48	0.47	0.44	-0.11	-0.43	-0.43	0.24	-0.07	0.44	0.00	0.66	0.39	-0.55	-0.54	0.04	0.30	0.38	0.92	0.26	0.37	
PUBLISH.&PRINT.	0.05	0.05	0.09	-0.11	0.44	0.44	-0.39	-0.24	-0.51	-0.29	-0.36	0.37	-0.08	-0.08	-0.30	0.33	0.73	-0.27	-0.47	-0.30	
RAIL, RD.FREIGHT	0.71	0.71	0.69	0.06	-0.70	-0.70	0.66	0.51	0.52	0.56	0.87	-0.22	0.08	0.07	0.59	-0.26	0.02	0.67	0.89	0.73	
REAL ESTATE	0.78	0.78	0.78	0.30	-0.80	-0.80	0.92	0.93	0.23	0.93	0.49	-0.72	0.69	0.70	0.93	-0.82	-0.28	0.14	0.79	0.89	
REAL ESTATE DEV.	0.78	0.78	0.79	0.30	-0.80	-0.80	0.91	0.92	0.23	0.92	0.49	-0.72	0.69	0.69	0.93	-0.82	-0.27	0.13	0.78	0.88	
RESOURCES	0.89	0.90	0.91	0.39	-0.89	-0.89	0.87	0.88	0.31	0.88	0.56	-0.53	0.59	0.60	0.89	-0.60	-0.14	0.31	0.81	0.93	
RETAIL, GENERAL	0.48	0.47	0.48	0.38	-0.20	-0.20	0.36	0.34	0.55	0.34	0.50	-0.07	0.18	0.18	0.37	0.08	-0.04	0.40	0.53	0.50	
RETAILERS-DEPT																					

B.7. Correlation Matrix of Total Monthly Returns of ASX Indexes
- continued

	DSCT & SPR STORES	ENG. FABRICATORS	ENG.&MACHINERY	FARMING&FISHING	FINANCIALS	FOOD PRDR./PRCR.	FOOD PROCESSORS	FOOD&DRUG RETLRS	GAMBLING	GAS DISTRIBUTION	GEN. INDUSTRIALS	GOLD MINING	HEALTH	HOSPITAL MNGMNT.	INSURANCE	INSURANCE NON-LF	INVEST. COS.(6)	INVESTMENT BANKS	INVESTMENT COS.	LEISURE + HOTELS	
S&P ASX 200																					
S&P ASX 300																					
ASX ALL ORD																					
AIRLINES&A PORTS																					
AUTO & PARTS																					
AUTO PARTS																					
BANKS																					
BASIC INDUSTRIES																					
BEVERAGES																					
BLDNG&CONS. MATS																					
BREWERS																					
BUSINESS SUPPORT																					
CHEMICALS																					
CHEMS. COMMODITY																					
CONS.&BLDG MAT.																					
CYC. CONS. GOODS																					
CYCLICAL SERVICE																					
DISTL.&VINTNRS																					
DIVERSIFIED INDS																					
MKT EX TMT																					
DSCT.&SPR.STORES	1.00																				
ENG. FABRICATORS	-0.43	1.00																			
ENG.&MACHINERY	-0.09	-0.54	1.00																		
FARMING&FISHING	-0.32	0.78	-0.55	1.00																	
FINANCIALS	0.13	0.64	-0.92	0.68	1.00																
FOOD PRDR./PRCR.	-0.44	0.93	-0.62	0.91	0.72	1.00															
FOOD PROCESSORS	-0.49	0.94	-0.62	0.87	0.70	0.99	1.00														
FOOD&DRUG RETLRS	-0.09	0.73	-0.94	0.72	0.95	0.80	0.79	1.00													
GAMBLING	-0.39	0.86	-0.51	0.87	0.66	0.95	0.93	0.70	1.00												
GAS DISTRIBUTION	-0.18	0.83	-0.57	0.80	0.70	0.79	0.80	0.71	0.78	1.00											
GEN. INDUSTRIALS	-0.22	0.27	0.09	0.46	0.10	0.34	0.32	0.12	0.36	0.01	1.00										
GOLD MINING	-0.27	0.89	-0.68	0.91	0.77	0.96	0.93	0.83	0.90	0.72	0.36	1.00									
HEALTH	0.64	-0.08	-0.65	-0.02	0.58	-0.05	-0.07	0.47	-0.11	0.08	-0.14	0.13	1.00								
HOSPITAL MNGMNT.	-0.19	0.83	-0.84	0.86	0.90	0.91	0.90	0.94	0.84	0.73	0.25	0.93	0.31	1.00							
INSURANCE	0.08	0.77	-0.53	0.58	0.89	0.71	0.68	0.64	0.67	0.76	0.30	0.74	0.24	0.71	1.00						
INSURANCE NON-LF	0.12	0.77	-0.67	0.58	0.80	0.71	0.69	0.75	0.66	0.79	0.19	0.78	0.38	0.77	0.98	1.00					
INVEST. COS.(6)	-0.15	0.80	-0.88	0.75	0.92	0.84	0.84	0.97	0.74	0.73	0.28	0.67	0.42	0.95	0.75	0.82	1.00				
INVESTMENT BANKS	0.43	0.41	-0.75	0.42	0.78	0.40	0.36	0.71	0.31	0.39	0.08	0.58	0.80	0.65	0.64	0.73	0.71	1.00			
INVESTMENT COS.	-0.15	0.80	-0.88	0.75	0.92	0.84	0.84	0.97	0.74	0.73	0.28	0.87	0.42	0.95	0.75	0.82	1.00	0.71	1.00		
LEISURE + HOTELS	0.37	0.40	-0.86	0.47	0.88	0.49	0.47	0.80	0.48	0.49	0.07	0.61	0.72	0.72	0.55	0.67	0.76	0.77	0.76	1.00	
LEISURE FACILITY	0.63	-0.09	-0.64	0.09	0.60	0.02	-0.01	0.47	0.02	0.07	-0.12	0.17	0.80	0.32	0.13	0.28	0.36	0.59	0.36	0.85	0.85
LIFE ASSURANCE	0.76	-0.70	-0.04	-0.38	0.03	-0.59	-0.82	-0.16	-0.52	-0.45	-0.13	-0.45	0.59	-0.32	-0.31	-0.23	-0.26	0.18	-0.26	0.28	0.28
MARKET	0.50	0.40	-0.71	0.46	0.80	0.41	0.37	0.68	0.38	0.46	0.01	0.58	0.71	0.66	0.62	0.71	0.63	0.88	0.63	0.81	0.81
MED. EQUIP&SUP.	0.60	-0.04	-0.69	0.03	0.61	0.00	-0.02	0.52	-0.07	0.10	-0.11	0.17	1.00	0.38	0.26	0.40	0.46	0.82	0.46	0.73	0.73
MEDIA AGENCIES	0.42	0.34	-0.89	0.41	0.90	0.41	0.39	0.82	0.35	0.47	-0.03	0.54	0.83	0.70	0.54	0.67	0.75	0.86	0.75	0.90	0.90
MEDIA, ENTERTAIN	0.58	-0.52	0.35	-0.60	-0.39	-0.66	-0.68	-0.53	-0.65	-0.42	-0.55	-0.57	0.15	-0.55	-0.31	-0.30	-0.60	-0.01	-0.80	-0.25	-0.25
MINING	0.09	0.71	-0.81	0.72	0.86	0.74	0.71	0.84	0.67	0.64	0.18	0.85	0.49	0.87	0.70	0.78	0.85	0.78	0.85	0.81	0.81
NON CYC CONS GDS	0.44	0.02	-0.63	0.31	0.68	0.18	0.14	0.57	0.14	0.12	0.31	0.31	0.80	0.46	0.28	0.38	0.55	0.69	0.55	0.74	0.74
NON CYC. SERVICES	0.01	-0.62	0.88	-0.52	-0.87	-0.83	-0.83	-0.91	-0.53	-0.66	0.04	-0.64	-0.48	-0.78	-0.55	-0.67	-0.85	-0.82	-0.85	-0.75	-0.75
NON-FIN. EX RESOR	0.55	-0.80	0.56	-0.55	-0.54	-0.69	-0.72	-0.70	-0.63	-0.57	-0.21	-0.57	0.05	-0.63	-0.33	-0.38	-0.70	-0.09	-0.70	-0.36	-0.36
NON-FINANCIAL	0.65	-0.22	0.11	-0.17	-0.05	-0.30	-0.35	-0.23	-0.28	-0.21	-0.13	-0.10	0.37	-0.15	0.07	0.08	-0.23	0.38	-0.23	0.12	0.12
OIL & GAS	0.39	0.54	-0.68	0.44	0.80	0.51	0.48	0.70	0.51	0.67	0.02	0.61	0.59	0.66	0.72	0.80	0.69	0.78	0.69	0.83	0.83
OIL&GAS EXP&PROD	0.38	0.55	-0.69	0.44	0.81	0.52	0.49	0.71	0.52	0.68	0.02	0.62	0.59	0.67	0.72	0.81	0.69	0.78	0.69	0.83	0.83
OTHER CONSTRUCT	-0.02	0.76	-0.84	0.76	0.92	0.82	0.80	0.93	0.76	0.74	0.30	0.87	0.46	0.93	0.76	0.83	0.95	0.75	0.95	0.81	0.81
OTHER FINANCIAL	0.89	-0.59	0.11	-0.39	-0.06	-0.57	-0.63	-0.29	-0.51	-0.40	-0.14	-0.39	0.57	-0.34	-0.07	-0.05	-0.33	0.33	-0.33	0.19	0.19
OTHER MINING	0.16	0.66	-0.80	0.65	0.85	0.67	0.64	0.81	0.60	0.62	0.13	0.79	0.54	0.83	0.68	0.78	0.81	0.80	0.81	0.82	0.82
OTHER UTILITIES	-0.18	0.63	-0.57	0.60	0.70	0.79	0.80	0.71	0.78	1.00	0.01	0.72	0.08	0.73	0.78	0.79	0.73	0.39	0.73	0.49	0.49
PHARM. & BIOTECH	0.75	-0.33	-0.47	-0.08	0.44	-0.24	-0.27	0.29	-0.27	-0.15	-0.11	-0.05	0.89	0.12	0.10	0.12	0.19	0.64	0.19	0.61	0.61
PHARMACEUTICALS	0.74	-0.40	-0.38	-0.13	0.35	-0.30	-0.34	0.21	-0.32	-0.24	-0.05	-0.12	0.85	0.05	-0.08	0.04	0.12	0.58	0.12	0.53	0.53
PUBLISH & PRINT.	0.35	-0.15	0.43	-0.17	-0.35	-0.28	-0.34	-0.46	-0.24	-0.24	-0.17	-0.18	-0.11	-0.31	-0.03	-0.10	-0.45	0.04	-0.45	-0.29	-0.29
RAIL, RD, FREIGHT	0.39	0.22	-0.71	0.35	0.72	0.28	0.25	0.66	0.18	0.27	0.14	0.40	0.78	0.56	0.40	0.50	0.65	0.62	0.65	0.65	0.65
REAL ESTATE	-0.12	0.82	-0.64	0.73	0.90	0.83	0.83	0.92	0.75	0.82	0.04	0.84	0.35	0.92	0.69	0.78	0.91	0.68	0.91	0.69	0.69
REAL ESTATE DEV.	-0.11	0.82	-0.84	0.72	0.90	0.83	0.82	0.92	0.75	0.82	0.04	0.84	0.35	0.92	0.69	0.78	0.90	0.69	0.90	0.68	0.68
RESOURCES	0.13	0.71	-0.81	0.70	0.87	0.73	0.70	0.84	0.66	0.66	0.16	0.84	0.51	0.86	0.72	0.80	0.85	0.80	0.84	0.83	0.83
RETAIL, GENERAL	0.37	0.19	-0.25	0.49	0.43	0.26	0.20	0.31	0.28	0.15	0.59	0.40	0.40	0.41	0.41	0.39	0.39	0.58	0.39	0.41	0.41
RETAILERS-DEPT	-0.11	0.32	-0.04	0.59	0.24	0.39	0.35	0.21	0.41	0.16	0.77	0.44	0.00	0.38	0.32	0.25	0.34	0.27	0.34	0.11	0.11
SHIPPING & PORTS	0.14	0.58	-0.91	0.64	0.93	0.67	0.66	0.90	0.84	0.83	-0.06	0.75	0.58	0.85	0.54	0.67	0.81	0.72	0.81	0.89	0.89
SOFT DRINKS	-0.42	0.44	-0.09	0.54	0.26	0.55	0.55	0.30	0.59	0.41	0.67	0.45	-0.24	0.40	0.42	0.34	0.42	-0.04	0.42	0.10	0.10
SPC&OTH. FINANCE	0.64	0.18	-0.62	0.30	0.68	0.21	0.15	0.54	0.16	0.24	0.11	0.40	0.84	0.49	0.56	0.63	0.53	0.94	0.53	0.74	0.74
STEEL	-0.60	0.30	0.52	0.27	-0.39	0.25	0.25	-0.29	0.28	-0.02	0.56	0.18	-0.75	-0.05	0.04	-0.12	-0.15	-0.41	-0.15	-0.54	-0.54
STEEL&OTH.METALS	-0.28	0.84	-0.45	0.69	0.50	0.78	0.76	0.56	0.71	0.62	0.08	0.79	-0.04	0.71	0.56	0.57	0.59	0.43	0.59	0.32	0.32
SUBSCR. ENTERTAIN	0.59	-0.53	0.32	-0.61	-0.37	-0.67	-0.69	-0.51	-0.66	-0.42	-0.57	-0.58	0.18	-0.55	-0.31	-0.29	-0.58	0.00	-0.58	-0.23	-0.23
SUPPORT SERVICES	0.65	-0.83	0.55	-0.76	-0.54	-0.86	-0.87	-0.71	-0.73	-0.56	-0.27	-0.77	0.16	-0.77	-0.44	-0.46	-0.74	-0.23	-0.74	-0.27	-0.27
TELECOM FXD.LINE	0.03	-0.84	0.90	-0.56	-0.90	-0.67	-0.67	-0.94	-0.57	-0.68	0.02	-0.67	-0.47	-0.81	-0.58	-0.69	-0.88	-0.63	-0.88	-0.76	-0.76
TELECOM SERVICES	0.03	-0.65	0.90	-0.5																	

B.7. Correlation Matrix of Total Monthly Returns of ASX Indexes

- continued

	LEISURE FACILITY	LIFE ASSURANCE	MARKET	MED. EQUIP&SUP.	MEDIA AGENCIES	MEDIA, ENTERTAIN	MINING	NON CYC CONS GDS	NON CYC SERVICES	NON-FIN. EX RESOR	NON-FINANCIAL	OIL & GAS	OIL&GAS EXP&PROD	OTHER CONSTRUCTI	OTHER FINANCIAL	OTHER MINING	OTHER UTILITIES	PHARM. & BIOTECH	PHARMACEUTICALS	PUBLISH & PRINT.	
S&P ASX 200																					
S&P ASX 300																					
ASX ALL ORD																					
AIRLINES&A'PORTS																					
AUTO & PARTS																					
AUTO PARTS																					
BANKS																					
BASIC INDUSTRIES																					
BEVERAGES																					
BLDNG&CONS. MATS																					
BREWERS																					
BUSINESS SUPPORT																					
CHEMICALS																					
CHEMS. COMMODITY																					
CONS.&BLDG MAT.																					
CYC. CONS. GOODS																					
CYCLICAL SERVICE																					
DISTIL.&VINTNERS																					
DIVERSIFIED INDS																					
MKT EX TMT																					
DSCT.&SPR.STORES																					
ENG. FABRICATORS																					
ENG.&MACHINERY																					
FARMING&FISHING																					
FINANCIALS																					
FOOD PRDR./PRCR.																					
FOOD PROCESSORS																					
FOOD&DRUG RETLRS																					
GAMBLING																					
GAS DISTRIBUTION																					
GEN. INDUSTRIALS																					
GOLD MINING																					
HEALTH																					
HOSPITAL MNGMNT.																					
INSURANCE																					
INSURANCE, NON-LF																					
INVEST. COS.(B)																					
INVESTMENT BANKS																					
INVESTMENT COS.																					
LEISURE + HOTELS																					
LEISURE FACILITY	1.00																				
LIFE ASSURANCE	0.68	1.00																			
MARKET	0.68	0.24	1.00																		
MED. EQUIP&SUP.	0.80	0.57	0.71	1.00																	
MEDIA AGENCIES	0.80	0.35	0.85	0.85	1.00																
MEDIA, ENTERTAIN	0.07	0.37	0.11	0.10	-0.15	1.00															
MINING	0.51	-0.12	0.84	0.52	0.78	-0.31	1.00														
NON CYC CONS GDS	0.75	0.58	0.61	0.82	0.81	-0.28	0.52	1.00													
NON CYC SERVICES	-0.50	0.07	-0.53	-0.52	-0.77	0.41	-0.70	-0.51	1.00												
NON-FIN. EX RESOR	-0.04	0.39	0.04	0.00	-0.30	0.87	-0.37	-0.22	0.72	1.00											
NON-FINANCIAL	0.29	0.36	0.55	0.33	0.17	0.74	0.20	0.09	0.33	0.83	1.00										
OIL & GAS	0.61	0.08	0.83	0.59	0.80	-0.11	0.81	0.53	-0.68	-0.24	0.26	1.00									
OIL&GAS EXP&PROD	0.60	0.07	0.83	0.59	0.79	-0.12	0.82	0.52	-0.69	-0.24	0.26	1.00	1.00								
OTHER CONSTRUCTI	0.44	-0.16	0.69	0.50	0.78	-0.55	0.86	0.62	-0.83	-0.62	-0.13	0.79	0.79	1.00							
OTHER FINANCIAL	0.51	0.80	0.37	0.52	0.27	0.61	-0.07	0.40	0.26	0.70	0.71	0.19	0.18	-0.19	1.00						
OTHER MINING	0.55	-0.06	0.86	0.56	0.79	-0.24	0.99	0.53	-0.68	-0.31	0.27	0.83	0.83	0.83	0.00	1.00					
OTHER UTILITIES	0.07	-0.45	0.46	0.10	0.47	-0.42	0.64	0.12	-0.66	-0.57	-0.21	0.67	0.68	0.74	-0.40	0.62	1.00				
PHARM. & BIOTECH	0.84	0.83	0.60	0.89	0.72	0.24	0.31	0.82	-0.33	0.17	0.39	0.43	0.42	0.28	0.69	0.36	-0.15	1.00			
PHARMACEUTICALS	0.79	0.85	0.52	0.85	0.65	0.23	0.23	0.82	-0.25	0.21	0.38	0.35	0.34	0.21	0.71	0.28	-0.24	0.99	1.00		
PUBLISH & PRINT.	-0.18	0.00	0.16	-0.16	-0.25	0.74	-0.11	-0.37	0.49	0.80	0.77	-0.02	-0.03	-0.35	0.46	-0.07	-0.24	-0.07	-0.06	1.00	
RAIL, RD. FREIGHT	0.56	0.31	0.68	0.80	0.80	-0.14	0.58	0.81	-0.62	-0.21	0.14	0.58	0.58	0.69	0.24	0.59	0.27	0.72	0.69	-0.24	
REAL ESTATE	0.31	-0.31	0.68	0.39	0.71	-0.39	0.81	0.39	-0.84	-0.58	-0.12	0.70	0.71	0.90	-0.33	0.78	0.82	0.16	0.07	-0.25	
REAL ESTATE DEV.	0.30	-0.31	0.68	0.39	0.71	-0.38	0.81	0.38	-0.83	-0.57	-0.12	0.71	0.71	0.89	-0.33	0.78	0.82	0.16	0.07	-0.24	
RESOURCES	0.53	-0.09	0.85	0.54	0.80	-0.29	1.00	0.53	-0.71	-0.36	0.21	0.85	0.86	0.87	-0.04	0.99	0.66	0.33	0.25	-0.10	
RETAIL, GENERAL	0.32	0.26	0.56	0.41	0.45	-0.19	0.47	0.65	-0.14	0.06	0.34	0.42	0.42	0.48	0.34	0.46	0.15	0.45	0.47	0.10	
RETAILERS-DEPT	-0.07	-0.09	0.23	0.03	0.12	-0.44	0.33	0.38	0.01	-0.11	0.06	0.14	0.14	0.37	-0.04	0.29	0.16	0.03	0.08	0.00	
SHIPPING & PORTS	0.67	0.05	0.80	0.59	0.88	-0.29	0.86	0.57	-0.80	-0.46	0.04	0.78	0.78	0.84	-0.04	0.85	0.63	0.43	0.33	-0.25	
SOFT DRINKS	-0.19	-0.30	-0.08	-0.22	0.07	-0.77	0.19	0.25	-0.19	-0.56	-0.49	0.10	0.11	0.43	-0.39	0.13	0.41	-0.29	-0.28	-0.43	
SPC&OTH. FINANCE	0.68	0.42	0.87	0.84	0.84	0.11	0.66	0.77	-0.47	0.09	0.50	0.74	0.73	0.62	0.59	0.69	0.24	0.76	0.72	0.13	
STEEL	-0.74	-0.64	-0.41	-0.74	-0.63	-0.30	-0.14	-0.50	0.44	-0.02	-0.13	-0.37	-0.36	-0.16	-0.46	-0.20	-0.02	-0.75	-0.69	0.21	
STEEL&OTH.METALS	-0.06	-0.62	0.49	-0.02	0.27	-0.19	0.70	-0.11	-0.40	-0.26	0.12	0.46	0.46	0.58	-0.40	0.66	0.62	-0.25	-0.33	0.20	
SUBSCR. ENTERTAIN	0.10	0.39	0.12	0.13	-0.12	1.00	-0.32	-0.25	0.37	0.84	0.71	-0.11	-0.11	-0.54	0.61	-0.24	-0.42	0.27	0.26	0.70	
SUPPORT SERVICES	0.14	0.86	-0.15	0.10	-0.23	0.65	-0.55	-0.03	0.62	0.76	0.49	-0.21	-0.22	-0.64	0.77	-0.48	-0.56	0.34	0.39	0.39	
TELECOM FXD LINE	-0.49	0.09	-0.55	-0.52	-0.78	0.44	-0.73	-0.52	1.00	0.73	0.32	-0.69	-0.69	-0.85	0.28	-0.71	-0.68	-0.32	-0.24	0.49	
TELECOM SERVICES	-0.50	0.09	-0.56	-0.52	-0.78	0.44	-0.73	-0.53	1.00	0.73	0.32	-0.69	-0.69	-0.86	0.28	-0.71	-0.68	-0.32	-0.24	0.49	
TELECOM.MEDIA.IT	-0.26	0.27	-0.28	-0.25	-0.56	0.85	-0.63	-0.48	0.83	0.94	0.61	-0.48	-0.49	-0.84	0.52	-0.57	-0.65	-0.08	-0.01	0.72	
TRANS. + PAYROLL	0.14	0.50	0.00	0.18	-0.18	0.85	-0.39	-0.17	0.51	0.83	0.67	-0.07	-0.08	-0.58	0.73	-0.30	-0.46	0.31	0.33	0.58	
TRANSPORT	0.56	0.05	0.74	0.57	0.82	-0.43	0.83	0.71	-0.74	-0.47	0.01	0.69	0.69	0.88	-0.06	0.80	0.50	0.47	0.42	-0.29	
TV, RADIO, FILM	0.12	0.11	0.44	0.16	0.11	0.76	0.10	-0.17	0.19	0.68	0.78	0.28	0.28	-0.10	0.53	0.14	0.05	0.17	0.12	0.82	
UTILITIES	-0.20	-0.35	0.13	-0.15	0.06	-0.15	0.18	-0.15	-0.19	-0.20	-0.08	0.41	0.41	0.29	-0.18	0.17	0.79	-0.30	-0.35	0.00	

B.7. Correlation Matrix of Total Monthly Returns of ASX Indexes

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	RAIL, RD. FREIGHT	REAL ESTATE	REAL ESTATE DEV.	RESOURCES	RETAIL, GENERAL	RETAILERS-DEPT	SHIPPING & PORTS	SOFT DRINKS	SPC&OTH. FINANCE	STEEL	STEEL&OTH.METALS	SUBSCR. ENTERTAIN	SUPPORT SERVICES	TELECOM FXD.LINE	TELECOM SERVICES	TELECOM.MEDIA,IT	TRANS. + PAYROLL	TRANSPORT	TV, RADIO, FILM	UTILITIES	
S&P ASX 200																					
S&P ASX 300																					
ASX ALL ORD																					
AIRLINES&A'PORTS																					
AUTO & PARTS																					
AUTO PARTS																					
BANKS																					
BASIC INDUSTRIES																					
BEVERAGES																					
BLDNG&CONS. MATS																					
BREWERS																					
BUSINESS SUPPORT																					
CHEMICALS																					
CHEMS. COMMODITY																					
CONS.&BLDG MAT.																					
CYC. CONS. GOODS																					
CYCLICAL SERVICE																					
DISTIL.&VINTNERS																					
DIVERSIFIED INDS																					
MKT EX TMT																					
DSCT.&SPR.STORES																					
ENG. FABRICATORS																					
ENG.&MACHINERY																					
FARMING&FISHING																					
FINANCIALS																					
FOOD PRDR./PRCR.																					
FOOD PROCESSORS																					
FOOD&DRUG RETLRS																					
GAMBLING																					
GAS DISTRIBUTION																					
GEN. INDUSTRIALS																					
GOLD MINING																					
HEALTH																					
HOSPITAL MNGMNT.																					
INSURANCE																					
INSURANCE, NON-LF																					
INVEST. COS.(6)																					
INVESTMENT BANKS																					
INVESTMENT COS.																					
LEISURE + HOTELS																					
LEISURE FACILITY																					
LIFE ASSURANCE																					
MARKET																					
MED. EQUIP&SUP.																					
MEDIA AGENCIES																					
MEDIA, ENTERTAIN																					
MINING																					
NON CYC CONS GDS																					
NON CYC.SERVICES																					
NON-FIN. EX RESOR																					
NON-FINANCIAL																					
OIL & GAS																					
OIL&GAS EXP&PROD																					
OTHER CONSTRUCTN																					
OTHER FINANCIAL																					
OTHER MINING																					
OTHER UTILITIES																					
PHARM. & BIOTECH																					
PHARMACEUTICALS																					
PUBLISH.&PRINT.																					
RAIL, RD.FREIGHT	1.00																				
REAL ESTATE	0.61	1.00																			
REAL ESTATE DEV.	0.61	1.00	1.00																		
RESOURCES	0.59	0.82	0.81	1.00																	
RETAIL, GENERAL	0.59	0.31	0.31	0.47	1.00																
RETAILERS-DEPT	0.31	0.23	0.23	0.31	0.86	1.00															
SHIPPING & PORTS	0.58	0.84	0.83	0.87	0.29	0.09	1.00														
SOFT DRINKS	0.06	0.24	0.24	0.18	0.32	0.55	0.10	1.00													
SPC&OTH. FINANCE	0.80	0.49	0.49	0.68	0.65	0.28	0.81	-0.05	1.00												
STEEL	-0.48	-0.19	-0.18	-0.18	0.10	0.50	-0.43	0.40	-0.47	1.00											
STEEL&OTH.METALS	0.18	0.71	0.71	0.68	0.19	0.25	0.56	0.07	0.22	0.33	1.00										
SUBSCR. ENTERTAIN	-0.11	-0.38	-0.37	-0.30	-0.20	-0.46	-0.28	-0.77	0.12	-0.35	-0.22	1.00									
SUPPORT SERVICES	-0.22	-0.72	-0.71	-0.52	-0.05	-0.28	-0.48	-0.42	0.02	-0.28	-0.69	0.64	1.00								
TELECOM FXD.LINE	-0.63	-0.86	-0.86	-0.74	-0.16	-0.02	-0.83	-0.21	-0.48	0.42	-0.44	0.40	0.64	1.00							
TELECOM SERVICES	-0.64	-0.87	-0.86	-0.74	-0.17	-0.02	-0.83	-0.21	-0.48	0.42	-0.44	0.41	0.65	1.00	1.00						
TELECOM.MEDIA,IT	-0.47	-0.75	-0.74	-0.62	-0.22	-0.28	-0.67	-0.58	-0.23	0.07	-0.38	0.82	0.76	0.85	0.85	1.00					
TRANS. + PAYROLL	-0.17	-0.55	-0.54	-0.38	-0.15	-0.41	-0.37	-0.69	0.10	-0.34	-0.40	0.84	0.87	0.54	0.54	0.82	1.00				
TRANSPORT	0.79	0.80	0.80	0.83	0.59	0.43	0.84	0.28	0.66	-0.23	0.50	-0.41	-0.53	-0.77	-0.77	-0.72	-0.50	1.00			
TV, RADIO, FILM	0.00	0.04	0.05	0.12	0.07	-0.17	0.10	-0.50	0.35	-0.16	0.29	0.73	0.37	0.19	0.55	0.63	-0.08	1.00			
UTILITIES	-0.05	0.35	0.36	0.21	0.06	0.10	0.11	0.37	0.01	0.12	0.25	-0.15	-0.06	-0.19	-0.16	-0.20	-0.06	0.01	0.19	1.00	

B.8. Share Indexes' Varimax-Rotated Loadings on Five Factors

The table above shows the results of principal components analysis on the total monthly returns of 29 Australian Stock Exchange (ASX) sector and subsector indexes over the period 1 January 1999 to 31 December 2003. The data were extracted from DataStream International. Of the 80 DataStream International and three Standard and Poor's indexes extracted, four are excluded due to insufficient data and 51 are excluded due to multicollinearity and singularity. Five extracted factors are used, and the loadings in the above table are subject to varimax (normalised) rotation. Loadings displayed in bold are above 0.700 and represent significant loadings. Refer to Appendix B.1 for the full names of the indexes.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
AIRLINES&A'PORTS	0.4913	-0.0659	-0.1750	0.5810	-0.3513
BEVERAGES	-0.1250	0.6048	-0.4076	0.5859	0.1554
BREWERS	0.1368	0.8471	-0.1551	0.1295	0.0991
CHEMICALS	0.8570	-0.2818	-0.1816	0.2706	0.2214
CYC. CONS. GOODS	-0.7558	-0.0417	0.3780	0.2541	-0.3481
CYCLICAL SERVICE	-0.2421	0.1716	0.8411	-0.3928	-0.0546
FARMING&FISHING	0.7643	0.1108	-0.2098	0.4720	0.0222
FINANCIALS	0.6615	0.6627	-0.2031	0.0545	0.1999
GEN. INDUSTRIALS	0.0662	-0.0184	-0.1756	0.9106	-0.0196
INSURANCE	0.6050	0.2440	0.0316	0.2418	0.6174
INVESTMENT BANKS	0.5093	0.7340	0.2399	0.0758	0.1319
LEISURE FACILITY	0.0837	0.8955	0.0768	-0.1083	-0.1364
LIFE ASSURANCE	-0.5747	0.7021	0.2289	-0.0237	-0.1781
NON CYC CONS GDS	0.0210	0.9151	-0.1364	0.3457	-0.0094
NON-FIN. EX RESOR	-0.4240	-0.0903	0.8726	-0.0466	-0.1191
NON-FINANCIAL	0.0199	0.2241	0.9356	0.0282	-0.0539
OIL & GAS	0.5664	0.6001	0.1531	0.0172	0.3795
OTHER FINANCIAL	-0.4495	0.5416	0.6630	0.0362	0.0196
OTHER UTILITIES	0.6824	0.0923	-0.2203	-0.0291	0.6504
PHARM. & BIOTECH	-0.1559	0.9295	0.2054	-0.0486	-0.1602
PUBLISH.&PRINT.	0.0260	-0.2701	0.9226	0.0126	-0.0308
RESOURCES	0.7905	0.5228	0.0388	0.1386	0.1303
RETAIL, GENERAL	0.1766	0.4673	0.2546	0.7263	0.0704
SOFT DRINKS	0.1015	-0.0651	-0.5145	0.6928	0.3901
STEEL	0.1696	-0.7659	0.0090	0.5697	-0.0478
STEEL&OTH.METALS	0.9488	-0.1490	0.1542	0.0519	0.0284
TV, RADIO, FILM	0.1622	0.0154	0.8854	-0.2492	0.1627
UTILITIES	0.2176	-0.1657	0.0035	0.0062	0.9055
Expl.Var	6.4921	7.1707	5.5366	3.6646	2.4553
Prp.Totl	0.2319	0.2561	0.1977	0.1309	0.0877

B.9. Varimax-rotation Decomposition of Australian Stock Market Risk into Five Factors

The table above shows the results of principal components analysis on the total monthly returns of 29 Australian Stock Exchange (ASX) sector and subsector indexes over the period 1 January 1999 to 31 December 2003. The data were extracted from DataStream International. Of the 80 DataStream International and three Standard and Poor's indexes extracted, four are excluded due to insufficient data and 51 are excluded due to multicollinearity and singularity. Five extracted factors are used, and the loadings in the above table are subject to varimax (normalised) rotation. Indexes with loadings greater than 0.700 on a factor are classified under that factor, and they are arranged from highest to lowest in terms of their loadings on their respective factor. * Negative loading on a factor. Refer to Appendix B.1 for the full names of the indexes.

<p>Factor 1 STEEL&OTH.METALS CHEMICALS RESOURCES FARMING&FISHING CYC. CONS. GOODS</p>	<p>Factor 3 NON-FINANCIAL PUBLISH.&PRINT. TV, RADIO, FILM NON-FIN. EX RESOR CYCLICAL SERVICE</p>
<p>Factor 2 PHARM. & BIOTECH NON CYC CONS GDS LEISURE FACILITY BREWERS STEEL INVESTMENT BANKS LIFE ASSURANCE</p>	<p>Factor 4 GEN. INDUSTRIALS</p> <p>Factor 5 UTILITIES</p>

B.10. Share Indexes' Promax-Rotated Loadings on Five Factors

The table above shows the results of principal components analysis on the total monthly returns of 29 Australian Stock Exchange (ASX) sector and subsector indexes over the period 1 January 1999 to 31 December 2003. The data were extracted from DataStream International. Of the 80 DataStream International and three Standard and Poor's indexes extracted, four are excluded due to insufficient data and 51 are excluded due to multicollinearity and singularity. Five extracted factors are used, and the loadings in the above table are subject to promax rotation. Loadings displayed in bold are above 0.700 and represent significant loadings. Refer to Appendix B.1 for the full names of the indexes.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
AIRLINES&A'PORTS	0.46			0.431	-0.301
BEVERAGES	-0.264	0.601	-0.346	0.605	0.114
BREWERS	0.135	0.841	-0.164	0.11	-0.108
CHEMICALS	0.875	-0.365		0.182	
CYC. CONS. GOODS	-0.769		0.33	0.34	-0.124
CYCLICAL SERVICE	-0.122	0.14	0.769	-0.337	
FARMING&FISHING	0.771			0.328	-0.135
FINANCIALS	0.663	0.63	-0.191		
GEN. INDUSTRIALS				0.914	
INSURANCE	0.563		0.146	0.202	0.385
INVESTMENT BANKS	0.558	0.682	0.249		
LEISURE FACILITY	0.112	0.909		-0.185	-0.149
LIFE ASSURANCE	-0.592	0.743	0.113		
NON CYC CONS GDS		0.932	-0.146	0.32	
NON-FIN. EX RESOR	-0.335	-0.138	0.89		
NON-FINANCIAL	0.136	0.134	0.994	0.1	
OIL & GAS	0.526	0.496	0.166		0.284
OTHER FINANCIAL	-0.439	0.497	0.6	0.12	
OTHER UTILITIES	0.572		-0.14		0.589
PHARM. & BIOTECH	-0.147	0.972			-0.142
PUBLISH.&PRINT.	0.131	-0.347	0.945		
RESOURCES	0.829	0.452	0.11		
RETAIL, GENERAL	0.106	0.389	0.36	0.705	
SOFT DRINKS		-0.123	-0.36	0.709	0.357
STEEL	0.147	-0.817	0.179	0.601	
STEEL&OTH.METALS	1.051	-0.209	0.246		-0.155
TV, RADIO, FILM	0.252		0.873	-0.213	0.192
UTILITIES		-0.328	0.105		1.018
Expl.Var	6.559	7.14	5.247	3.424	2.031
Prp.Totl	0.234	0.255	0.187	0.122	0.073

B.11. Promax-rotation Decomposition of Australian Stock Market Risk into Five Factors

The table above shows the results of principal components analysis on the total monthly returns of 29 Australian Stock Exchange (ASX) sector and subsector indexes over the period 1 January 1999 to 31 December 2003. The data were extracted from DataStream International. Of the 80 DataStream International and three Standard and Poor's indexes extracted, four are excluded due to insufficient data and 51 are excluded due to multicollinearity and singularity. Five extracted factors are used, and the loadings in the above table are subject to promax rotation. Indexes with loadings greater than 0.700 on a factor are classified under that factor, and they are arranged from highest to lowest in terms of their loadings on their respective factor. * Negative loading on a factor. Refer to Appendix B.1 for the full names of the indexes.

<p>Factor 1 STEEL&OTH.METALS CHEMICALS RESOURCES FARMING&FISHING CYC. CONS. GOODS</p>	<p>Factor 3 NON-FINANCIAL PUBLISH.&PRINT. NON-FIN. EX RESOR TV, RADIO, FILM CYCLICAL SERVICE</p>
<p>Factor 2 PHARM. & BIOTECH NON CYC CONS GDS LEISURE FACILITY BREWERS STEEL LIFE ASSURANCE</p>	<p>Factor 4 GEN. INDUSTRIALS SOFT DRINKS RETAIL, GENERAL</p> <p>Factor 5 UTILITIES</p>

Appendix C

C.1. Nonstandardised versus Standardised Attributes Results

The standardising of the style characteristics data for the univariate cross-sectional regressions does have an effect on the results of the tests. In statistical tests, t-statistics remain unchanged before and after standardisation. However, the methodology in this study first determines monthly slopes, and then calculates the t-statistic value to test whether the mean of these monthly slopes is significantly different from zero. This two-step procedure allows the t-statistic value to be different for the standardised and nonstandardised datasets.

The standardising procedure, however, allows for direct comparison between the magnitudes of the slopes of the various characteristics and is thus a necessary part of the methodology.

The standardised and nonstandardised t-statistics are displayed in Appendix C.1.1 for comparison. Both sets are unadjusted for risk, but subject to the same windsoring and limiting procedures described in the methodology. Appendix C.1.2 highlights the differences between the results with regards to significant characteristics.

All characteristics that are significant both before and after standardisation maintain the direction of their payoff after standardisation.

C.1.1. Nonstandardised versus Standardised Attributes: Cross-sectional Regression Results

Univariate cross-sectional regressions of firm-specific attributes on total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of regression slope coefficients for each characteristic. Both sets of attribute data are subject to a windsorisation procedure. The share sample comprises ASX All Ordinary Index constituents as at 31 May 2004, and has been filtered for thin trading and excludes preference shares and shares with insufficient returns data. The data were extracted from DataStream International. The average monthly coefficient for each attribute is tested for significance using Student's (1908) t-statistic. The table shows these statistics for regressions performed on a standardised and nonstandardised set of attributes. Figures in bold indicate significance at the 5% level. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Characteristic	t-statistic (Standardised)	t-statistic (Non- standardised)	Characteristic	t-statistic (Standardised)	t-statistic (Non- standardised)
A_TURN	1.2074	1.0783	CFTTL_1YR	-0.2051	-0.4539
A_TURN_1YR	-0.0721	1.0672	CFTTL_2YR	0.9662	0.3864
A_TURN_2YR	0.8586	1.4322	CFTTL_6M	1.0227	0.6015
A_TURN_6M	0.8272	0.2571	CHSALE_LES_CHACRE	1.5894	3.5018
ACCREC_1YR_CH	1.3609	1.0957	CHSALE_LES_CHIN	-0.9207	1.3403
ACCREC_2YR_CH	0.2998	-0.4918	CROSS1_MOM18M	0.9069	-0.5669
ACCREC_6M_CH	1.2169	1.5492	CROSS1_MOM1M	0.1030	0.3770
ACCRU	-2.5853	-1.7965	CROSS1_MOM3M	-1.3228	-0.3928
ACCRU_1YR	0.5457	0.3484	CROSS3_MOM12M	1.2857	0.8504
ACCRU_6M	0.3484	-0.2181	CROSS3_MOM18M	0.8279	0.8975
AV6M_TV	0.4645	1.1116	CROSS3_MOM1M	0.5282	0.0549
BORROW	1.5803	0.5340	CROSS6_MOM12M	-1.1492	-0.1104
BORROW_1YR	1.2144	0.5345	DIV	-1.1547	-1.3798
BORROW_2YR	0.0085	-2.3043	DIV_1YR	0.4291	1.5392
BORROW_6M	0.7147	0.3051	DIV_2YR	-2.9020	-2.4954
BTMV	3.7980	3.4735	DIV_6M	1.0106	0.6626
BTMV_1YR	0.9897	-0.2135	DPS	-1.6080	-1.4578
BTMV_2YR	1.3731	0.3711	DPS_1YR	2.1253	1.8783
BTMV_6M	-0.0155	-0.9641	DPS_2YR	0.1919	0.0134
BVPS	-4.6467	-4.4525	DPS_6M	2.6616	2.4176
BVPS_1YR	-0.5987	-0.0197	DY	0.7134	-0.6792
BVPS_2YR	-0.4960	0.3986	DY_1YR	-1.3466	-1.9530
BVPS_6M	0.9690	1.5934	DY_2YR	-0.3048	-0.6970
CEPS	-1.3494	-1.2544	DY_6M	1.0378	-0.1712
CEPS_1YR	0.2465	0.2998	ECANDRES	-1.8790	-1.6003
CEPS_2YR	0.6614	1.8623	ECANDRES_1YR	-1.1621	-0.8736
CEPS_6M	1.1024	1.3892	ECANDRES_2YR	-1.1450	-0.0398
CF	-0.5131	0.0210	ECANDRES_6M	0.2983	1.3730
CF_1YR	1.4185	0.2860	EPS	-2.4229	-2.1324
CF_2YR	0.7715	0.5834	EPS_1YR	0.9384	0.6663
CF_6M	1.2513	0.1433	EPS_2YR	0.5707	1.1558
CFMTP	-0.9697	-0.1083	EPS_2YRAV	-2.6309	-2.4412
CFMTP_1YR	0.3860	-1.4873	EPS_2YRAV_1YR	0.6460	0.6083
CFMTP_2YR	0.9752	0.0048	EPS_2YRAV_2YR	-0.1760	0.4691
CFMTP_6M	-0.1753	-1.3372	EPS_2YRAV_6M	0.5054	1.0926
CFTBORRREP	-0.6170	0.7394	EPS_6M	2.0014	2.2404
CFTBORRREP_1YR	-0.7043	-0.8631	EPSCH_P_12M	1.8127	1.7293
CFTBORRREP_2YR	0.2723	0.8461	EPSCH_P_24M	0.9471	1.2446
CFTBORRREP_6M	1.3830	1.5881	EPSCH_P_6M	1.8179	2.8247
CFTBORRREP_DIV	-1.9885	-0.9759	EY	0.7764	1.1046
CFTBORRREP_DIV_1YR	1.3411	0.6675	EY_1YR	-0.9876	-0.5515
CFTBORRREP_DIV_2YR	2.4192	1.7687	EY_2YR	-0.4636	-0.1908
CFTBORRREP_DIV_6M	1.8012	-0.1188	EY_6M	-0.1812	-0.4142
CFTP	2.8650	3.1026	FOUR_YREARNGROWA	1.5836	0.6635
CFTP_1YR	0.2138	-0.4152	FOUR_YREARNGROWG	0.0925	1.4676
CFTP_2YR	-0.1387	0.2479	GEAR	0.5419	-0.0665
CFTP_6M	-0.4875	-1.4607	GEAR_1YR	0.8907	0.7537
CFTTD	-0.1985	-0.0831	GEAR_2YR	-0.2376	-1.7092
CFTTD_1YR	0.3463	-0.0104	GEAR_6M	1.0406	1.0232
CFTTD_2YR	0.7693	0.7672	GROW	-0.3093	-0.8418
CFTTD_6M	0.9447	-0.9240	GROW_1YR	0.1264	1.4726
CFTTL	-0.8464	-0.7415	GROW_2YR	1.0268	0.8886

C.1.1. Nonstandardised versus Standardised Attributes: Cross-sectional Regression Results

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Characteristic	t-statistic		Characteristic	t-statistic	
	(Standardised)	(Non-standardised)		(Standardised)	(Non-standardised)
GROW_6M	-0.2517	1.0031	OPMTP	-1.0947	1.5350
ICBT	1.4143	0.7748	OPMTP_1YR	0.0122	0.8258
ICBT_1YR	0.1076	0.1471	OPMTP_2YR	0.6383	0.0108
ICBT_2YR	1.1727	1.1266	OPMTP_6M	-0.8478	-0.7124
INTANMV	-0.8709	-1.5787	P	-3.5067	-3.4537
INTANMV_1YR	-1.7724	-2.9271	P_1M	1.0339	0.7831
INTANMV_2YR	0.1776	-1.0682	P_1YR	4.4603	3.9082
INTANMV_6M	-1.8624	-2.0181	P_2YR	1.3540	1.8200
INV_1YR_CH	0.3257	-0.3643	P_3M	4.3553	3.6540
INV_2YR_CH	-0.6686	-0.1116	P_6M	4.1562	3.8499
INV_6M_CH	0.9596	0.9496	QUICK	1.9277	1.6620
LNMV	-3.9974	-4.0118	QUICK_1YR	-0.4727	-1.1984
LNMV_1M	0.0667	0.1643	QUICK_2YR	0.9215	-0.3709
LNMV_1YR	3.0386	3.1655	QUICK_6M	-0.2469	-0.2994
LNMV_2YR	2.2226	2.1815	RETEN	1.4336	1.4238
LNMV_3M	2.8673	3.4691	RETEN_1YR	-3.4560	-2.2128
LNMV_6M	2.0872	3.1903	RETEN_2YR	-2.0716	-0.7673
LNP	-5.4805	-5.5115	ROCE	0.1227	-0.1370
LNP_1M	0.3732	0.4298	ROCE_1YR	-1.4978	-0.6553
LNP_1YR	0.2668	-0.2302	ROCE_2YR	-0.6706	-1.6907
LNP_2YR	1.0019	1.3635	ROCE_6M	-2.5567	-1.1193
LNP_3M	0.0903	0.1846	ROEPUB	0.3008	-0.2422
LNP_6M	0.8423	0.5930	ROEPUB_1YR	0.7626	1.0525
MOM_12M	5.0548	4.1901	ROEPUB_2YR	0.9778	0.7679
MOM_18M	3.4789	3.4638	ROEPUB_6M	-0.1218	-0.0191
MOM_1M	0.9254	0.7273	SALEPEMPLY	0.0476	0.5366
MOM_24M	2.0266	2.2085	SALEPEMPLY_1YR	-1.0606	-0.6049
MOM_3M	4.1820	3.5059	SALEPEMPLY_2YR	1.8666	2.6759
MOM_6M	4.4467	3.8610	SALESTP	1.8214	1.6246
MTBV	-2.3677	-1.6550	SALESTP_1YR	-0.5013	-0.1546
MTBV_1YR	-0.4930	0.5008	SALESTP_2YR	1.0047	1.6791
MTBV_2YR	-2.5593	-1.0103	SALESTP_6M	-1.6027	-2.6312
MTBV_6M	1.2200	1.9855	TDTTA	-0.2658	-0.5323
MVTRADE	-2.2102	-1.3049	TDTTA_1YR	0.5162	0.2997
MVTRADE_1M	2.7317	2.4284	TDTTA_2YR	0.4659	-0.5363
MVTRADE_1YR	4.1784	2.0537	TDTTA_6M	0.3304	0.4609
MVTRADE_2YR	3.1834	2.1533	TLTTA	-1.4828	-1.4450
MVTRADE_3M	3.5646	3.5023	TLTTA_1YR	-0.6435	-0.5806
MVTRADE_6M	3.0778	2.7331	TLTTA_2YR	-0.8875	-1.3276
MVTRADEMV	2.0696	2.7137	TLTTA_6M	0.0516	0.7444
MVTRADEMV_1M	3.0522	3.0864	TV	2.3754	2.6150
MVTRADEMV_1YR	4.5636	3.7316	TV_1M	3.4001	2.6561
MVTRADEMV_2YR	4.1182	2.9548	TV_1YR	4.2608	3.4689
MVTRADEMV_3M	2.4763	2.5182	TV_2YR	2.8235	2.1184
MVTRADEMV_6M	3.3444	3.1504	TV_3M	2.5599	2.3959
NPMTTP	-1.6804	-0.0188	TV_6M	3.7417	2.6094
NPMTTP_1YR	0.6851	0.3516	VO	-0.9380	-0.5109
NPMTTP_2YR	0.8353	0.1962	WC	1.7437	1.3652
NPMTTP_6M	-0.3157	-1.7816	WC_1YR	-1.5910	-2.3239
NS	-1.6084	-1.2863	WC_2YR	0.6844	-0.5823
OBOS_3MMA	1.9244	2.0499	WC_6M	-0.8260	-0.0124
OBOS_6MMA	3.6359	3.7213			

C.1.2. Differences between Results of Nonstandardised and Standardised Attributes

Univariate cross-sectional regressions of firm-specific attributes on total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of regression slope coefficients for each characteristic. Both sets of attribute data are subject to a windsorisation procedure. The share sample comprises ASX All Ordinary Index constituents as at 31 May 2004, and has been filtered for thin trading and excludes preference shares and shares with insufficient returns data. The data were extracted from DataStream International. The average monthly coefficient for each attribute is tested for significance using Student's (1908) t-statistic. The table highlights the differences in significant attributes between regressions performed on standardised and nonstandardised sets of attributes. Figures in bold indicate significance at the 5% level. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Characteristic	t-statistic (Standardised)	t-statistic (Non- standardised)
Only Significant when Standardised		
ACCRU	-2.5853	-1.7965
CFTBORRREPDIV	-1.9885	-0.9759
CFTBORRREPDIV_2YR	2.4192	1.7687
DPS_1YR	2.1253	1.8783
MTBV	-2.3677	-1.6550
MTBV_2YR	-2.5593	-1.0103
MVTRADE	-2.2102	-1.3049
RETEN_2YR	-2.0716	-0.7673
ROCE_6M	-2.5567	-1.1193
Only Significant when Non-standardised		
BORROW_2YR	0.0085	-2.3043
CHSALE_LES_CHACRE	1.5894	3.5018
EPSCH_P_6M	1.8179	2.8247
INTANMV_1YR	-1.7724	-2.9271
INTANMV_6M	-1.8624	-2.0181
MTBV_6M	1.2200	1.9855
OBOS_3MMA	1.9244	2.0499
SALEPEMPLOY_2YR	1.8666	2.6759
SALESTP_6M	-1.6027	-2.6312
WC_1YR	-1.5910	-2.3239

C.2. Results of Univariate Cross-sectional Regressions

Univariate cross-sectional regressions of standardised firm-specific attributes on three sets of total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of regression slope coefficients for each characteristic. The share sample comprises ASX All Ordinary Index constituents as at 31 May 2004, and has been filtered for thin trading, excludes preference shares and shares with insufficient returns data, and has been adjusted for outliers. The three sets of returns comprise unadjusted, CAPM risk adjusted, and five-factor APT risk adjusted returns. The data were extracted from DataStream International. The table displays the average monthly coefficient for each attribute with the related Student's (1908) t-statistic. Attributes significant at the 5% level are displayed in bold. Attributes are displayed in descending order of the absolute value of the t-statistic related to the unadjusted returns average monthly coefficient. Refer to Table 4.2 in Chapter Four for the definitions of the attributes.

Characteristic	Unadjusted		CAPM-Adjusted		APT-Adjusted	
	Slope	t-stat	Slope	t-stat	Slope	t-stat
LNP	-0.008	-5.481	-0.008	-5.372	-0.008	-5.533
MOM_12M	0.009	5.055	0.008	4.779	0.006	3.152
BVPS	-0.005	-4.647	-0.004	-4.366	-0.005	-4.592
MVTRADEMV_1YR	0.004	4.564	0.005	4.619	0.004	4.449
P_1YR	0.008	4.460	0.007	4.206	0.005	2.783
MOM_6M	0.008	4.447	0.008	4.384	0.006	3.222
P_3M	0.008	4.355	0.008	4.335	0.007	3.667
TV_1YR	0.005	4.261	0.005	4.327	0.005	4.163
MOM_3M	0.008	4.182	0.008	4.196	0.007	3.513
MVTRADE_1YR	0.005	4.178	0.005	3.937	0.004	3.120
P_6M	0.007	4.156	0.007	4.085	0.005	3.118
MVTRADEMV_2YR	0.004	4.118	0.004	4.091	0.004	3.969
LN MV	-0.006	-3.997	-0.006	-4.030	-0.007	-4.206
BTMV	0.006	3.798	0.006	4.212	0.006	4.211
TV_6M	0.003	3.742	0.004	4.118	0.003	3.718
OBOS_6MMA	0.007	3.636	0.007	3.895	0.006	3.096
MVTRADE_3M	0.003	3.565	0.003	3.370	0.003	2.940
P	-0.004	-3.507	-0.004	-3.594	-0.004	-3.630
MOM_18M	0.005	3.479	0.005	3.121	0.002	1.481
RETEN_1YR	-0.002	-3.456	-0.002	-3.287	-0.002	-2.816
TV_1M	0.003	3.400	0.003	3.590	0.003	3.607
MVTRADEMV_6M	0.003	3.344	0.003	3.506	0.003	3.274
MVTRADE_2YR	0.004	3.183	0.004	3.058	0.003	2.415
MVTRADE_6M	0.004	3.078	0.004	3.117	0.004	2.821
MVTRADEMV_1M	0.003	3.052	0.003	3.419	0.003	3.653
LN MV_1YR	0.005	3.039	0.005	2.960	0.003	1.626
DIV_2YR	-0.003	-2.902	-0.003	-3.066	-0.003	-2.976
LN MV_3M	0.005	2.867	0.006	2.971	0.005	2.653
CFTP	0.004	2.865	0.004	2.819	0.003	2.205
TV_2YR	0.003	2.824	0.003	3.200	0.003	3.386
MVTRADE_1M	0.003	2.732	0.003	3.126	0.003	3.333
DPS_6M	0.003	2.662	0.003	2.667	0.003	2.265
EPS_2YRAV	-0.002	-2.631	-0.002	-2.376	-0.002	-2.562
ACCRU	-0.004	-2.585	-0.004	-2.502	-0.003	-2.068
TV_3M	0.003	2.560	0.003	2.864	0.002	2.449
MTBV_2YR	-0.004	-2.559	-0.004	-2.449	-0.004	-2.462
ROCE_6M	-0.004	-2.557	-0.004	-2.563	-0.004	-2.656
MVTRADEMV_3M	0.002	2.476	0.002	2.830	0.002	2.354
EPS	-0.002	-2.423	-0.002	-2.168	-0.002	-2.460
CFTBORRREPDIV_2YR	0.003	2.419	0.003	2.318	0.002	2.153
TV	0.004	2.375	0.003	2.380	0.003	2.243
MTBV	-0.003	-2.368	-0.004	-2.879	-0.004	-2.922
LN MV_2YR	0.003	2.223	0.003	1.999	0.001	0.873
MVTRADE	-0.001	-2.210	-0.002	-2.517	-0.002	-2.591
DPS_1YR	0.002	2.125	0.002	2.317	0.001	2.024
LN MV_6M	0.003	2.087	0.004	2.141	0.003	1.562
RETEN_2YR	-0.001	-2.072	-0.001	-2.232	-0.001	-1.912

C.2. Results of Univariate Cross-sectional Regressions

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Characteristic	Unadjusted		CAPM-Adjusted		APT-Adjusted	
	Slope	t-stat	Slope	t-stat	Slope	t-stat
MVTRADEMV	0.003	2.070	0.003	1.979	0.003	2.123
MOM_24M	0.003	2.027	0.003	1.835	0.001	0.730
EPS_6M	0.002	2.001	0.002	2.033	0.002	2.028
CFTBORRREPDIV	-0.003	-1.988	-0.003	-1.963	-0.003	-1.694
QUICK	0.003	1.928	0.002	1.717	0.003	2.011
OBOS_3MMA	0.004	1.924	0.004	2.239	0.003	1.604
ECANDRES	-0.001	-1.879	-0.002	-2.179	-0.002	-2.176
SALEPEMPLY_2YR	0.003	1.867	0.003	2.083	0.003	1.868
INTANMV_6M	-0.002	-1.862	-0.002	-2.179	-0.001	-1.384
SALESTP	0.003	1.821	0.003	1.943	0.003	2.121
EPSCH_P_6M	0.002	1.818	0.002	1.877	0.002	1.565
EPSCH_P_12M	0.002	1.813	0.001	1.504	0.001	0.769
CFTBORRREPDIV_6M	0.002	1.801	0.003	1.867	0.002	1.639
INTANMV_1YR	-0.002	-1.772	-0.002	-1.939	-0.001	-1.197
WC	0.003	1.744	0.002	1.572	0.003	1.883
NPMTTP	-0.003	-1.680	-0.003	-1.528	-0.003	-1.630
NS	-0.001	-1.608	-0.001	-1.832	-0.001	-1.761
DPS	-0.002	-1.608	-0.001	-1.219	-0.001	-1.465
SALESTP_6M	-0.002	-1.603	-0.002	-1.632	-0.001	-0.869
WC_1YR	-0.002	-1.591	-0.001	-1.384	-0.001	-1.187
CHSALE_LES_CHACRE	0.002	1.589	0.002	1.863	0.002	1.769
FOUR_YREARNGROWA	0.001	1.584	0.001	1.473	0.001	1.689
BORROW	0.002	1.580	0.002	1.530	0.002	1.491
ROCE_1YR	-0.002	-1.498	-0.002	-1.522	-0.002	-1.493
TLTTA	-0.001	-1.483	-0.001	-1.389	-0.001	-1.373
RETN	0.003	1.434	0.002	1.160	0.003	1.832
CF_1YR	0.002	1.419	0.001	1.265	0.001	1.016
ICBT	0.005	1.414	0.005	1.409	0.006	1.641
CFTBORRREP_6M	0.002	1.383	0.002	1.327	0.002	1.378
BTMV_2YR	0.002	1.373	0.002	1.314	0.003	2.122
ACCREC_1YR_CH	0.002	1.361	0.002	1.272	0.002	1.154
P_2YR	0.002	1.354	0.002	1.115	0.000	-0.044
CEPS	-0.001	-1.349	-0.001	-1.259	-0.002	-1.614
DY_1YR	-0.001	-1.347	-0.001	-1.222	0.000	-0.398
CFTBORRREPDIV_1YR	0.002	1.341	0.002	1.306	0.002	1.128
CROSS1_MOM3M	-0.001	-1.323	-0.001	-1.601	-0.001	-1.198
CROSS3_MOM12M	0.001	1.286	0.001	1.227	0.001	1.338
CF_6M	0.002	1.251	0.002	1.233	0.001	0.971
MTBV_6M	0.002	1.220	0.002	1.091	0.002	0.936
ACCREC_6M_CH	0.002	1.217	0.001	1.010	0.001	0.753
BORROW_1YR	0.001	1.214	0.001	0.997	0.001	0.982
A_TURN	0.001	1.207	0.001	1.358	0.001	1.456
ICBT_2YR	0.002	1.173	0.002	1.196	0.001	1.073
ECANDRES_1YR	-0.001	-1.162	-0.002	-1.483	-0.002	-1.459
DIV	-0.001	-1.155	-0.001	-1.260	-0.001	-1.722
CROSS6_MOM12M	-0.001	-1.149	-0.001	-0.844	0.000	-0.704
ECANDRES_2YR	-0.001	-1.145	-0.001	-1.289	-0.001	-0.978
CEPS_6M	0.001	1.102	0.001	0.920	0.001	1.284
OPMTTP	-0.002	-1.095	-0.001	-0.761	-0.002	-0.953
SALEPEMPLY_1YR	-0.002	-1.061	-0.002	-0.899	-0.001	-0.904
GEAR_6M	0.001	1.041	0.001	0.931	0.000	0.473
DY_6M	0.001	1.038	0.001	0.987	0.002	1.253
P_1M	0.002	1.034	0.002	1.407	0.002	1.043
GROW_2YR	0.001	1.027	0.001	0.913	0.001	0.564

C.2. Results of Univariate Cross-sectional Regressions

- continued

Characteristic	Unadjusted		CAPM-Adjusted		APT-Adjusted	
	Slope	t-stat	Slope	t-stat	Slope	t-stat
CFTTL_6M	0.001	1.023	0.001	1.096	0.001	0.925
DIV_6M	0.001	1.011	0.001	0.799	0.000	0.037
SALESTP_2YR	0.001	1.005	0.002	1.140	0.001	1.022
LNP_2YR	0.001	1.002	0.001	1.008	0.001	0.997
BTMV_1YR	0.002	0.990	0.002	1.085	0.003	1.656
EY_1YR	-0.001	-0.988	-0.001	-0.956	0.000	-0.603
ROEPUB_2YR	0.001	0.978	0.001	0.899	0.000	0.306
CFMTP_2YR	0.001	0.975	0.001	1.245	0.001	0.604
CFMTP	-0.002	-0.970	-0.001	-0.828	-0.002	-0.873
BVPS_6M	0.001	0.969	0.001	0.637	0.001	0.557
CFTTL_2YR	0.001	0.966	0.001	0.908	0.001	0.773
INV_6M_CH	0.001	0.960	0.001	0.794	0.001	1.184
EPSCH_P_24M	0.001	0.947	0.001	0.927	0.000	0.383
CFTTD_6M	0.001	0.945	0.001	1.033	0.001	0.934
EPS_1YR	0.001	0.938	0.001	0.974	0.001	0.707
VO	-0.001	-0.938	-0.001	-1.083	-0.001	-1.439
MOM_1M	0.002	0.925	0.002	1.305	0.002	0.885
QUICK_2YR	0.002	0.922	0.002	0.921	0.002	0.968
CHSALE_LES_CHIN	-0.001	-0.921	-0.001	-0.809	-0.001	-0.958
CROSS1_MOM18M	0.001	0.907	0.001	1.339	0.001	1.654
GEAR_1YR	0.001	0.891	0.001	0.696	0.001	0.626
TLTTA_2YR	-0.001	-0.888	-0.001	-1.091	0.000	-0.018
INTANMV	-0.001	-0.871	-0.001	-1.025	-0.001	-0.609
A_TURN_2YR	0.001	0.859	0.001	1.034	0.001	0.514
OPMTP_6M	-0.001	-0.848	-0.001	-0.785	-0.001	-0.803
CFTTL	-0.001	-0.846	-0.001	-1.216	-0.001	-1.125
LNP_6M	0.001	0.842	0.001	0.873	0.001	0.658
NPMTTP_2YR	0.001	0.835	0.001	0.595	0.001	0.345
CROSS3_MOM18M	0.001	0.828	0.001	0.687	0.001	0.896
A_TURN_6M	0.001	0.827	0.002	1.117	0.002	1.191
WC_6M	-0.001	-0.826	-0.001	-0.691	0.000	-0.221
EY	0.001	0.776	0.001	1.202	0.001	0.773
CF_2YR	0.001	0.772	0.001	0.886	0.002	1.531
CFTTD_2YR	0.001	0.769	0.001	0.857	0.001	0.824
ROEPUB_1YR	0.001	0.763	0.001	0.509	0.000	0.381
BORROW_6M	0.001	0.715	0.000	0.486	0.000	0.254
DY	0.001	0.713	0.002	1.345	0.002	1.241
CFTBORRREP_1YR	-0.001	-0.704	-0.001	-0.917	-0.001	-0.648
NPMTTP_1YR	0.001	0.685	0.001	0.679	0.001	0.570
WC_2YR	0.001	0.684	0.001	0.684	0.001	0.617
ROCE_2YR	-0.001	-0.671	-0.001	-0.684	-0.002	-1.252
INV_2YR_CH	-0.001	-0.669	-0.001	-0.810	-0.001	-1.163
CEPS_2YR	0.001	0.661	0.001	0.626	0.000	0.286
EPS_2YRAV_1YR	0.001	0.646	0.001	0.693	0.000	0.028
TLTTA_1YR	-0.001	-0.644	-0.001	-0.806	0.000	-0.218
OPMTP_2YR	0.001	0.638	0.001	0.624	0.001	0.655
CFTBORRREP	0.000	-0.617	0.000	-0.627	0.000	-0.975
BVPS_1YR	-0.001	-0.599	-0.001	-1.002	-0.001	-0.747
EPS_2YR	0.000	0.571	0.000	0.577	0.000	0.133
ACCRU_1YR	0.001	0.546	0.001	0.648	0.001	0.586
GEAR	0.001	0.542	0.001	0.416	0.000	0.344
CROSS3_MOM1M	0.000	0.528	0.000	-0.059	0.000	-0.264
TDTTA_1YR	0.000	0.516	0.000	0.598	0.001	1.191
CF	0.000	-0.513	0.000	-0.783	-0.001	-0.983

C.2. Results of Univariate Cross-sectional Regressions

- continued

Characteristic	Unadjusted		CAPM-Adjusted		APT-Adjusted	
	Slope	t-stat	Slope	t-stat	Slope	t-stat
EPS_2YRAV_6M	0.000	0.505	0.001	0.644	0.000	0.068
SALESTP_1YR	-0.001	-0.501	-0.001	-0.362	0.000	-0.192
BVPS_2YR	-0.001	-0.496	-0.001	-0.700	-0.001	-0.374
MTBV_1YR	-0.001	-0.493	-0.001	-0.582	-0.001	-0.511
CFTP_6M	-0.001	-0.488	0.000	-0.335	-0.001	-0.452
QUICK_1YR	-0.001	-0.473	0.000	-0.375	0.000	-0.197
TDTTA_2YR	0.000	0.466	0.000	0.579	0.000	0.580
AV6M_TV	0.001	0.465	0.000	0.145	0.001	0.569
EY_2YR	0.000	-0.464	0.000	-0.345	0.000	-0.154
DIV_1YR	0.000	0.429	0.000	0.415	0.000	-0.387
CFMTP_1YR	0.000	0.386	0.000	0.299	0.000	0.417
LNP_1M	0.000	0.373	0.000	0.156	0.000	0.135
ACCRU_6M	0.000	0.348	0.000	0.378	0.000	0.138
CFTTD_1YR	0.000	0.346	0.000	0.296	0.000	-0.094
TDTTA_6M	0.000	0.330	0.000	0.318	0.000	0.432
INV_1YR_CH	0.000	0.326	0.000	0.099	0.000	-0.142
NPMT_6M	0.000	-0.316	-0.001	-0.358	0.000	-0.230
GROW	0.000	-0.309	0.000	-0.246	0.000	-0.119
DY_2YR	0.000	-0.305	0.000	-0.191	0.000	0.136
ROEPUB	0.000	0.301	0.000	0.372	0.000	0.363
ACCREC_2YR_CH	0.000	0.300	0.000	0.158	-0.001	-0.628
ECANDRES_6M	0.000	0.298	0.000	0.096	0.000	0.149
CFTBORRREP_2YR	0.000	0.272	0.000	0.314	0.000	0.519
LNP_1YR	0.000	0.267	0.000	0.258	0.000	0.665
TDTTA	0.000	-0.266	0.000	-0.300	0.000	-0.265
GROW_6M	0.000	-0.252	0.000	-0.295	-0.001	-0.473
QUICK_6M	0.000	-0.247	0.000	-0.239	0.000	0.323
CEPS_1YR	0.000	0.246	0.000	-0.026	0.000	-0.023
GEAR_2YR	0.000	-0.238	0.000	-0.074	0.000	-0.228
CFTP_1YR	0.000	0.214	0.000	0.248	0.000	-0.056
CFTTL_1YR	0.000	-0.205	0.000	-0.114	0.000	-0.277
CFTTD	0.000	-0.198	0.000	-0.218	0.000	0.030
DPS_2YR	0.000	0.192	0.000	0.422	0.000	0.102
EY_6M	0.000	-0.181	0.000	-0.068	0.000	0.313
INTANMV_2YR	0.000	0.178	0.000	-0.020	0.000	0.384
EPS_2YRAV_2YR	0.000	-0.176	0.000	-0.121	0.000	-0.459
CFMTP_6M	0.000	-0.175	0.000	-0.164	0.000	0.176
CFTP_2YR	0.000	-0.139	0.000	-0.187	0.000	-0.136
GROW_1YR	0.000	0.126	0.000	0.014	0.000	-0.188
ROCE	0.000	0.123	0.000	0.042	0.000	-0.246
ROEPUB_6M	0.000	-0.122	0.000	-0.220	0.000	-0.359
ICBT_1YR	0.000	0.108	0.000	0.310	0.000	0.219
CROSS1_MOM1M	0.000	0.103	0.000	-0.021	0.000	-0.067
FOUR_YREARNGROWG	0.000	0.093	0.000	-0.089	0.000	0.190
LNP_3M	0.000	0.090	0.000	0.312	0.000	0.431
A_TURN_1YR	0.000	-0.072	0.000	0.237	0.000	-0.030
LNMV_1M	0.000	0.067	0.000	0.177	0.000	-0.004
TLTTA_6M	0.000	0.052	0.000	-0.079	0.000	-0.114
SALEPEMPLOY	0.000	0.048	0.000	-0.038	0.000	-0.267
BTMV_6M	0.000	-0.015	0.000	0.080	0.001	0.533
OPMTP_1YR	0.000	0.012	0.000	0.093	0.000	0.181
BORROW_2YR	0.000	0.008	0.000	0.096	0.000	-0.076

C.3. Results of Univariate Cross-sectional Regressions: Twelve Month Averages

Univariate cross-sectional regressions of standardised firm-specific attributes on unadjusted total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of regression slope coefficients for each characteristic. The share sample comprises ASX All Ordinary Index constituents as at 31 May 2004, and has been filtered for thin trading, excludes preference shares and shares with insufficient returns data, and has been adjusted for outliers. The data were extracted from DataStream International. The table displays the average monthly coefficient for each attribute for each twelve month period, with the related Student's (1908) t-statistic. Attributes with an overall t-statistic significant at the 5% level are displayed in bold. Results are ordered in descending order of absolute overall t-statistic. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	YEARS										
	All	1	2	3	4	5	6	7	8	9	10
LNP											
- Average slope	-0.008	-0.005	-0.010	-0.003	-0.001	-0.007	-0.013	-0.007	-0.019	-0.010	-0.005
- t-stat	-5.481	-1.325	-2.685	-0.644	-0.218	-1.204	-1.783	-1.926	-4.158	-2.095	-1.021
MOM_12M											
- Average slope	0.009	0.003	0.014	0.010	0.000	0.011	0.016	0.012	0.003	0.009	0.007
- t-stat	5.055	0.841	1.785	2.272	-0.008	2.075	1.499	2.489	0.724	3.045	1.724
BVPS											
- Average slope	-0.005	-0.002	-0.008	0.000	0.002	-0.010	-0.009	-0.005	-0.007	-0.006	-0.003
- t-stat	-4.647	-0.630	-2.402	0.040	0.450	-3.874	-1.654	-2.437	-4.080	-1.516	-0.908
MVTRADEM_1YR											
- Average slope	0.004	0.001	0.008	0.000	0.003	0.009	0.014	0.003	0.003	0.003	0.000
- t-stat	4.564	0.445	2.689	-0.163	1.064	2.603	2.508	2.079	1.183	0.967	-0.118
P_1YR											
- Average slope	0.008	0.003	0.014	0.010	-0.001	0.012	0.013	0.010	0.003	0.007	0.007
- t-stat	4.460	0.743	1.798	2.252	-0.091	2.146	1.118	1.728	0.821	2.489	1.704
MOM_6M											
- Average slope	0.008	0.002	0.009	0.008	-0.004	0.012	0.010	0.021	0.006	0.008	0.004
- t-stat	4.447	0.655	1.174	1.697	-0.577	2.681	1.000	3.740	1.413	1.923	1.008
P_3M											
- Average slope	0.008	0.003	0.014	0.008	-0.006	0.011	0.009	0.017	0.012	0.002	0.007
- t-stat	4.355	0.983	1.791	2.045	-0.989	1.832	0.858	2.603	2.452	0.630	1.519
TV_1YR											
- Average slope	0.005	0.003	0.010	0.005	0.001	0.007	0.012	0.004	0.004	0.001	0.000
- t-stat	4.261	1.206	1.491	1.928	0.212	2.285	1.801	2.221	1.397	0.508	0.025
MOM_3M											
- Average slope	0.008	0.004	0.013	0.008	-0.006	0.010	0.011	0.018	0.010	0.002	0.007
- t-stat	4.182	0.999	1.712	2.031	-0.953	1.640	1.026	2.641	2.008	0.423	1.515
MVTRADE_1YR											
- Average slope	0.005	0.000	0.009	0.002	0.001	0.013	0.010	0.004	0.005	0.003	0.001
- t-stat	4.178	0.055	1.977	0.535	0.470	3.076	1.420	2.302	1.434	1.112	0.276
P_6M											
- Average slope	0.007	0.002	0.010	0.008	-0.004	0.012	0.009	0.020	0.006	0.007	0.004
- t-stat	4.156	0.614	1.230	1.644	-0.636	2.963	0.770	3.586	1.359	1.972	1.010
MVTRADEM_2YR											
- Average slope	0.004	0.008	0.005	0.004	-0.002	0.011	0.006	0.002	0.001	0.001	0.001
- t-stat	4.118	2.854	2.055	1.148	-0.629	3.036	1.230	1.114	0.515	0.361	0.230
LNMV											
- Average slope	-0.006	0.001	-0.010	0.000	0.000	-0.006	-0.013	-0.001	-0.020	-0.012	-0.002
- t-stat	-3.997	0.209	-2.629	0.065	-0.035	-1.184	-1.529	-0.180	-4.023	-3.008	-0.462
BTMV											
- Average slope	0.006	-0.002	0.006	0.001	0.004	0.002	0.006	0.008	0.022	0.011	0.000
- t-stat	3.798	-0.191	1.568	0.336	0.884	0.302	0.769	2.295	7.304	2.741	0.044
TV_6M											
- Average slope	0.003	0.001	0.003	0.005	0.003	0.005	0.006	0.001	0.004	0.005	-0.002
- t-stat	3.742	0.387	0.886	1.597	0.684	1.406	1.845	0.502	1.796	2.943	-1.001

C.3. Results of Univariate Cross-sectional Regressions: Twelve Month Averages

- continued

	YEARS										
	All	1	2	3	4	5	6	7	8	9	10
OBOS_6MMA											
- Average slope	0.007	0.001	0.011	0.009	-0.004	0.012	0.005	0.022	0.007	0.001	0.007
- t-stat	3.636	0.300	1.543	2.008	-0.568	1.962	0.381	3.382	1.322	0.389	1.658
MVTRADE_3M											
- Average slope	0.003	0.002	0.008	-0.001	0.001	0.005	0.009	0.003	0.005	0.001	-0.001
- t-stat	3.565	1.020	3.719	-0.345	0.468	1.135	1.730	1.181	1.871	0.662	-0.329
P											
- Average slope	-0.004	-0.003	-0.007	-0.001	0.001	-0.004	0.001	-0.005	-0.009	-0.007	-0.003
- t-stat	-3.507	-1.013	-2.949	-0.246	0.256	-1.200	0.150	-1.738	-3.214	-2.655	-1.127
MOM_18M											
- Average slope	0.005	0.001	0.016	0.003	0.001	0.010	0.011	0.007	0.000	0.001	0.002
- t-stat	3.479	0.387	2.044	0.896	0.144	2.764	1.063	2.676	0.118	0.394	0.569
RETEN_1YR											
- Average slope	-0.002	-0.001	0.002	-0.004	-0.005	-0.004	-0.005	0.000	0.000	-0.002	-0.003
- t-stat	-3.456	-0.379	0.917	-1.581	-2.045	-3.083	-1.697	-0.070	0.216	-1.456	-2.192
TV_1M											
- Average slope	0.003	0.009	0.003	0.001	0.004	0.002	0.009	-0.001	0.005	0.002	-0.001
- t-stat	3.400	2.673	1.271	0.334	1.187	0.720	1.584	-0.178	1.260	0.850	-0.325
MVTRADEM_6M											
- Average slope	0.003	-0.001	0.006	-0.002	0.003	0.005	0.007	0.001	0.005	0.005	-0.001
- t-stat	3.344	-0.217	1.621	-0.380	0.954	1.532	2.581	0.526	2.335	3.084	-0.665
MVTRADE_2YR											
- Average slope	0.004	0.005	0.005	0.004	-0.003	0.012	0.012	0.002	0.000	0.002	0.002
- t-stat	3.183	1.477	1.549	1.143	-1.418	3.068	1.190	0.693	-0.013	0.791	0.545
MVTRADE_6M											
- Average slope	0.004	0.001	0.011	0.000	0.000	0.008	0.004	0.005	0.002	0.008	-0.002
- t-stat	3.078	0.250	1.657	-0.002	-0.097	2.312	0.687	1.359	0.777	4.043	-0.608
MVTRADEM_1M											
- Average slope	0.003	0.004	0.003	0.004	0.004	0.000	0.006	0.000	0.005	0.001	-0.001
- t-stat	3.052	2.362	1.555	1.424	2.144	-0.002	1.128	0.013	1.194	0.696	-0.518
LNMV_1YR											
- Average slope	0.005	0.006	0.008	0.004	-0.002	0.009	0.001	0.013	0.001	0.007	0.007
- t-stat	3.039	2.655	1.223	0.771	-0.300	1.690	0.099	2.253	0.147	2.875	1.514
DIV_2YR											
- Average slope	-0.003	-0.002	-0.008	-0.005	-0.001	-0.005	0.002	-0.003	-0.007	0.001	0.000
- t-stat	-2.902	-1.021	-1.706	-1.955	-0.282	-2.137	0.559	-0.795	-3.494	0.760	0.234
LNMV_3M											
- Average slope	0.005	0.008	0.011	0.006	-0.011	0.007	0.000	0.011	0.012	0.004	0.007
- t-stat	2.867	1.831	1.724	1.448	-1.254	1.108	0.014	1.933	3.268	0.885	1.046
CFTP											
- Average slope	0.004	0.010	0.004	0.005	0.004	0.007	0.000	0.005	-0.001	0.006	0.000
- t-stat	2.865	2.110	0.524	1.475	1.520	1.203	-0.033	1.679	-0.196	2.920	-0.057
TV_2YR											
- Average slope	0.003	0.011	0.003	0.006	-0.001	0.005	-0.001	0.001	0.002	-0.001	0.003
- t-stat	2.824	1.589	2.438	1.214	-0.151	2.031	-0.373	0.703	0.891	-0.438	0.860
MVTRADE_1M											
- Average slope	0.003	0.004	0.003	0.004	0.003	-0.001	0.008	0.001	0.005	0.001	-0.001
- t-stat	2.732	2.117	1.526	1.585	1.166	-0.167	1.083	0.180	1.536	0.411	-0.434
DPS_6M											
- Average slope	0.003	0.003	0.004	0.001	0.005	0.001	0.021	-0.001	-0.001	-0.001	0.001
- t-stat	2.662	1.406	1.256	0.844	1.834	0.309	2.000	-0.453	-0.213	-0.688	0.428
EPS_2YRAV											
- Average slope	-0.002	0.002	-0.004	0.002	0.003	-0.006	-0.008	-0.001	-0.005	-0.006	-0.002
- t-stat	-2.631	0.738	-1.604	1.040	1.134	-2.067	-1.225	-0.525	-1.882	-2.160	-0.938
ACCRU											
- Average slope	-0.004	-0.004	-0.001	-0.001	-0.005	-0.020	0.001	-0.003	-0.007	-0.004	0.004
- t-stat	-2.585	-1.242	-0.177	-0.227	-0.561	-2.748	0.281	-0.698	-1.725	-1.162	1.184
TV_3M											
- Average slope	0.003	0.003	0.004	0.002	0.005	0.001	0.005	0.003	0.005	0.001	-0.002
- t-stat	2.560	0.982	1.908	0.646	0.845	0.609	0.636	1.214	3.401	0.414	-0.678

C.3. Results of Univariate Cross-sectional Regressions: Twelve Month Averages

- continued

	YEARS										
	All	1	2	3	4	5	6	7	8	9	10
MTBV_2YR											
- Average slope	-0.004	-0.002	0.003	-0.007	-0.016	-0.002	0.001	-0.010	-0.001	-0.001	-0.001
- t-stat	-2.559	-0.916	0.435	-1.490	-2.385	-0.535	0.093	-2.428	-0.428	-0.796	-0.566
ROCE_6M											
- Average slope	-0.004	-0.002	0.001	-0.002	-0.014	-0.003	-0.010	-0.004	-0.002	-0.001	0.001
- t-stat	-2.557	-0.394	0.086	-0.536	-2.426	-1.982	-1.212	-1.391	-0.477	-0.483	0.506
MVTRADEM_3M											
- Average slope	0.002	0.001	0.006	-0.002	0.004	0.002	0.002	0.002	0.004	0.001	-0.002
- t-stat	2.476	0.677	2.945	-0.822	1.692	0.558	0.447	1.131	3.036	0.553	-0.709
EPS											
- Average slope	-0.002	0.002	-0.006	0.003	0.003	-0.005	-0.007	-0.001	-0.006	-0.005	-0.002
- t-stat	-2.423	1.000	-2.123	1.227	0.947	-2.119	-0.989	-0.553	-2.164	-1.975	-0.861
CFTBORRREPDIV_2YR											
- Average slope	0.003	0.001	0.001	0.000	0.002	-0.001	0.003	0.004	0.005	0.008	0.003
- t-stat	2.419	0.271	0.770	0.205	0.695	-0.276	0.505	0.853	1.610	1.607	1.553
TV											
- Average slope	0.004	0.003	0.011	0.003	-0.002	0.011	0.016	-0.005	-0.002	0.000	-0.001
- t-stat	2.375	0.988	1.751	0.974	-2.009	2.612	1.619	-0.932	-0.570	-0.122	-0.165
MTBV											
- Average slope	-0.003	-0.004	0.000	0.001	-0.013	0.004	0.002	-0.010	-0.006	-0.006	0.002
- t-stat	-2.368	-0.990	-0.171	0.469	-2.399	0.884	0.179	-2.977	-2.418	-2.317	0.541
LNMV_2YR											
- Average slope	0.003	0.003	0.003	0.002	-0.001	0.013	0.007	0.001	-0.001	0.003	0.002
- t-stat	2.223	1.153	0.871	0.569	-0.228	2.225	0.693	0.208	-0.195	0.787	0.387
MVTRADE											
- Average slope	-0.001	0.003	-0.006	0.000	0.004	-0.002	-0.004	0.000	-0.005	-0.004	-0.001
- t-stat	-2.210	2.078	-3.759	-0.052	1.247	-0.656	-1.167	-0.144	-3.332	-1.809	-0.697
DPS_1YR											
- Average slope	0.002	0.002	0.002	0.002	0.004	-0.001	0.007	0.001	-0.005	0.001	0.001
- t-stat	2.125	1.011	0.914	1.272	1.586	-0.553	2.440	0.461	-1.547	0.599	0.533
LNMV_6M											
- Average slope	0.003	0.005	0.007	0.005	-0.007	0.005	-0.010	0.015	0.004	0.007	0.006
- t-stat	2.087	2.025	1.348	0.881	-0.828	1.539	-1.384	2.559	0.836	2.025	1.108
RETEN_2YR											
- Average slope	-0.001	0.001	0.000	-0.004	-0.003	-0.002	-0.002	-0.002	0.001	-0.001	-0.001
- t-stat	-2.072	0.357	0.084	-1.346	-0.680	-0.651	-1.188	-1.049	0.577	-0.982	-1.536
MVTRADEM											
- Average slope	0.003	0.004	0.012	0.000	-0.001	0.014	0.009	-0.005	-0.002	0.001	0.000
- t-stat	2.070	1.119	1.942	0.091	-0.509	2.756	0.772	-0.842	-0.675	0.278	-0.087
MOM_24M											
- Average slope	0.003	-0.003	0.005	0.003	-0.001	0.009	0.010	0.000	0.002	0.000	0.003
- t-stat	2.027	-0.878	0.759	0.843	-0.328	2.065	1.136	0.124	0.789	-0.038	1.144
EPS_6M											
- Average slope	0.002	0.000	0.001	0.001	0.008	-0.002	0.000	0.007	0.001	0.002	0.001
- t-stat	2.001	-0.177	0.374	0.270	1.599	-0.591	0.018	3.846	0.399	0.672	0.447
CFTBORRREPDIV											
- Average slope	-0.003	-0.005	-0.021	0.002	-0.004	0.003	-0.012	0.003	0.001	0.001	0.001
- t-stat	-1.988	-0.907	-1.898	0.812	-1.287	0.697	-1.179	1.238	0.350	0.372	0.423
QUICK											
- Average slope	0.003	0.001	0.009	0.000	0.001	0.008	-0.001	0.000	0.008	0.001	0.002
- t-stat	1.928	0.146	1.594	0.034	0.110	1.749	-0.112	-0.051	1.275	0.173	0.540
OBOS_3MMA											
- Average slope	0.004	-0.005	0.010	0.004	-0.006	0.007	0.005	0.010	0.008	-0.003	0.006
- t-stat	1.924	-1.384	1.753	0.964	-0.857	1.141	0.371	1.910	1.682	-1.071	1.334
ECANDRES											
- Average slope	-0.001	0.004	-0.008	-0.001	0.005	-0.002	-0.003	0.001	-0.005	-0.004	-0.001
- t-stat	-1.879	1.843	-4.660	-0.505	1.322	-1.094	-0.726	0.509	-4.966	-1.431	-0.654
SALEPEMPLY_2YR											
- Average slope	0.003	0.005	0.012	0.002	0.010	0.003	-0.007	0.004	-0.003	0.000	0.000
- t-stat	1.867	0.992	1.604	0.577	1.991	0.520	-1.814	1.001	-0.450	0.047	-0.089

C.3. Results of Univariate Cross-sectional Regressions: Twelve Month Averages

- continued

	YEARS										
	All	1	2	3	4	5	6	7	8	9	10
INTANMV_6M											
- Average slope	-0.002	-0.002	-0.002	0.000	-0.003	-0.003	0.000	-0.017	0.003	-0.001	0.006
- t-stat	-1.862	-1.007	-0.659	0.076	-0.707	-1.577	-0.067	-3.780	1.248	-0.415	1.742
SALESTP											
- Average slope	0.003	0.000	0.006	0.002	-0.003	0.006	-0.005	0.005	0.008	0.006	0.000
- t-stat	1.821	-0.009	0.718	0.837	-1.104	1.049	-0.511	1.572	1.797	2.020	-0.196
EPSCH_P_6M											
- Average slope	0.002	0.002	0.007	0.005	0.005	-0.002	-0.005	0.005	-0.001	0.003	0.001
- t-stat	1.818	0.675	1.159	1.192	1.756	-0.811	-1.199	1.651	-0.252	1.918	0.365
EPSCH_P_12M											
- Average slope	0.002	0.005	0.001	0.001	0.005	0.000	0.002	0.005	-0.003	-0.001	0.001
- t-stat	1.813	1.248	0.237	0.297	1.905	0.147	0.960	2.118	-0.766	-0.845	0.572
CFTBORRREPDIV_6M											
- Average slope	0.002	-0.001	0.004	0.003	0.001	0.000	-0.004	0.009	0.003	0.004	0.005
- t-stat	1.801	-0.196	0.688	0.834	0.122	0.118	-0.748	1.159	0.551	0.987	1.415
INTANMV_1YR											
- Average slope	-0.002	-0.002	-0.003	-0.003	0.004	0.001	-0.004	-0.018	0.005	-0.003	0.002
- t-stat	-1.772	-0.693	-1.235	-0.855	1.958	0.938	-1.455	-2.909	0.571	-1.316	0.959
WC											
- Average slope	0.003	-0.001	0.008	0.000	0.001	0.008	-0.001	0.000	0.008	0.001	0.002
- t-stat	1.744	-0.210	1.522	0.049	0.100	1.693	-0.248	-0.005	1.271	0.219	0.489
NPMTP											
- Average slope	-0.003	-0.007	0.002	0.006	-0.010	-0.004	-0.009	0.000	-0.007	-0.001	0.000
- t-stat	-1.680	-0.630	0.315	1.312	-2.121	-0.740	-1.759	-0.097	-0.953	-0.112	-0.089
NS											
- Average slope	-0.001	0.005	-0.008	-0.001	0.004	0.001	-0.004	0.000	-0.004	-0.003	-0.001
- t-stat	-1.608	2.355	-4.122	-0.385	1.020	0.345	-1.354	-0.066	-2.034	-2.104	-0.348
DPS											
- Average slope	-0.002	0.001	-0.007	0.002	0.003	-0.007	-0.007	0.005	-0.002	-0.003	-0.002
- t-stat	-1.608	0.421	-2.302	0.670	0.763	-1.824	-0.984	2.100	-0.900	-1.106	-0.634
SALESTP_6M											
- Average slope	-0.002	-0.003	0.002	0.000	0.000	-0.007	0.001	-0.015	-0.004	0.000	0.002
- t-stat	-1.603	-0.489	0.329	0.040	0.081	-1.550	0.248	-1.980	-1.457	0.072	0.475
WC_1YR											
- Average slope	-0.002	-0.006	-0.005	-0.003	-0.002	-0.001	0.003	-0.001	-0.006	0.000	0.004
- t-stat	-1.591	-2.126	-1.101	-0.786	-0.572	-0.882	0.585	-0.154	-1.676	0.067	1.150
CHSALE_LES_CHACRE											
- Average slope	0.002	0.005	0.005	0.009	0.004	0.001	0.005	-0.009	0.000	-0.004	-0.001
- t-stat	1.589	1.697	1.792	3.676	1.114	0.210	1.509	-2.188	-0.097	-1.586	-0.333
FOUR_YREARNGROWA											
- Average slope	0.001	-0.001	0.001	-0.002	0.003	0.000	0.005	0.008	-0.003	0.002	0.001
- t-stat	1.584	-0.371	0.642	-0.885	0.958	-0.115	1.350	2.274	-0.874	0.806	0.463
BORROW											
- Average slope	0.002	0.000	0.004	0.011	-0.005	0.008	0.001	0.003	-0.001	0.000	0.001
- t-stat	1.580	-0.065	1.195	1.643	-2.495	1.013	0.131	1.511	-0.198	-0.027	0.310
ROCE_1YR											
- Average slope	-0.002	-0.002	0.000	-0.002	-0.016	0.001	0.007	-0.006	-0.003	0.001	-0.001
- t-stat	-1.498	-0.542	0.039	-0.476	-2.935	0.449	0.865	-2.092	-0.623	0.794	-0.831
TLTTA											
- Average slope	-0.001	0.002	-0.001	0.002	-0.005	-0.003	-0.005	0.003	-0.004	-0.002	-0.001
- t-stat	-1.483	0.384	-0.472	0.818	-1.564	-0.914	-0.891	1.375	-1.346	-0.633	-0.246
RETEN											
- Average slope	0.003	-0.001	0.011	-0.005	-0.004	0.010	0.015	-0.010	0.005	0.005	0.001
- t-stat	1.434	-0.199	1.613	-1.151	-0.774	1.660	1.352	-2.313	0.818	1.027	0.216
CF_1YR											
- Average slope	0.002	-0.003	0.012	-0.002	-0.004	0.006	0.000	0.003	0.001	0.005	-0.002
- t-stat	1.419	-1.458	2.414	-0.731	-0.631	1.376	-0.069	0.742	0.520	1.286	-0.978
ICBT											
- Average slope	0.005	0.002	0.003	0.002	-0.002	0.024	0.001	0.006	0.009	0.002	0.004
- t-stat	1.414	1.047	0.958	0.570	-0.062	1.332	0.438	1.442	2.212	1.092	0.926

C.3. Results of Univariate Cross-sectional Regressions: Twelve Month Averages

- continued

	YEARS										
	All	1	2	3	4	5	6	7	8	9	10
CFTBORRREP_6M											
- Average slope	0.002	0.000	0.004	0.003	0.001	-0.002	-0.004	0.009	-0.004	0.006	0.003
- t-stat	1.383	-0.154	0.736	0.995	0.189	-0.533	-1.807	1.258	-1.698	2.129	3.171
BTMV_2YR											
- Average slope	0.002	0.000	-0.003	-0.003	0.008	0.007	0.003	-0.003	0.009	0.004	-0.002
- t-stat	1.373	0.113	-0.516	-0.978	1.284	1.339	0.555	-0.779	1.080	1.052	-0.644
ACCREC_1YR_CH											
- Average slope	0.002	0.002	0.023	-0.005	0.002	0.000	0.003	-0.007	0.000	0.001	0.004
- t-stat	1.361	0.293	1.935	-2.696	0.512	0.034	0.702	-2.990	-0.132	0.350	1.143
P_2YR											
- Average slope	0.002	-0.004	0.005	0.003	-0.002	0.010	0.010	-0.004	-0.002	0.000	0.002
- t-stat	1.354	-0.896	0.783	0.828	-0.453	2.344	1.108	-0.584	-0.535	0.085	0.972
CEPS											
- Average slope	-0.001	0.000	-0.007	0.001	0.003	-0.009	-0.006	0.007	-0.001	-0.002	-0.001
- t-stat	-1.349	0.055	-1.747	0.506	0.773	-2.979	-0.884	2.999	-0.455	-0.859	-0.432
DY_1YR											
- Average slope	-0.001	0.001	-0.001	-0.002	-0.001	-0.006	0.004	-0.005	-0.003	-0.001	0.001
- t-stat	-1.347	0.632	-0.593	-0.744	-0.435	-1.918	1.177	-1.324	-0.699	-0.335	0.640
CFTBORRREPDIV_1YR											
- Average slope	0.002	0.001	-0.001	0.001	-0.004	0.003	0.009	0.004	-0.003	0.006	0.002
- t-stat	1.341	0.340	-0.286	0.637	-0.754	1.210	0.911	0.776	-0.617	1.190	0.854
CROSS1_MOM3M											
- Average slope	-0.001	-0.004	0.001	-0.001	0.001	0.001	-0.001	0.001	-0.003	0.001	-0.004
- t-stat	-1.323	-2.030	0.521	-0.379	0.472	0.354	-0.232	0.972	-1.542	0.347	-2.254
CROSS3_MOM12M											
- Average slope	0.001	0.003	0.001	0.000	0.002	0.003	0.002	-0.004	0.001	0.003	-0.001
- t-stat	1.286	1.350	0.294	0.038	0.543	0.654	0.587	-1.319	0.609	1.916	-0.825
CF_6M											
- Average slope	0.002	-0.005	0.007	-0.001	0.001	-0.002	-0.001	0.013	0.001	0.002	0.001
- t-stat	1.251	-1.887	1.178	-0.491	0.177	-0.514	-0.437	1.979	0.197	0.527	0.277
MTBV_6M											
- Average slope	0.002	0.003	0.009	0.000	-0.015	0.011	0.006	0.005	0.000	-0.001	0.004
- t-stat	1.220	0.689	1.255	0.085	-2.353	1.731	0.611	0.700	-0.079	-0.273	0.820
ACCREC_6M_CH											
- Average slope	0.002	0.006	0.003	0.000	0.000	-0.001	0.005	-0.007	0.005	0.003	0.003
- t-stat	1.217	0.876	0.625	-0.125	-0.001	-0.131	1.165	-2.093	1.046	0.914	0.759
BORROW_1YR											
- Average slope	0.001	-0.002	0.004	0.001	0.001	0.007	0.001	0.000	-0.003	0.003	0.001
- t-stat	1.214	-0.821	1.950	0.265	0.215	1.499	0.155	0.078	-0.994	0.734	0.300
A_TURN											
- Average slope	0.001	-0.001	-0.002	0.003	-0.001	0.005	-0.001	0.004	0.001	0.002	0.000
- t-stat	1.207	-0.445	-0.713	1.309	-0.461	2.194	-0.410	1.581	0.190	0.904	-0.013
ICBT_2YR											
- Average slope	0.002	-0.003	-0.004	0.008	0.004	-0.007	-0.001	0.013	0.005	0.000	0.001
- t-stat	1.173	-0.754	-1.063	3.517	0.580	-1.774	-0.165	1.786	1.617	-0.007	0.807
ECANDRES_1YR											
- Average slope	-0.001	-0.001	-0.001	-0.005	-0.004	0.001	0.002	-0.010	0.011	-0.001	-0.005
- t-stat	-1.162	-0.349	-0.313	-2.333	-1.743	0.456	0.286	-2.199	2.469	-0.557	-1.567
DIV											
- Average slope	-0.001	0.003	-0.008	0.001	0.006	0.000	-0.003	0.000	-0.003	-0.003	-0.002
- t-stat	-1.155	1.723	-3.615	0.356	1.092	-0.166	-0.888	-0.284	-1.748	-1.906	-0.868
CROSS6_MOM12M											
- Average slope	-0.001	-0.002	0.002	-0.001	0.001	-0.003	-0.002	0.001	-0.002	0.000	-0.002
- t-stat	-1.149	-0.999	0.737	-0.326	0.898	-1.323	-0.526	0.311	-1.171	0.345	-1.218
ECANDRES_2YR											
- Average slope	-0.001	0.002	0.000	-0.005	0.002	-0.005	0.004	-0.009	-0.006	0.002	0.001
- t-stat	-1.145	0.419	-0.124	-1.423	0.400	-1.722	0.669	-1.850	-1.643	0.700	0.871
CEPS_6M											
- Average slope	0.001	0.002	-0.001	0.002	0.006	0.000	0.001	-0.003	0.001	0.001	-0.001
- t-stat	1.102	0.887	-0.288	1.054	1.949	0.002	0.305	-1.181	0.369	0.615	-0.508

C.3. Results of Univariate Cross-sectional Regressions: Twelve Month Averages

- continued

	YEARS										
	All	1	2	3	4	5	6	7	8	9	10
OPMTP											
- Average slope	-0.002	0.010	-0.005	0.005	-0.009	-0.002	-0.004	-0.003	-0.007	-0.001	0.000
- t-stat	-1.095	1.871	-0.783	1.163	-1.940	-0.375	-0.802	-0.760	-0.915	-0.116	-0.168
SALEPEMPLOY_1YR											
- Average slope	-0.002	0.003	0.012	-0.002	-0.005	-0.006	-0.008	-0.008	0.000	-0.001	-0.004
- t-stat	-1.061	0.601	1.646	-0.572	-1.462	-1.089	-0.906	-1.122	-0.023	-0.638	-1.472
GEAR_6M											
- Average slope	0.001	-0.002	0.003	0.005	-0.001	0.000	0.002	-0.001	-0.001	0.001	0.002
- t-stat	1.041	-1.125	1.830	1.989	-0.215	0.045	0.412	-0.316	-0.354	0.391	0.715
DY_6M											
- Average slope	0.001	0.002	0.004	-0.004	-0.001	-0.003	0.021	-0.005	0.000	-0.001	0.001
- t-stat	1.038	1.111	1.079	-1.563	-0.372	-1.197	2.164	-1.820	-0.005	-0.377	0.334
P_1M											
- Average slope	0.002	-0.008	0.009	-0.002	-0.007	0.007	0.010	0.006	0.005	-0.002	0.003
- t-stat	1.034	-1.993	2.547	-0.584	-0.921	1.218	0.751	0.960	0.850	-0.713	0.715
GROW_2YR											
- Average slope	0.001	0.000	0.001	0.002	0.010	0.003	-0.005	-0.001	0.000	-0.001	0.003
- t-stat	1.027	0.136	0.474	1.039	2.470	0.319	-1.309	-0.181	-0.020	-0.733	0.975
CFTTL_6M											
- Average slope	0.001	-0.001	0.006	-0.001	-0.001	-0.004	0.004	0.009	0.001	-0.002	0.002
- t-stat	1.023	-0.267	0.812	-0.310	-0.127	-0.993	1.357	1.307	0.543	-0.656	0.938
DIV_6M											
- Average slope	0.001	-0.002	0.002	-0.001	0.002	-0.001	0.000	0.002	0.002	0.002	0.001
- t-stat	1.011	-0.799	0.924	-0.307	0.810	-0.638	0.066	0.653	1.173	1.556	0.503
SALESTP_2YR											
- Average slope	0.001	-0.002	0.013	0.005	-0.003	0.000	0.004	-0.010	0.001	0.003	0.004
- t-stat	1.005	-0.591	1.619	1.178	-1.115	0.150	0.951	-2.565	0.139	1.164	0.786
LNP_2YR											
- Average slope	0.001	0.004	0.000	-0.002	0.005	-0.002	0.007	0.001	0.000	-0.003	0.000
- t-stat	1.002	1.359	-0.064	-0.852	1.559	-0.753	1.014	0.362	0.095	-0.884	0.179
BTMV_1YR											
- Average slope	0.002	-0.001	0.000	-0.004	0.004	0.006	0.015	-0.002	0.003	-0.001	-0.004
- t-stat	0.990	-0.401	0.023	-1.390	0.985	1.038	1.894	-0.360	0.393	-0.123	-1.009
EY_1YR											
- Average slope	-0.001	0.001	0.002	-0.007	0.001	-0.003	-0.001	0.000	-0.003	-0.001	0.002
- t-stat	-0.988	0.598	1.290	-1.596	0.397	-0.863	-0.422	-0.081	-1.349	-0.241	1.544
ROEPUB_2YR											
- Average slope	0.001	0.001	0.002	0.003	0.006	-0.002	-0.001	-0.002	0.001	0.003	0.002
- t-stat	0.978	0.385	0.552	1.299	1.538	-0.299	-0.388	-0.355	0.206	0.477	0.703
CFMTP_2YR											
- Average slope	0.001	0.003	0.010	-0.002	0.010	-0.009	-0.001	0.005	-0.002	-0.001	-0.001
- t-stat	0.975	0.970	2.081	-1.676	2.432	-2.445	-0.237	2.353	-0.591	-0.304	-0.206
CFMTP											
- Average slope	-0.002	-0.007	0.005	0.005	-0.009	-0.001	-0.004	0.006	-0.010	0.000	-0.001
- t-stat	-0.970	-0.595	0.575	1.481	-2.038	-0.295	-1.697	2.415	-1.343	-0.068	-0.232
BVPS_6M											
- Average slope	0.001	0.005	0.003	0.003	0.005	0.003	0.005	-0.010	-0.002	0.000	0.000
- t-stat	0.969	1.248	0.643	0.771	1.248	0.574	1.000	-2.495	-0.639	-0.014	0.147
CFTTL_2YR											
- Average slope	0.001	0.002	0.000	-0.003	0.005	-0.003	0.001	0.005	0.007	-0.005	0.002
- t-stat	0.966	0.546	0.020	-1.306	0.961	-0.636	0.119	1.008	1.732	-1.747	0.555
INV_6M_CH											
- Average slope	0.001	-0.001	0.002	0.001	0.004	0.000	0.001	-0.003	-0.002	0.006	-0.001
- t-stat	0.960	-0.351	0.662	0.879	0.891	-0.059	0.643	-0.377	-0.966	1.971	-0.321
EPSCH_P_24M											
- Average slope	0.001	0.004	0.002	0.006	0.000	0.003	0.002	-0.002	-0.002	-0.002	-0.001
- t-stat	0.947	0.944	0.333	1.290	0.017	0.877	0.772	-1.121	-0.804	-1.218	-1.068
CFTTD_6M											
- Average slope	0.001	-0.002	0.009	0.002	-0.001	-0.004	-0.001	0.008	-0.001	0.002	-0.001
- t-stat	0.945	-0.520	1.420	0.418	-0.115	-1.143	-0.168	1.187	-0.371	1.079	-0.232

C.3. Results of Univariate Cross-sectional Regressions: Twelve Month Averages

- continued

	YEARS										
	All	1	2	3	4	5	6	7	8	9	10
EPS_1YR											
- Average slope	0.001	0.002	0.003	-0.004	0.005	0.000	0.001	0.003	-0.001	-0.002	0.001
- t-stat	0.938	0.597	1.808	-1.020	1.430	-0.071	0.469	1.651	-0.496	-1.139	0.758
VO											
- Average slope	-0.001	0.005	-0.005	0.000	0.001	0.002	-0.003	0.001	-0.005	-0.003	-0.001
- t-stat	-0.938	2.118	-2.945	0.188	0.456	0.460	-0.771	0.580	-1.935	-1.584	-0.672
MOM_1M											
- Average slope	0.002	-0.008	0.008	-0.003	-0.006	0.007	0.013	0.006	0.003	-0.004	0.003
- t-stat	0.925	-2.042	2.307	-0.663	-0.905	1.193	0.912	0.949	0.537	-1.048	0.706
QUICK_2YR											
- Average slope	0.002	0.000	0.000	-0.004	-0.001	-0.001	0.016	-0.001	0.000	0.004	0.003
- t-stat	0.922	-0.094	-0.120	-1.118	-0.122	-0.145	1.100	-0.273	0.277	1.348	1.265
CHSALE_LES_CHIN											
- Average slope	-0.001	0.003	0.004	0.001	-0.006	-0.001	0.000	0.000	-0.001	-0.008	0.000
- t-stat	-0.921	2.370	1.223	0.704	-1.102	-0.433	-0.249	0.018	-0.595	-3.003	-0.123
CROSS1_MOM18M											
- Average slope	0.001	-0.002	0.002	0.001	-0.003	0.003	0.004	0.000	0.001	-0.002	0.003
- t-stat	0.907	-1.024	0.904	0.574	-1.020	0.897	1.039	-0.190	0.624	-0.880	1.168
GEAR_1YR											
- Average slope	0.001	0.000	0.003	0.001	0.002	0.002	0.001	-0.001	-0.003	0.002	0.001
- t-stat	0.891	-0.157	1.700	0.287	0.535	0.923	0.196	-0.301	-1.130	0.642	0.295
TLTTA_2YR											
- Average slope	-0.001	-0.002	0.000	-0.004	0.001	0.004	0.002	-0.005	-0.002	0.000	-0.002
- t-stat	-0.888	-0.786	0.228	-1.479	0.142	0.871	0.720	-1.971	-1.419	0.159	-0.810
INTANMV											
- Average slope	-0.001	-0.001	0.000	-0.004	-0.004	0.004	-0.006	-0.006	0.005	0.001	-0.001
- t-stat	-0.871	-0.212	-0.033	-2.760	-1.112	0.544	-1.291	-1.190	0.691	0.452	-0.300
A_TURN_2YR											
- Average slope	0.001	0.000	0.007	0.008	-0.001	0.001	0.004	-0.009	0.000	0.002	0.000
- t-stat	0.859	-0.032	0.963	1.942	-0.238	0.206	0.965	-2.515	-0.109	1.268	-0.158
OPMTP_6M											
- Average slope	-0.001	0.001	0.001	-0.004	-0.002	-0.002	-0.001	0.002	-0.005	-0.002	0.001
- t-stat	-0.848	0.208	0.436	-1.316	-0.401	-0.350	-0.130	0.712	-2.118	-0.830	0.542
CFTTL											
- Average slope	-0.001	-0.001	-0.016	-0.002	-0.003	0.005	0.001	0.004	0.001	0.001	0.003
- t-stat	-0.846	-0.678	-2.554	-0.611	-0.956	2.406	0.289	1.177	0.498	0.724	1.076
LNP_6M											
- Average slope	0.001	-0.002	-0.003	0.002	0.005	-0.004	0.007	0.002	-0.001	0.002	-0.001
- t-stat	0.842	-0.874	-0.714	0.866	1.650	-1.081	1.573	0.710	-0.278	0.607	-0.325
NPMTTP_2YR											
- Average slope	0.001	0.001	0.002	-0.003	0.008	0.001	0.004	-0.003	-0.003	0.003	0.002
- t-stat	0.835	0.284	0.684	-1.716	1.780	0.124	0.494	-1.525	-0.337	0.626	0.575
CROSS3_MOM18M											
- Average slope	0.001	0.002	0.003	-0.001	-0.002	0.003	0.002	0.000	0.002	-0.001	-0.002
- t-stat	0.828	0.850	1.008	-0.286	-0.583	1.185	0.704	-0.020	0.868	-0.498	-1.245
A_TURN_6M											
- Average slope	0.001	0.001	0.000	0.011	0.002	-0.005	0.002	-0.003	-0.001	0.000	0.002
- t-stat	0.827	0.403	-0.103	1.425	0.379	-2.047	0.730	-0.549	-0.546	0.002	0.883
WC_6M											
- Average slope	-0.001	-0.007	-0.002	0.002	0.002	-0.001	-0.002	0.000	-0.002	-0.002	0.005
- t-stat	-0.826	-2.637	-0.550	0.407	0.486	-1.019	-0.451	-0.108	-0.536	-0.727	1.476
EY											
- Average slope	0.001	0.006	-0.001	0.007	0.005	-0.002	-0.006	0.001	0.001	-0.002	-0.001
- t-stat	0.776	1.838	-0.149	2.160	1.471	-1.242	-0.872	0.221	0.161	-1.134	-0.258
CF_2YR											
- Average slope	0.001	0.000	0.001	-0.003	0.000	-0.002	0.001	-0.002	0.011	0.002	0.000
- t-stat	0.772	-0.043	0.490	-0.723	0.066	-0.663	0.216	-0.508	2.567	0.961	-0.049
CFTTD_2YR											
- Average slope	0.001	0.000	-0.009	-0.001	0.004	-0.002	0.001	0.006	0.006	0.004	0.000
- t-stat	0.769	-0.094	-1.699	-0.203	0.800	-0.577	0.236	1.160	1.656	1.065	0.307

C.3. Results of Univariate Cross-sectional Regressions: Twelve Month Averages

- continued

	YEARS										
	All	1	2	3	4	5	6	7	8	9	10
ROEPUB_1YR											
- Average slope	0.001	0.002	0.009	0.001	-0.005	-0.001	0.002	-0.004	0.002	0.002	0.001
- t-stat	0.763	0.742	1.579	0.155	-1.984	-0.342	0.386	-1.227	0.562	1.462	0.831
BORROW_6M											
- Average slope	0.001	-0.005	0.003	0.005	-0.003	0.002	0.004	0.000	-0.001	0.002	-0.001
- t-stat	0.715	-2.386	1.770	2.027	-0.657	0.433	0.714	0.027	-0.291	0.516	-0.551
DY											
- Average slope	0.001	0.001	-0.007	0.001	0.006	-0.008	0.012	0.006	0.001	-0.002	-0.001
- t-stat	0.713	0.297	-1.494	0.610	1.333	-1.734	1.320	1.904	0.216	-0.574	-0.317
CFTBORRREP_1YR											
- Average slope	-0.001	-0.003	-0.003	0.001	0.000	0.002	-0.004	0.003	-0.005	0.001	0.003
- t-stat	-0.704	-1.291	-1.134	0.259	0.493	0.490	-1.668	0.714	-1.309	0.293	1.444
NPMTP_1YR											
- Average slope	0.001	0.002	0.009	-0.005	-0.004	-0.004	0.002	0.007	-0.002	0.004	0.001
- t-stat	0.685	0.899	0.901	-1.354	-1.090	-0.800	0.267	2.247	-0.454	1.373	0.887
WC_2YR											
- Average slope	0.001	-0.002	0.000	-0.003	-0.002	0.000	0.015	-0.003	0.000	0.005	0.001
- t-stat	0.684	-0.829	-0.032	-0.854	-0.535	-0.053	1.079	-0.945	0.205	1.124	0.524
ROCE_2YR											
- Average slope	-0.001	0.001	-0.002	-0.006	0.005	0.007	-0.006	-0.006	-0.004	0.002	0.001
- t-stat	-0.671	0.218	-0.635	-1.912	1.695	0.668	-1.434	-3.191	-1.660	0.291	0.561
INV_2YR_CH											
- Average slope	-0.001	-0.002	0.002	0.002	-0.004	-0.002	0.004	0.002	-0.004	-0.003	-0.002
- t-stat	-0.669	-0.779	0.766	0.909	-1.648	-0.906	0.906	1.053	-1.376	-0.765	-0.841
CEPS_2YR											
- Average slope	0.001	0.001	0.009	0.001	-0.003	-0.004	0.001	0.003	-0.001	0.001	-0.003
- t-stat	0.661	0.415	4.770	0.442	-0.662	-1.018	0.403	2.397	-0.756	0.130	-1.750
EPS_2YRAV_1YR											
- Average slope	0.001	0.001	0.001	0.001	0.004	0.000	0.001	-0.001	0.000	-0.001	0.000
- t-stat	0.646	0.259	0.705	0.396	1.478	0.020	0.118	-0.465	-0.259	-0.351	0.092
TLTTA_1YR											
- Average slope	-0.001	-0.001	0.001	-0.005	-0.001	0.005	0.001	0.002	-0.008	-0.001	0.000
- t-stat	-0.644	-0.347	0.616	-1.136	-0.120	0.745	0.143	1.148	-2.886	-0.204	0.012
OPMTP_2YR											
- Average slope	0.001	0.000	0.001	0.000	0.006	0.003	0.004	-0.004	0.000	0.000	-0.003
- t-stat	0.638	-0.066	0.223	0.034	1.080	0.625	0.552	-1.105	0.009	0.093	-1.058
CFTBORRREP											
- Average slope	0.000	0.001	-0.002	0.002	0.002	-0.002	-0.004	0.001	0.000	0.000	0.001
- t-stat	-0.617	0.451	-1.317	0.968	1.763	-2.578	-2.375	0.347	-0.162	-0.186	0.519
BVPS_1YR											
- Average slope	-0.001	0.001	-0.001	0.001	0.005	0.003	0.000	-0.012	-0.002	-0.002	0.001
- t-stat	-0.599	0.366	-0.257	0.205	1.216	0.723	-0.040	-3.450	-0.415	-0.920	0.223
EPS_2YR											
- Average slope	0.000	0.000	-0.002	0.002	0.004	-0.002	0.004	0.001	-0.002	-0.001	0.000
- t-stat	0.571	-0.099	-1.875	0.976	1.540	-0.653	1.184	0.414	-1.446	-0.490	-0.219
ACCRU_1YR											
- Average slope	0.001	0.001	-0.003	0.002	0.001	-0.002	0.005	-0.001	0.003	-0.003	0.000
- t-stat	0.546	0.276	-0.979	0.816	0.642	-1.071	1.159	-0.092	1.936	-1.501	0.034
GEAR											
- Average slope	0.001	0.010	-0.001	0.008	-0.005	0.000	-0.003	0.005	-0.006	0.001	-0.002
- t-stat	0.542	0.901	-0.314	2.359	-1.704	0.068	-0.544	2.795	-1.848	0.290	-0.785
CROSS3_MOM1M											
- Average slope	0.000	-0.001	0.001	-0.001	0.003	0.000	-0.002	0.003	0.001	0.000	0.000
- t-stat	0.528	-0.429	0.282	-1.052	1.334	0.177	-0.735	1.392	0.633	-0.022	0.079
TDTTA_1YR											
- Average slope	0.000	-0.002	0.004	-0.001	0.002	0.002	0.000	-0.001	-0.003	0.002	0.001
- t-stat	0.516	-0.667	2.113	-0.774	0.532	0.727	-0.002	-0.399	-1.195	0.640	0.530
CF											
- Average slope	0.000	0.004	-0.004	0.001	0.002	0.001	-0.003	0.002	-0.003	-0.001	-0.001
- t-stat	-0.513	2.173	-3.187	0.748	0.893	0.195	-0.780	1.159	-1.617	-0.710	-0.800

C.3. Results of Univariate Cross-sectional Regressions: Twelve Month Averages

- continued

	YEARS										
	All	1	2	3	4	5	6	7	8	9	10
EPS_2YRAV_6M											
- Average slope	0.000	0.000	0.000	0.003	0.006	-0.004	-0.002	0.002	-0.002	0.000	0.001
- t-stat	0.505	0.135	0.171	0.918	1.231	-0.967	-0.774	0.723	-0.565	-0.095	0.421
SALESTP_1YR											
- Average slope	-0.001	0.002	0.005	0.000	-0.001	0.001	-0.003	-0.010	0.001	-0.003	0.002
- t-stat	-0.501	0.441	0.724	-0.056	-0.423	0.203	-0.437	-2.253	0.281	-0.753	0.370
BVPS_2YR											
- Average slope	-0.001	0.004	0.000	0.000	0.000	0.002	0.000	-0.011	-0.001	-0.001	0.000
- t-stat	-0.496	0.576	-0.075	0.100	0.009	0.376	-0.088	-2.442	-0.207	-0.201	0.294
MTBV_1YR											
- Average slope	-0.001	0.003	-0.002	-0.003	-0.014	-0.004	0.007	-0.001	0.001	0.002	0.005
- t-stat	-0.493	0.610	-0.935	-0.806	-2.442	-1.490	0.703	-0.264	0.142	0.769	1.230
CFTP_6M											
- Average slope	-0.001	-0.001	0.001	-0.002	0.002	-0.002	0.001	-0.001	-0.002	0.000	-0.003
- t-stat	-0.488	-0.328	0.237	-0.689	0.316	-0.772	0.097	-0.115	-0.585	0.124	-0.621
QUICK_1YR											
- Average slope	-0.001	-0.003	-0.005	-0.003	-0.003	-0.001	0.002	0.001	0.000	0.002	0.005
- t-stat	-0.473	-1.418	-1.058	-0.702	-0.691	-0.736	0.403	0.172	-0.061	0.819	1.373
TDTTA_2YR											
- Average slope	0.000	-0.002	0.002	-0.001	0.002	0.006	0.000	-0.001	-0.004	0.000	0.001
- t-stat	0.466	-0.752	0.548	-0.789	1.178	1.557	-0.084	-0.283	-1.783	0.116	0.362
AV6M_TV											
- Average slope	0.001	0.003	0.007	0.003	-0.007	0.007	0.012	-0.010	-0.005	-0.001	-0.001
- t-stat	0.465	0.827	1.392	0.936	-3.387	1.388	1.250	-1.662	-1.083	-0.579	-0.301
EY_2YR											
- Average slope	0.000	0.001	-0.002	0.002	0.004	-0.004	-0.001	0.000	-0.001	-0.002	0.000
- t-stat	-0.464	0.498	-1.448	0.656	1.856	-1.826	-0.204	-0.084	-0.906	-0.830	0.208
DIV_1YR											
- Average slope	0.000	0.001	0.003	-0.005	0.005	-0.001	0.000	-0.001	0.001	0.001	-0.001
- t-stat	0.429	0.616	1.183	-1.195	1.876	-0.512	-0.111	-0.382	0.377	0.807	-0.403
CFMTP_1YR											
- Average slope	0.000	0.001	-0.003	-0.004	0.010	0.004	0.001	-0.004	0.000	-0.001	-0.002
- t-stat	0.386	0.292	-0.859	-1.764	2.103	1.126	0.253	-1.812	0.098	-0.218	-1.643
LNP_1M											
- Average slope	0.000	0.000	-0.002	0.004	0.000	0.001	-0.002	0.002	-0.001	0.003	-0.002
- t-stat	0.373	0.053	-0.881	1.952	-0.019	1.031	-1.010	0.584	-0.256	0.891	-1.142
ACCRU_6M											
- Average slope	0.000	0.001	-0.002	0.006	-0.004	-0.002	0.007	0.002	0.002	-0.005	-0.001
- t-stat	0.348	0.506	-0.947	2.916	-1.068	-0.736	1.814	0.514	0.841	-1.712	-0.457
CFTTD_1YR											
- Average slope	0.000	0.000	0.006	-0.004	-0.005	-0.002	0.002	0.004	-0.003	0.005	0.003
- t-stat	0.346	-0.125	1.377	-1.258	-0.970	-0.392	0.425	0.834	-0.719	1.824	1.054
TDTTA_6M											
- Average slope	0.000	-0.004	0.004	0.001	-0.001	0.000	0.003	-0.001	-0.001	0.002	-0.001
- t-stat	0.330	-1.719	2.258	0.800	-0.282	0.079	0.424	-0.241	-0.390	0.574	-0.448
INV_1YR_CH											
- Average slope	0.000	-0.001	0.001	-0.001	0.006	-0.001	0.001	0.000	-0.007	0.006	0.001
- t-stat	0.326	-0.439	0.229	-0.693	1.017	-0.337	0.558	0.000	-1.436	1.781	0.520
NPMTTP_6M											
- Average slope	0.000	0.001	0.001	-0.005	0.000	-0.004	-0.003	0.005	-0.001	0.002	-0.001
- t-stat	-0.316	0.376	0.109	-1.305	-0.003	-0.876	-0.358	1.569	-0.358	1.248	-1.078
GROW											
- Average slope	0.000	-0.002	-0.007	-0.002	-0.001	-0.002	0.001	0.000	0.003	0.001	0.004
- t-stat	-0.309	-0.240	-0.775	-0.448	-0.336	-0.363	0.161	0.072	0.684	0.314	1.629
DY_2YR											
- Average slope	0.000	0.001	0.001	-0.001	0.001	-0.002	-0.001	-0.002	0.001	-0.005	0.003
- t-stat	-0.305	0.412	0.179	-0.290	0.275	-0.460	-0.292	-0.564	0.157	-1.545	1.196
ROEPUB											
- Average slope	0.000	-0.001	-0.003	0.000	0.000	-0.002	0.001	0.001	0.003	0.001	0.005
- t-stat	0.301	-0.094	-0.493	-0.131	-0.083	-0.249	0.114	0.474	0.809	0.369	1.512

C.3. Results of Univariate Cross-sectional Regressions: Twelve Month Averages

- continued

	All	YEARS										
		1	2	3	4	5	6	7	8	9	10	
ACCREC_2YR_CH												
- Average slope	0.000	-0.004	0.000	0.003	0.002	-0.001	0.005	-0.002	-0.003	-0.002	0.006	
- t-stat	0.300	-1.186	0.012	0.623	0.484	-0.156	0.738	-1.039	-1.364	-0.766	1.190	
ECANDRES_6M												
- Average slope	0.000	0.003	0.001	0.001	0.004	0.000	0.004	-0.010	0.005	0.001	-0.006	
- t-stat	0.298	0.891	0.274	0.197	1.718	0.128	0.902	-2.689	1.157	0.315	-2.080	
CFTBORRREP_2YR												
- Average slope	0.000	0.001	-0.004	-0.001	0.004	-0.003	-0.005	0.001	0.005	0.003	0.002	
- t-stat	0.272	0.201	-1.944	-0.486	1.098	-2.409	-2.251	0.142	1.341	0.840	2.240	
LNP_1YR												
- Average slope	0.000	-0.001	0.001	0.001	0.001	-0.001	-0.004	0.003	0.002	0.002	-0.001	
- t-stat	0.267	-0.428	0.317	0.353	0.436	-0.269	-1.445	1.350	0.778	0.862	-0.999	
TDTTA												
- Average slope	0.000	0.008	-0.002	0.004	-0.007	0.000	-0.005	0.003	-0.005	0.002	-0.002	
- t-stat	-0.266	0.877	-0.985	1.617	-2.147	-0.058	-0.920	1.158	-1.458	0.759	-0.635	
GROW_6M												
- Average slope	0.000	0.000	0.004	0.001	-0.011	-0.001	-0.001	0.000	0.001	0.003	-0.001	
- t-stat	-0.252	0.234	0.403	0.424	-2.011	-0.424	-0.123	0.023	0.277	1.254	-0.616	
QUICK_6M												
- Average slope	0.000	-0.005	-0.002	0.003	0.000	-0.002	-0.005	0.001	0.003	-0.002	0.006	
- t-stat	-0.247	-1.833	-0.676	0.560	0.053	-0.972	-1.116	0.355	0.612	-0.527	1.707	
CEPS_1YR												
- Average slope	0.000	0.000	-0.002	0.003	0.002	0.003	0.002	-0.005	0.002	0.000	-0.002	
- t-stat	0.246	-0.079	-2.118	0.956	0.362	0.680	0.657	-1.920	1.020	0.069	-0.694	
GEAR_2YR												
- Average slope	0.000	0.000	0.001	-0.006	0.001	0.006	0.000	-0.001	-0.005	0.000	0.001	
- t-stat	-0.238	-0.071	0.386	-3.011	0.339	1.548	-0.155	-0.359	-2.027	0.128	0.314	
CFTP_1YR												
- Average slope	0.000	-0.002	0.002	-0.002	-0.002	0.003	0.002	0.000	0.003	0.001	-0.002	
- t-stat	0.214	-0.825	0.330	-0.986	-0.335	0.659	0.211	-0.048	1.041	0.369	-0.399	
CFTTL_1YR												
- Average slope	0.000	0.000	-0.003	-0.004	-0.006	-0.002	0.003	0.008	0.001	0.002	-0.001	
- t-stat	-0.205	-0.113	-1.042	-1.381	-0.986	-0.492	1.186	1.223	0.320	0.660	-0.341	
CFTTD												
- Average slope	0.000	0.001	-0.003	-0.001	-0.002	0.001	0.000	0.001	0.002	-0.001	0.001	
- t-stat	-0.198	0.553	-1.458	-1.159	-0.787	0.464	-0.090	0.491	0.890	-0.677	0.505	
DPS_2YR												
- Average slope	0.000	0.001	0.001	0.000	0.003	-0.001	0.003	0.001	-0.005	-0.003	0.001	
- t-stat	0.192	0.217	0.285	0.051	1.102	-0.331	1.069	0.664	-1.546	-1.887	0.754	
EY_6M												
- Average slope	0.000	-0.001	0.001	-0.003	0.008	-0.003	-0.001	-0.001	-0.004	0.003	0.000	
- t-stat	-0.181	-0.623	0.335	-1.287	1.708	-0.922	-0.602	-0.268	-0.947	0.530	-0.042	
INTANMV_2YR												
- Average slope	0.000	-0.001	-0.003	0.000	0.003	0.007	0.002	-0.005	-0.002	0.000	0.001	
- t-stat	0.178	-0.464	-1.265	-0.217	2.195	2.710	0.597	-0.887	-0.375	0.061	1.189	
EPS_2YRAV_2YR												
- Average slope	0.000	0.001	-0.002	0.006	0.001	-0.003	0.001	0.000	-0.002	-0.003	-0.001	
- t-stat	-0.176	0.200	-1.406	2.672	0.316	-1.459	0.270	0.077	-1.300	-1.119	-0.607	
CFMTP_6M												
- Average slope	0.000	-0.001	-0.003	-0.004	0.008	0.005	0.005	-0.005	-0.001	-0.002	-0.003	
- t-stat	-0.175	-0.284	-1.056	-2.582	1.755	1.255	0.512	-2.204	-0.249	-0.751	-1.472	
CFTP_2YR												
- Average slope	0.000	0.000	0.003	-0.002	0.004	-0.005	-0.003	-0.004	0.005	0.001	-0.001	
- t-stat	-0.139	0.109	0.900	-0.675	0.572	-1.519	-0.288	-2.209	1.196	0.306	-0.213	
GROW_1YR												
- Average slope	0.000	0.002	0.010	0.002	-0.013	0.000	0.001	-0.005	0.001	0.002	0.001	
- t-stat	0.126	0.920	1.529	0.664	-2.474	-0.133	0.217	-1.351	0.384	1.082	0.823	
ROCE												
- Average slope	0.000	-0.003	-0.003	0.004	0.001	-0.001	-0.005	0.004	0.001	0.001	0.004	
- t-stat	0.123	-0.593	-0.859	0.874	0.430	-0.198	-0.507	1.617	0.241	0.245	2.802	

C.3. Results of Univariate Cross-sectional Regressions: Twelve Month Averages

- continued

	YEARS										
	All	1	2	3	4	5	6	7	8	9	10
ROEPUB_6M											
- Average slope	0.000	0.000	0.002	0.000	-0.005	-0.002	-0.001	0.000	0.001	0.003	-0.001
- t-stat	-0.122	0.233	0.201	0.027	-1.903	-0.565	-0.225	0.143	0.368	1.276	-0.604
ICBT_1YR											
- Average slope	0.000	-0.002	0.000	0.006	-0.001	-0.006	0.004	-0.003	0.004	-0.003	0.000
- t-stat	0.108	-0.960	0.125	2.767	-0.211	-1.711	0.561	-0.627	1.281	-1.131	0.165
CROSS1_MOM1M											
- Average slope	0.000	-0.001	0.002	-0.001	0.001	0.000	0.000	-0.002	0.002	-0.001	0.000
- t-stat	0.103	-0.275	0.710	-0.421	0.340	0.141	-0.041	-0.653	0.769	-0.270	0.035
FOUR_YREARNGROWG											
- Average slope	0.000	-0.002	0.002	0.002	0.004	0.002	0.003	-0.006	-0.006	0.000	0.001
- t-stat	0.093	-0.464	0.829	0.792	1.438	0.536	0.951	-1.753	-1.149	0.024	0.239
LNP_3M											
- Average slope	0.000	0.003	-0.001	0.002	0.003	-0.001	-0.001	0.002	0.000	-0.002	-0.004
- t-stat	0.090	1.489	-0.155	0.864	1.342	-0.536	-0.167	0.767	-0.228	-0.768	-2.266
A_TURN_1YR											
- Average slope	0.000	0.001	0.002	0.004	-0.001	-0.001	0.004	-0.007	0.000	-0.002	0.000
- t-stat	-0.072	0.270	0.393	1.490	-0.405	-0.248	1.131	-2.092	-0.092	-0.562	0.136
LNMV_1M											
- Average slope	0.000	0.002	0.007	-0.005	-0.014	0.001	0.005	-0.001	0.007	-0.004	0.004
- t-stat	0.067	0.442	1.570	-1.281	-1.273	0.172	0.454	-0.325	1.077	-1.383	0.694
TLTTA_6M											
- Average slope	0.000	-0.002	0.003	-0.001	0.001	-0.002	0.006	0.002	-0.008	0.001	0.002
- t-stat	0.052	-0.964	1.482	-0.405	0.264	-0.731	1.386	1.369	-2.620	0.306	0.649
SALEPEMPLY											
- Average slope	0.000	0.003	-0.001	0.000	0.006	-0.004	-0.003	0.001	-0.002	0.000	-0.001
- t-stat	0.048	0.774	-0.223	0.069	1.208	-1.074	-1.185	0.947	-1.226	0.212	-0.343
BTMV_6M											
- Average slope	0.000	-0.003	0.003	-0.002	0.001	-0.003	0.016	-0.007	-0.001	0.000	-0.006
- t-stat	-0.015	-0.795	0.362	-0.746	0.232	-0.489	1.968	-0.846	-0.173	0.055	-1.007
OPMTP_1YR											
- Average slope	0.000	0.000	0.000	0.002	0.002	-0.003	0.004	0.005	-0.007	-0.005	0.002
- t-stat	0.012	0.076	0.010	0.611	0.665	-0.346	0.442	1.735	-1.424	-1.748	1.638
BORROW_2YR											
- Average slope	0.000	-0.002	0.001	-0.006	0.001	0.009	0.000	-0.001	-0.004	0.001	0.001
- t-stat	0.008	-0.994	0.479	-3.084	0.243	2.031	-0.057	-0.199	-1.454	0.167	0.424

C.4. Correlation Matrix of Monthly Payoffs to Attributes

Matrix of Pearson (1896) correlation coefficients between the monthly payoffs to standardised firm-specific attributes as calculated in univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The attributes displayed are those significant at the 5% level in a Student's (1908) t-test. The data were extracted from DataStream International. Correlations above 0.7 and below -0.7 are displayed in bold. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	LNP	MOM_12M	BVPS	MVTRADEMV_1YR	P_1YR	MOM_6M	P_3M	TV_1YR	MOM_3M	MVTRADE_1YR	P_6M
LNP	1.00										
MOM_12M	0.14	1.00									
BVPS	0.71	-0.25	1.00								
MVTRADEMV_1YR	-0.22	0.22	-0.33	1.00							
P_1YR	0.15	0.98	-0.25	0.21	1.00						
MOM_6M	0.15	0.84	-0.15	0.18	0.83	1.00					
P_3M	0.11	0.71	-0.15	0.21	0.72	0.88	1.00				
TV_1YR	-0.32	0.09	-0.38	0.74	0.09	0.07	0.10	1.00			
MOM_3M	0.09	0.69	-0.13	0.23	0.70	0.88	0.98	0.11	1.00		
MVTRADE_1YR	-0.15	0.54	-0.36	0.78	0.54	0.55	0.52	0.58	0.53	1.00	
P_6M	0.16	0.85	-0.18	0.18	0.85	0.98	0.88	0.07	0.84	0.54	1.00
MVTRADEMV_2YR	-0.28	0.34	-0.37	0.36	0.35	0.22	0.17	0.28	0.18	0.40	0.22
LNMV	0.89	0.00	0.72	-0.26	0.00	0.06	0.05	-0.32	0.03	-0.25	0.06
BTMV	-0.33	-0.27	0.00	-0.04	-0.28	-0.22	-0.21	0.06	-0.20	-0.14	-0.26
TV_6M	-0.26	0.21	-0.33	0.31	0.19	0.16	0.13	0.36	0.11	0.32	0.19
OBOS_6MMA	0.27	0.74	-0.07	0.17	0.75	0.87	0.89	0.07	0.87	0.49	0.88
MVTRADE_3M	-0.20	0.41	-0.26	0.40	0.39	0.48	0.52	0.23	0.51	0.49	0.48
P	0.70	0.34	0.39	0.03	0.34	0.31	0.23	-0.05	0.21	0.14	0.35
MOM_18M	0.12	0.84	-0.31	0.20	0.84	0.68	0.58	0.14	0.57	0.46	0.69
RETEN_1YR	-0.24	-0.15	-0.16	-0.04	-0.17	-0.12	-0.03	0.08	-0.01	-0.12	-0.14
TV_1M	-0.34	-0.01	-0.27	0.37	-0.03	-0.05	-0.03	0.43	-0.02	0.20	-0.03
MVTRADEMV_6M	-0.17	0.28	-0.28	0.39	0.27	0.27	0.26	0.25	0.23	0.37	0.29
MVTRADE_2YR	-0.11	0.62	-0.35	0.28	0.63	0.46	0.40	0.23	0.39	0.46	0.48
MVTRADE_6M	-0.05	0.60	-0.31	0.32	0.61	0.62	0.57	0.20	0.52	0.55	0.66
MVTRADEMV_1M	-0.20	0.05	-0.16	0.20	0.04	0.01	0.00	0.21	-0.03	0.05	0.05
LNMV_1YR	0.15	0.57	-0.05	-0.07	0.56	0.44	0.35	-0.12	0.34	0.21	0.40
DIV_2YR	0.11	-0.01	-0.07	-0.16	-0.01	-0.04	-0.11	-0.12	-0.08	-0.16	-0.05
LNMV_3M	0.18	0.54	-0.05	-0.02	0.57	0.68	0.82	-0.08	0.77	0.29	0.70
CFTP	0.27	-0.24	0.27	-0.08	-0.02	-0.26	-0.24	-0.04	-0.26	-0.23	-0.24
TV_2YR	-0.21	0.12	-0.23	0.13	0.13	0.10	0.08	0.21	0.08	0.14	0.11
MVTRADE_1M	-0.14	0.27	-0.21	0.25	0.27	0.23	0.25	0.23	0.21	0.20	0.29
DPS_6M	-0.01	0.32	-0.11	0.34	0.30	0.24	0.20	0.22	0.29	0.32	0.18
EPS_2YRAV	0.71	-0.28	0.87	-0.28	-0.28	-0.11	-0.08	-0.32	-0.06	-0.34	-0.16
ACCRU	0.32	0.07	0.30	-0.21	0.07	0.09	0.09	-0.28	0.09	-0.22	0.07
TV_3M	-0.42	0.08	-0.44	0.37	0.05	0.12	0.11	0.42	0.12	0.35	0.12
MTBV_2YR	-0.13	0.43	-0.40	0.12	0.45	0.41	0.41	0.12	0.38	0.36	0.44
ROCE_6M	-0.03	0.02	-0.02	-0.19	0.02	0.11	0.12	-0.26	0.13	-0.10	0.09
MVTRADEMV_3M	-0.35	0.09	-0.29	0.40	0.07	0.08	0.06	0.23	0.06	0.34	0.09
EPS	0.72	-0.23	0.86	-0.30	-0.23	-0.09	-0.06	-0.35	-0.04	-0.33	-0.13
CFTBORRREPDIV_2YR	0.17	0.01	0.12	-0.07	0.05	0.03	0.03	-0.11	0.03	-0.04	0.04
TV	-0.22	0.43	-0.42	0.48	0.43	0.38	0.38	0.51	0.39	0.57	0.39
MTBV	0.10	0.42	-0.31	0.11	0.44	0.31	0.30	0.03	0.28	0.26	0.36
LNMV_2YR	0.00	0.61	-0.34	0.19	0.62	0.57	0.50	0.12	0.49	0.52	0.59
MVTRADE	0.65	-0.06	0.63	-0.16	-0.05	0.01	0.03	-0.19	0.03	-0.13	0.01
DPS_1YR	0.12	0.20	-0.06	0.15	0.17	0.10	0.05	0.03	0.08	0.13	0.09
LNMV_6M	0.23	0.38	0.17	-0.16	0.38	0.53	0.50	-0.17	0.48	0.10	0.48
RETEN_2YR	-0.05	-0.15	0.05	-0.01	-0.15	-0.06	-0.09	0.02	-0.06	0.01	-0.10
MVTRADEMV	-0.23	0.42	-0.42	0.39	0.43	0.35	0.33	0.35	0.31	0.49	0.38
MOM_24M	-0.04	0.69	-0.35	0.14	0.71	0.56	0.47	0.11	0.46	0.44	0.58
EPS_6M	0.26	0.25	0.24	-0.10	0.23	0.33	0.27	-0.18	0.30	0.06	0.29
CFTBORRREPDIV	0.22	-0.48	0.36	-0.10	-0.49	-0.31	-0.27	-0.17	-0.28	-0.24	-0.32

C.4. Correlation Matrix of Monthly Payoffs to Attributes

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	MVTRADEM _V _2YR	LN _{MV}	BT _{MV}	TV_6M	OBOS_6MMA	MVTRADE_3M	P	MOM_18M	RETE _N _1YR	TV_1M	MVTRADEM _V _6M
LNP											
MOM_12M											
BVPS											
MVTRADEM _V _1YR											
P_1YR											
MOM_6M											
P_3M											
TV_1YR											
MOM_3M											
MVTRADE_1YR											
P_6M											
MVTRADEM _V _2YR	1.00										
LN _{MV}	-0.31	1.00									
BT _{MV}	-0.11	-0.33	1.00								
TV_6M	0.31	-0.27	0.07	1.00							
OBOS_6MMA	0.12	0.18	-0.27	0.13	1.00						
MVTRADE_3M	0.38	-0.26	0.00	0.29	0.37	1.00					
P	-0.02	0.54	-0.34	-0.02	0.38	0.05	1.00				
MOM_18M	0.30	-0.03	-0.27	0.20	0.66	0.32	0.32	1.00			
RETE _N _1YR	-0.09	-0.16	0.11	-0.09	-0.08	0.03	-0.20	-0.05	1.00		
TV_1M	0.24	-0.31	0.08	0.31	-0.05	0.21	-0.06	-0.01	0.10	1.00	
MVTRADEM _V _6M	0.27	-0.19	0.11	0.71	0.24	0.45	-0.03	0.26	-0.12	0.28	1.00
MVTRADE_2YR	0.76	-0.23	-0.21	0.34	0.41	0.37	0.25	0.63	-0.23	0.13	0.28
MVTRADE_6M	0.29	-0.14	-0.12	0.57	0.56	0.54	0.13	0.55	-0.15	0.11	0.78
MVTRADEM _V _1M	0.16	-0.20	0.12	0.32	0.02	0.23	0.01	0.06	0.11	0.77	0.31
LN _{MV} _1YR	0.18	0.13	-0.09	0.11	0.44	-0.01	-0.05	0.49	-0.06	-0.24	0.15
DIV_2YR	-0.04	0.10	-0.03	-0.05	-0.12	0.04	0.16	0.04	-0.04	0.03	-0.11
LN _{MV} _3M	0.12	0.12	-0.17	0.14	0.81	0.35	0.25	0.48	-0.03	-0.10	0.24
CFTP	-0.16	0.27	0.05	-0.20	-0.13	-0.36	0.00	-0.18	-0.17	-0.09	-0.06
TV_2YR	0.50	-0.21	0.03	0.17	0.04	0.19	-0.10	0.07	-0.04	0.25	0.03
MVTRADE_1M	0.22	-0.17	0.01	0.35	0.28	0.37	0.18	0.23	0.06	0.73	0.35
DPS_6M	0.26	-0.06	-0.20	0.04	0.21	0.31	0.29	0.36	-0.01	0.12	0.09
EPS_2YRAV	-0.42	0.78	-0.11	-0.34	-0.01	-0.27	0.29	-0.27	-0.11	-0.28	-0.30
ACCRU	-0.04	0.32	-0.04	-0.07	0.09	0.06	0.17	0.03	-0.01	-0.10	-0.01
TV_3M	0.30	-0.46	0.01	0.34	0.04	0.52	-0.05	0.05	0.07	0.48	0.23
MTBV_2YR	0.19	-0.22	-0.10	0.27	0.36	0.36	0.11	0.42	0.04	0.17	0.27
ROCE_6M	0.15	-0.06	0.06	-0.07	0.01	0.18	0.00	-0.08	0.26	0.10	-0.04
MVTRADEM _V _3M	0.33	-0.36	0.12	0.29	0.00	0.77	-0.22	0.06	0.04	0.24	0.46
EPS	-0.38	0.80	-0.15	-0.37	0.03	-0.25	0.29	-0.25	-0.17	-0.26	-0.31
CFTBORRREPDIV_2YR	-0.14	0.13	-0.08	-0.08	-0.04	-0.11	0.00	-0.02	0.05	-0.26	0.00
TV	0.43	-0.24	-0.13	0.40	0.29	0.44	0.20	0.42	0.04	0.30	0.32
MTBV	0.24	-0.05	-0.38	0.09	0.29	0.23	0.31	0.33	-0.05	0.03	0.04
LN _{MV} _2YR	0.42	-0.17	-0.16	0.23	0.54	0.37	0.31	0.63	-0.14	0.02	0.30
MVTRADE	-0.25	0.77	-0.25	-0.21	0.10	-0.20	0.48	-0.06	-0.11	-0.18	-0.22
DPS_1YR	0.07	0.09	-0.24	0.02	0.09	0.21	0.24	0.17	0.03	-0.07	0.01
LN _{MV} _6M	0.03	0.28	-0.06	0.07	0.54	0.10	-0.07	0.29	-0.09	-0.29	0.17
RETE _N _2YR	-0.16	-0.01	0.13	0.03	-0.09	-0.11	-0.14	-0.10	0.34	-0.03	-0.02
MVTRADEM _V	0.50	-0.23	-0.11	0.39	0.24	0.47	0.18	0.40	-0.02	0.22	0.43
MOM_24M	0.31	-0.22	-0.15	0.20	0.51	0.34	0.23	0.81	-0.16	0.03	0.23
EPS_6M	-0.30	0.23	0.00	-0.05	0.37	0.08	0.19	0.20	-0.05	-0.17	0.01
CFTBORRREPDIV	-0.32	0.29	0.08	-0.24	-0.26	-0.25	-0.06	-0.63	-0.14	-0.11	-0.21

C.4. Correlation Matrix of Monthly Payoffs to Attributes

- continued

	MVTRADE_2YR	MVTRADE_6M	MVTRADEMV_1M	LNMV_1YR	DIV_2YR	LNMV_3M	CFTP	TV_2YR	MVTRADE_1M	DPS_6M	EPS_2YRAV
LNP											
MOM_12M											
BVPS											
MVTRADEMV_1YR											
P_1YR											
MOM_6M											
P_3M											
TV_1YR											
MOM_3M											
MVTRADE_1YR											
P_6M											
MVTRADEMV_2YR											
LNMV											
BTMV											
TV_6M											
OBOS_6MMA											
MVTRADE_3M											
P											
MOM_18M											
RETEN_1YR											
TV_1M											
MVTRADEMV_6M											
MVTRADE_2YR	1.00										
MVTRADE_6M	0.45	1.00									
MVTRADEMV_1M	0.10	0.16	1.00								
LNMV_1YR	0.29	0.28	-0.18	1.00							
DIV_2YR	0.05	-0.11	0.02	-0.14	1.00						
LNMV_3M	0.34	0.52	0.05	0.42	-0.15	1.00					
CFTP	-0.24	-0.14	-0.20	-0.02	0.01	-0.17	1.00				
TV_2YR	0.29	0.07	0.22	0.01	0.01	0.07	-0.03	1.00			
MVTRADE_1M	0.26	0.33	0.92	-0.13	0.06	0.26	-0.24	0.22	1.00		
DPS_6M	0.32	0.16	-0.05	0.03	0.17	0.02	-0.13	0.04	0.11	1.00	
EPS_2YRAV	-0.42	-0.33	-0.19	-0.02	-0.02	0.01	0.28	-0.21	-0.24	-0.12	1.00
ACCRU	0.02	-0.01	-0.01	0.07	0.23	0.15	0.08	-0.11	0.07	0.12	0.26
TV_3M	0.22	0.23	0.30	-0.29	0.19	-0.05	-0.27	0.28	0.34	0.24	-0.41
MTBV_2YR	0.33	0.51	0.14	0.09	0.09	0.38	-0.24	0.05	0.28	0.15	-0.37
ROCE_6M	0.00	0.00	0.20	-0.10	0.24	0.12	-0.17	0.16	0.21	-0.01	-0.04
MVTRADEMV_3M	0.15	0.35	0.24	-0.09	0.01	-0.03	-0.19	0.19	0.24	0.12	-0.31
EPS	-0.39	-0.33	-0.19	0.02	0.01	0.03	0.31	-0.20	-0.23	-0.08	0.96
CFTBORRREPDIV_2YR	-0.05	0.08	-0.21	0.02	0.01	0.06	0.13	-0.14	-0.20	-0.17	0.06
TV	0.48	0.46	0.15	0.01	0.10	0.19	-0.33	0.26	0.30	0.39	-0.41
MTBV	0.34	0.28	0.05	0.06	0.18	0.27	-0.17	0.01	0.20	0.22	-0.31
LNMV_2YR	0.65	0.54	0.03	0.37	0.10	0.51	-0.09	0.26	0.21	0.38	-0.34
MVTRADE	-0.16	-0.14	-0.16	0.03	0.07	0.05	0.15	-0.10	-0.12	0.06	0.66
DPS_1YR	0.12	0.04	-0.06	0.04	0.26	0.00	-0.13	0.04	0.03	0.46	0.00
LNMV_6M	0.08	0.33	-0.14	0.74	-0.23	0.64	0.01	0.03	-0.10	-0.14	0.26
RETEN_2YR	-0.22	-0.04	-0.09	0.06	0.03	-0.08	0.11	-0.14	-0.15	-0.03	0.08
MVTRADEMV	0.51	0.54	0.19	0.07	0.00	0.23	-0.30	0.28	0.31	0.31	-0.44
MOM_24M	0.68	0.50	0.06	0.35	0.05	0.43	-0.15	0.12	0.20	0.34	-0.39
EPS_6M	-0.12	0.14	-0.06	0.27	-0.03	0.26	-0.01	-0.17	0.02	0.14	0.31
CFTBORRREPDIV	-0.49	-0.35	-0.14	-0.19	-0.04	-0.21	0.37	-0.09	-0.21	-0.23	0.39

C.4. Correlation Matrix of Monthly Payoffs to Attributes

- continued

	ACCRU	TV_3M	MTBV_2YR	ROCE_6M	MVTRADEM_3M	EPS	CFTBORRRPDIV_2YR	TV	MTBV	LNMV_2YR	MVTRADE
LNP											
MOM_12M											
BVPS											
MVTRADEM_1YR											
P_1YR											
MOM_6M											
P_3M											
TV_1YR											
MOM_3M											
MVTRADE_1YR											
P_6M											
MVTRADEM_2YR											
LNMV											
BTMV											
TV_6M											
OBOS_6MMA											
MVTRADE_3M											
P											
MOM_18M											
RETEN_1YR											
TV_1M											
MVTRADEM_6M											
MVTRADE_2YR											
MVTRADE_6M											
MVTRADEM_1M											
LNMV_1YR											
DIV_2YR											
LNMV_3M											
CFTP											
TV_2YR											
MVTRADE_1M											
DPS_6M											
EPS_2YRAV											
ACCRU	1.00										
TV_3M	-0.27	1.00									
MTBV_2YR	0.00	0.24	1.00								
ROCE_6M	0.23	0.14	0.25	1.00							
MVTRADEM_3M	-0.13	0.55	0.12	0.07	1.00						
EPS	0.33	-0.42	-0.34	-0.01	-0.31	1.00					
CFTBORRRPDIV_2YR	0.14	-0.26	0.10	-0.15	-0.12	0.11	1.00				
TV	-0.20	0.48	0.44	-0.04	0.20	-0.42	-0.05	1.00			
MTBV	-0.05	0.17	0.53	0.22	0.07	-0.28	0.03	0.33	1.00		
LNMV_2YR	-0.04	0.19	0.44	0.10	0.16	-0.30	0.00	0.42	0.37	1.00	
MVTRADE	0.10	-0.31	-0.17	-0.14	-0.33	0.66	0.14	-0.08	-0.09	-0.10	1.00
DPS_1YR	0.14	0.14	0.12	0.00	0.18	0.04	0.03	0.13	0.11	0.27	0.07
LNMV_6M	0.16	-0.32	0.04	-0.02	-0.05	0.28	0.03	-0.13	-0.04	0.18	0.14
RETEN_2YR	0.08	-0.12	0.04	0.05	-0.11	0.05	0.04	-0.03	-0.01	-0.16	-0.01
MVTRADEM	-0.29	0.42	0.41	0.00	0.31	-0.48	-0.08	0.83	0.37	0.49	-0.04
MOM_24M	0.01	0.17	0.46	0.02	0.11	-0.35	-0.01	0.35	0.37	0.73	-0.17
EPS_6M	0.14	-0.11	-0.01	-0.03	-0.03	0.35	0.01	-0.20	-0.05	0.18	0.29
CFTBORRRPDIV	0.13	-0.17	-0.35	0.10	-0.09	0.42	0.09	-0.47	-0.16	-0.31	0.18

C.4. Correlation Matrix of Monthly Payoffs to Attributes

- continued

	DPS_1YR	LNMV_6M	RETEN_2YR	MVTRADEM	MOM_24M	EPS_6M	CFTBORRREPDIV
LNP							
MOM_12M							
BVPS							
MVTRADEM_1YR							
P_1YR							
MOM_6M							
P_3M							
TV_1YR							
MOM_3M							
MVTRADE_1YR							
P_6M							
MVTRADEM_2YR							
LNMV							
BTMV							
TV_6M							
OBOS_6MMA							
MVTRADE_3M							
P							
MOM_18M							
RETEN_1YR							
TV_1M							
MVTRADEM_6M							
MVTRADE_2YR							
MVTRADE_6M							
MVTRADEM_1M							
LNMV_1YR							
DIV_2YR							
LNMV_3M							
CFTP							
TV_2YR							
MVTRADE_1M							
DPS_6M							
EPS_2YRAV							
ACCRU							
TV_3M							
MTBV_2YR							
ROCE_6M							
MVTRADEM_3M							
EPS							
CFTBORRREPDIV_2YR							
TV							
MTBV							
LNMV_2YR							
MVTRADE							
DPS_1YR	1.00						
LNMV_6M	-0.16	1.00					
RETEN_2YR	-0.18	0.08	1.00				
MVTRADEM	0.12	-0.07	-0.08	1.00			
MOM_24M	0.13	0.16	-0.14	0.38	1.00		
EPS_6M	0.22	0.33	-0.03	-0.17	0.13	1.00	
CFTBORRREPDIV	-0.08	-0.03	0.04	-0.43	-0.45	0.01	1.00

C.5. Correlation Matrix of Monthly Payoffs to Attributes: Simplified List of Attributes

Matrix of Pearson (1896) correlation coefficients between the monthly payoffs to standardised firm-specific attributes as calculated in univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The attributes displayed are those significant at the 5% level in a Student's (1908) t-test and who remain after in-cluster correlation analysis was conducted to eliminate the attributes with the lower t-statistic out of every pair of highly correlated attributes. The data were extracted from DataStream International. Correlations above 0.85 and below -0.85 are displayed in white with a black background. Correlations above 0.7 and below -0.7 are displayed in bold with a grey background. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	ACCRU	CFTBORRREPDV	CFTBORRREPDV_2YR	CFTP	LNP	MVTRADE	LNMV_1YR	MOM_12M	MOM_3M	LNMV_2YR	MOM_18M	MVTRADE_3M	MVTRADEMV_1M	MVTRADEMV_1YR	MVTRADEMV_2YR	MVTRADEMV_6M	TV	TV_1YR	TV_2YR	TV_3M	TV_6M	DIV_2YR	DPS_1YR	DPS_6M	EPS_6M	RETEN_1YR	RETEN_2YR	BTMV	MTBV	MTBV_2YR	ROCE_6M					
ACCRU	1.00																																			
CFTBORRREPDV	0.13	1.00																																		
CFTBORRREPDV_2YR	0.14	0.09	1.00																																	
CFTP	0.08	0.37	0.13	1.00																																
LNP	0.32	0.22	0.17	0.27	1.00																															
MVTRADE	0.10	0.18	0.14	0.15	0.65	1.00																														
LNMV_1YR	0.07	-0.19	0.02	-0.02	0.15	0.03	1.00																													
MOM_12M	0.07	-0.48	0.01	-0.24	0.14	-0.06	0.57	1.00																												
MOM_3M	0.08	-0.28	0.03	-0.28	0.09	0.03	0.34	0.89	1.00																											
LNMV_2YR	-0.04	-0.31	0.00	-0.09	0.00	-0.10	0.37	0.61	0.49	1.00																										
MOM_18M	0.03	-0.63	-0.02	-0.16	0.12	-0.06	0.84	0.57	0.63	1.00																										
MVTRADE_3M	0.06	-0.25	-0.11	-0.36	-0.20	-0.20	-0.01	0.41	0.51	0.37	0.32	1.00																								
MVTRADEMV_1M	-0.01	-0.14	-0.21	-0.20	-0.20	-0.16	-0.18	0.05	-0.03	0.03	0.06	0.23	1.00																							
MVTRADEMV_1YR	-0.21	-0.10	-0.07	-0.08	-0.22	-0.16	-0.07	0.22	0.23	0.19	0.20	0.40	0.20	1.00																						
MVTRADEMV_2YR	-0.04	-0.32	-0.14	-0.16	-0.28	-0.25	0.18	0.34	0.18	0.42	0.30	0.38	0.16	0.38	1.00																					
MVTRADEMV_6M	-0.01	-0.21	0.00	-0.06	-0.17	-0.22	0.15	0.28	0.23	0.30	0.28	0.45	0.31	0.39	0.27	1.00																				
TV	-0.20	-0.47	-0.05	-0.33	-0.22	-0.08	0.01	0.43	0.39	0.42	0.42	0.44	0.15	0.48	0.43	0.32	1.00																			
TV_1YR	-0.28	-0.17	-0.11	-0.04	-0.32	-0.19	-0.12	0.09	0.11	0.12	0.14	0.23	0.21	0.74	0.28	0.25	0.51	1.00																		
TV_2YR	-0.11	-0.09	-0.14	-0.03	-0.21	-0.10	0.01	0.12	0.08	0.26	0.07	0.19	0.22	0.13	0.50	0.03	0.26	0.21	1.00																	
TV_3M	-0.27	-0.17	-0.26	-0.27	-0.42	-0.31	-0.29	0.08	0.12	0.19	0.05	0.52	0.30	0.37	0.30	0.23	0.48	0.42	0.28	1.00																
TV_6M	-0.07	-0.24	-0.08	-0.20	-0.26	-0.21	0.11	0.21	0.11	0.23	0.20	0.29	0.32	0.31	0.31	0.71	0.40	0.36	0.17	0.34	1.00															
DIV_2YR	0.23	-0.04	0.01	0.01	0.11	0.07	-0.14	-0.01	-0.08	0.10	0.04	0.04	0.02	-0.16	-0.04	-0.11	0.10	-0.12	0.01	0.19	-0.05	1.00														
DPS_1YR	0.14	-0.08	0.03	-0.13	0.12	0.07	0.04	0.20	0.08	0.27	0.17	0.21	-0.06	0.15	0.07	0.01	0.13	0.03	0.04	0.14	0.02	0.26	1.00													
DPS_6M	0.12	-0.23	-0.17	-0.13	-0.01	0.06	0.03	0.32	0.29	0.38	0.31	-0.05	0.34	0.28	0.09	0.39	0.22	0.04	0.24	0.04	0.17	0.46	1.00													
EPS_6M	0.14	0.01	0.01	0.01	0.26	0.29	0.27	0.25	0.30	0.18	0.20	0.08	-0.06	-0.10	-0.30	0.01	-0.20	-0.18	-0.17	-0.11	-0.05	0.22	0.14	1.00												
RETEN_1YR	-0.01	-0.14	0.05	-0.17	-0.24	-0.11	-0.06	-0.15	-0.01	-0.14	-0.05	0.03	0.11	-0.04	-0.09	-0.12	0.04	0.08	-0.04	0.07	-0.09	0.04	0.03	-0.01	-0.05	1.00										
RETEN_2YR	0.08	0.04	0.04	0.11	-0.05	-0.01	0.06	-0.15	-0.06	-0.16	-0.10	-0.11	-0.09	-0.01	-0.16	-0.02	-0.03	0.02	-0.14	-0.12	0.03	0.03	-0.18	-0.03	-0.03	0.34	1.00									
BTMV	-0.04	0.08	-0.08	0.05	-0.33	-0.25	-0.09	-0.27	-0.20	-0.16	-0.27	0.00	0.12	-0.04	-0.11	0.11	-0.13	0.06	0.03	0.01	0.07	-0.03	-0.24	-0.20	0.00	0.11	0.13	1.00								
MTBV	-0.05	-0.16	0.03	-0.17	0.10	-0.09	0.06	0.42	0.28	0.37	0.33	0.23	0.05	0.11	0.24	0.04	0.33	0.03	0.01	0.17	0.09	0.18	0.11	0.22	-0.05	-0.05	-0.01	-0.38	1.00							
MTBV_2YR	0.00	-0.35	0.10	-0.24	-0.13	-0.17	0.09	0.43	0.38	0.44	0.42	0.36	0.14	0.12	0.19	0.27	0.44	0.12	0.05	0.24	0.27	0.09	0.12	0.15	0.22	-0.05	-0.01	0.04	0.04	-0.10	0.53	1.00				
ROCE_6M	0.23	0.10	-0.15	-0.17	-0.03	-0.14	-0.10	0.02	0.13	0.10	-0.08	0.18	0.20	-0.19	0.15	-0.04	-0.04	-0.26	0.16	0.14	-0.07	0.24	0.00	-0.01	-0.03	0.26	0.05	0.06	0.22	0.25	1.00					

Appendix D

D.1. Average Intercept Term and Lag Coefficients for Twelve-lag Autoregressions on Monthly Payoffs

For each attribute for each month, an intercept and lag coefficients for the lagged variables are calculated from running an Ordinary Least Squares twelve-lag autoregression only on the monthly payoffs data before that month. This is known as an "expanding window". The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The firm-specific attributes are standardised before the regressions are performed. The data were extracted from DataStream International. Given the autoregression's number of observations requirement, these lag coefficients and intercepts can only be calculated for the last 95 months. The expanding window results in 24 observations being used for the autoregression for month 25's payoff, and 118 observations being used for the last month's payoff. The average lag coefficients of the lagged variables and average intercept for each attribute are displayed, and the related t-statistics of the averages are displayed in brackets. The average lag coefficients and intercepts significant at the 5% level in a Student's (1908) test are displayed in bold. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

		Lag Coefficients											
	Intercept	t-1	t-2	t-3	t-4	t-5	t-6	t-7	t-8	t-9	t-10	t-11	t-12
Liquidity	0.006 (7.63)	0.038 (6.52)	0.335 (44.64)	0.026 (2.55)	0.016 (2.88)	-0.232 (-12.42)	-0.040 (-1.92)	0.054 (4.53)	0.011 (0.56)	-0.026 (-1.59)	0.012 (0.32)	-0.072 (-1.23)	-0.260 (-4.95)
Momentum	0.013 (36.41)	-0.003 (-0.19)	0.144 (10.55)	0.101 (5.15)	-0.035 (-2.84)	-0.092 (-4.33)	-0.222 (-8.93)	0.003 (0.12)	-0.037 (-1.82)	0.203 (6.4)	-0.102 (-3.27)	-0.072 (-4.14)	-0.154 (-8.3)
	0.006 (13.05)	0.030 (2.59)	0.357 (25.27)	0.095 (6.36)	-0.117 (-6.3)	0.041 (1.54)	-0.156 (-7.17)	-0.069 (-2.77)	0.011 (0.65)	0.197 (6.27)	-0.130 (-5.02)	0.026 (0.7)	0.136 (3.58)
Performance	-0.006 (-21.48)	0.015 (0.69)	-0.016 (-0.53)	-0.240 (-9.92)	0.076 (3.19)	-0.258 (-11.87)	-0.232 (-8.15)	-0.134 (-6.45)	-0.202 (-9.38)	-0.033 (-0.87)	-0.108 (-9.14)	-0.242 (-8.97)	-0.084 (-6.68)
	-0.005 (-6.16)	0.125 (9.35)	0.311 (8.07)	-0.006 (-0.74)	0.123 (4.03)	-0.284 (-33.21)	0.125 (3.34)	0.088 (6.13)	-0.134 (-2.21)	0.060 (4.62)	0.038 (1.81)	-0.083 (-4.13)	-0.261 (-4.06)
Size	0.003 (0.28)	0.291 (0.67)	0.106 (0.62)	0.426 (1.34)	0.064 (2.87)	-0.007 (-0.05)	0.468 (3.76)	-0.183 (-1.48)	-0.004 (-0.19)	-0.021 (-0.44)	-0.087 (-9.91)	0.049 (4.06)	-0.090 (-2.94)
Value	0.006 (13.84)	-0.377 (-11.66)	-0.102 (-5.87)	0.177 (7.86)	0.056 (2.17)	0.015 (1.59)	-0.301 (-24.56)	-0.244 (-10.68)	-0.135 (-11.31)	-0.076 (-8.74)	0.072 (5.41)	-0.023 (-1.43)	-0.006 (-0.43)
	-0.330 (-0.99)	-2.062 (-1)	2.067 (0.92)	2.514 (1)	4.301 (0.98)	2.791 (0.99)	2.032 (0.88)	3.129 (1.02)	9.583 (0.99)	9.955 (1.02)	-1.111 (-1.03)	-1.252 (-0.89)	2.646 (0.97)

D.2. Autocorrelations of Lags One to Twelve of Monthly Payoffs to Attributes

The autocorrelations of lags one to twelve of monthly payoffs to standardised attributes. The actual monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. Autocorrelations significant at the 5% level in a Student t-test are displayed in bold. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	LAGS											
	1	2	3	4	5	6	7	8	9	10	11	12
Liquidity												
TV	0.01	0.36	0.01	0.15	-0.07	0.05	0.04	0.09	0.04	0.09	0.03	-0.01
Momentum												
MOM_12M	0.03	0.08	0.14	0.05	-0.11	-0.09	-0.03	-0.03	0.04	-0.16	-0.04	-0.01
MOM_3M	-0.07	0.31	0.09	-0.09	0.01	-0.05	-0.08	0.00	0.08	-0.12	0.08	0.00
Performance												
ACCRU	0.11	0.14	-0.04	0.17	-0.02	-0.01	-0.09	-0.05	0.06	-0.05	-0.11	-0.10
CFTBORRREPDIV	0.19	0.27	0.05	0.23	-0.12	0.03	-0.07	0.02	-0.02	0.03	-0.10	-0.08
Size												
LNP	0.00	0.06	0.19	0.06	-0.11	0.29	-0.05	-0.01	0.06	-0.06	-0.02	0.13
Value												
BTMV	-0.11	0.10	0.24	0.14	0.15	-0.02	0.14	0.11	-0.04	0.18	0.04	0.10
CFTP	-0.09	0.02	-0.12	0.10	-0.06	-0.09	-0.02	-0.05	0.10	-0.04	0.13	-0.09
Change in Liquidity												
MVTRADEMV_1YR	0.09	0.15	0.05	0.02	0.10	0.07	0.05	0.11	-0.05	0.05	0.05	0.03
MVTRADEMV_2YR	0.14	0.11	0.04	0.08	-0.09	-0.03	-0.04	0.12	0.06	0.09	0.02	0.00
TV_6M	-0.14	0.00	-0.02	-0.10	-0.19	0.00	0.04	0.05	0.04	0.11	-0.01	-0.15
MVTRADEMV_1M	-0.10	-0.05	-0.10	-0.16	0.02	0.15	0.03	-0.02	-0.06	-0.07	-0.12	0.10
TV_2YR	-0.12	0.18	0.00	-0.11	-0.04	0.05	0.00	0.01	0.04	0.02	0.03	0.03
TV_3M	-0.26	0.04	-0.10	-0.09	-0.02	0.17	-0.09	-0.03	0.00	-0.01	-0.05	0.06
Change in Performance												
DIV_2YR	0.11	-0.07	-0.08	0.04	0.02	0.13	-0.03	-0.12	-0.11	0.05	-0.10	0.06
DPS_6M	0.32	0.23	0.11	0.01	0.09	0.02	-0.04	-0.10	-0.02	-0.02	0.00	0.00
ROCE_6M	-0.02	-0.04	0.01	-0.08	-0.19	0.04	-0.04	0.05	0.16	0.06	0.01	0.06
CFTBORRREPDIV_2YR	-0.23	0.02	0.01	0.04	-0.13	0.05	0.04	-0.10	0.28	-0.18	0.19	-0.13
DPS_1YR	0.08	0.06	0.15	0.16	0.11	-0.02	-0.01	-0.01	0.03	0.05	-0.06	0.09
Change in Size												
LNMV_1YR	0.11	0.14	-0.09	-0.08	-0.16	-0.07	-0.01	-0.07	-0.08	-0.04	-0.13	-0.06
LNMV_2YR	0.12	-0.01	0.20	0.01	-0.07	-0.01	-0.06	0.07	0.09	-0.11	-0.04	-0.04
Change in Value												
RETEN_1YR	-0.09	0.09	-0.10	0.23	-0.01	0.12	-0.02	0.20	0.04	-0.08	0.09	-0.01
MTBV_2YR	-0.01	0.15	0.10	0.05	0.07	-0.03	0.05	0.09	0.00	0.21	-0.03	0.01
RETEN_2YR	-0.05	0.07	-0.01	0.07	-0.08	-0.03	-0.13	0.00	-0.10	0.02	-0.10	0.11
Liquidity/Size												
MVTRADE	0.17	0.01	0.11	0.15	0.16	0.16	-0.10	0.02	0.01	-0.05	-0.06	0.13
Change in Liquidity /												
Change in Size												
MVTRADE_3M	-0.03	0.20	-0.04	0.04	0.06	-0.04	-0.04	-0.02	-0.11	0.02	-0.01	-0.06
Change in Size / Change in												
Performance												
EPS_6M	-0.01	-0.01	-0.12	-0.07	-0.03	0.09	0.02	-0.01	-0.01	-0.10	-0.07	0.10

D.3. Partial-autocorrelations of Lags One to Twelve of Monthly Payoffs to Attributes

The partial-autocorrelations of lags one to twelve of monthly payoffs to standardised attributes. The actual monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. Partial-autocorrelations significant at the 5% level in a Student t-test are displayed in bold. Partial-autocorrelations show the explanatory power of each lag after controlling the other eleven lags. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	LAGS											
	1	2	3	4	5	6	7	8	9	10	11	12
Liquidity												
TV	0.01	0.36	0.01	0.03	-0.09	-0.02	0.10	0.09	0.01	0.02	-0.01	-0.06
Momentum												
MOM_12M	0.03	0.08	0.14	0.03	-0.14	-0.12	-0.02	0.03	0.09	-0.17	-0.08	-0.02
MOM_3M	-0.07	0.30	0.14	-0.18	-0.10	0.02	-0.03	0.00	0.14	-0.12	-0.04	0.08
Performance												
ACCRU	0.11	0.13	-0.07	0.16	-0.04	-0.05	-0.06	-0.05	0.10	-0.06	-0.10	-0.04
CFTBORRREPDIV	0.19	0.24	-0.05	0.18	-0.21	-0.01	0.01	-0.02	0.08	-0.02	-0.12	-0.07
Size												
LNP	0.00	0.06	0.19	0.06	-0.14	0.25	-0.06	0.00	-0.01	-0.10	0.06	0.05
Value												
BTMV	-0.11	0.09	0.26	0.20	0.16	-0.08	0.01	0.04	-0.06	0.12	0.05	0.07
CFTP	-0.09	0.02	-0.11	0.08	-0.04	-0.11	-0.02	-0.07	0.09	-0.02	0.11	-0.06
Change in Liquidity												
MVTRADEM _{1YR}	0.09	0.14	0.03	-0.01	0.09	0.05	0.01	0.08	-0.08	0.02	0.05	0.01
MVTRADEM _{2YR}	0.14	0.09	0.01	0.07	-0.11	-0.02	-0.01	0.13	0.05	0.05	-0.01	-0.05
TV _{6M}	-0.14	-0.02	-0.03	-0.11	-0.23	-0.08	0.01	0.03	0.01	0.08	0.02	-0.13
MVTRADEM _{1M}	-0.10	-0.06	-0.12	-0.19	-0.04	0.12	0.02	-0.03	-0.03	-0.03	-0.15	0.02
TV _{2YR}	-0.12	0.17	0.04	-0.14	-0.07	0.09	0.04	-0.04	0.01	0.05	0.04	0.01
TV _{3M}	-0.26	-0.03	-0.10	-0.16	-0.09	0.14	-0.04	-0.10	-0.02	0.01	-0.09	-0.03
Change in Performance												
DIV _{2YR}	0.11	-0.08	-0.07	0.05	0.00	0.13	-0.06	-0.10	-0.07	0.04	-0.14	0.08
DPS _{6M}	0.32	0.14	0.00	-0.06	0.10	-0.02	-0.08	-0.09	0.07	0.00	-0.01	0.00
ROCE _{6M}	-0.02	-0.04	0.01	-0.08	-0.20	0.02	-0.06	0.05	0.13	0.05	0.03	0.06
CFTBORRREPDIV _{2YR}	-0.23	-0.04	0.01	0.05	-0.11	-0.01	0.05	-0.08	0.27	-0.10	0.17	-0.08
DPS _{1YR}	0.08	0.06	0.14	0.14	0.08	-0.07	-0.06	-0.06	0.02	0.07	-0.04	0.11
Change in Size												
LNMV _{1YR}	0.11	0.13	-0.12	-0.08	-0.13	-0.03	0.04	-0.10	-0.10	-0.02	-0.14	-0.05
LNMV _{2YR}	0.12	-0.02	0.21	-0.05	-0.06	-0.04	-0.05	0.12	0.08	-0.12	-0.06	-0.09
Change in Value												
RETEN _{1YR}	-0.09	0.08	-0.08	0.21	0.04	0.09	0.03	0.16	0.08	-0.14	0.10	-0.07
MTBV _{2YR}	-0.01	0.15	0.11	0.03	0.04	-0.05	0.03	0.10	-0.01	0.18	-0.04	-0.06
RETEN _{2YR}	-0.05	0.07	0.00	0.06	-0.08	-0.04	-0.12	-0.01	-0.08	0.02	-0.08	0.08
Liquidity/Size												
MVTRADE	0.17	-0.02	0.12	0.12	0.12	0.12	-0.18	0.03	-0.07	-0.08	-0.05	0.17
Change in Liquidity / Change in Size												
MVTRADE _{3M}	-0.03	0.20	-0.03	0.00	0.08	-0.05	-0.07	0.00	-0.10	0.01	0.04	-0.07
Change in Size / Change in Performance												
EPS _{6M}	-0.01	-0.01	-0.12	-0.08	-0.03	0.08	0.01	-0.02	0.01	-0.09	-0.07	0.10

D.4. Ljung-Box Q-Statistics of Lags One to Twelve of Monthly Payoffs to Attributes

The Ljung-Box (1978) Q-statistics of lags one to twelve of monthly payoffs to standardised attributes. The actual monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The Q-statistics test for the null hypothesis that there is no autocorrelation up to order k. If the null hypothesis holds, Q follows a chi-squared distribution with k degrees of freedom. Q-statistics significant at the 5% level are displayed in bold. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	LAGS											
	1	2	3	4	5	6	7	8	9	10	11	12
Liquidity												
TV	0.0	15.8	15.8	18.7	19.4	19.7	19.8	20.9	21.0	22.0	22.1	22.1
Momentum												
MOM_12M	0.1	0.9	3.4	3.6	5.2	6.3	6.4	6.5	6.7	9.9	10.1	10.1
MOM_3M	0.6	12.0	13.1	14.0	14.0	14.3	15.1	15.1	16.0	17.9	18.8	18.8
Performance												
ACCRU	1.6	4.1	4.3	7.7	7.7	7.7	8.8	9.0	9.5	9.8	11.3	12.6
CFTBORRREPDIV	4.5	13.5	13.8	20.2	22.0	22.1	22.7	22.8	22.8	22.9	24.2	25.1
Size												
LNP	0.0	0.5	4.8	5.3	6.9	17.3	17.6	17.6	18.0	18.5	18.6	20.8
Value												
BTMV	1.4	2.6	9.8	12.3	15.0	15.1	17.7	19.2	19.4	23.6	23.8	25.0
CFTP	1.0	1.1	2.7	3.8	4.3	5.3	5.3	5.6	7.0	7.2	9.6	10.8
Change in Liquidity												
MVTRADEM _{1YR}	1.0	3.6	3.9	4.0	5.3	5.9	6.1	7.6	7.9	8.2	8.6	8.7
MVTRADEM _{2YR}	2.5	4.0	4.2	5.0	5.9	6.0	6.2	8.0	8.4	9.4	9.5	9.5
TV _{6M}	2.4	2.4	2.5	3.6	8.2	8.2	8.4	8.7	9.0	10.7	10.7	13.6
MVTRADEM _{1M}	1.1	1.5	2.8	5.8	5.8	8.8	8.9	8.9	9.4	10.0	12.0	13.3
TV _{2YR}	1.6	5.5	5.5	7.0	7.1	7.5	7.5	7.5	7.6	7.7	7.8	7.9
TV _{3M}	8.0	8.2	9.4	10.5	10.5	14.1	15.2	15.3	15.3	15.3	15.7	16.2
Change in Performance												
DIV _{2YR}	1.4	2.0	2.8	3.0	3.0	5.2	5.4	7.3	8.7	9.1	10.5	11.0
DPS _{6M}	12.7	19.2	20.6	20.7	21.7	21.8	22.0	23.1	23.2	23.3	23.3	23.3
ROCE _{6M}	0.0	0.3	0.3	1.1	5.8	6.0	6.2	6.5	9.8	10.3	10.3	10.8
CFTBORRREPDIV _{2YR}	6.6	6.6	6.6	6.8	8.8	9.1	9.3	10.6	20.8	25.2	30.2	32.5
DPS _{1YR}	0.8	1.3	3.9	7.2	8.7	8.8	8.8	8.8	8.9	9.2	9.7	10.8
Change in Size												
LNMV _{1YR}	1.6	4.0	4.9	5.6	9.0	9.7	9.7	10.4	11.1	11.3	13.5	13.9
LNMV _{2YR}	1.7	1.7	6.9	6.9	7.6	7.6	8.0	8.7	9.8	11.4	11.7	11.9
Change in Value												
RETEN _{1YR}	1.0	2.0	3.2	9.6	9.6	11.4	11.4	16.6	16.8	17.6	18.7	18.7
MTBV _{2YR}	0.0	2.6	4.0	4.2	4.9	5.0	5.3	6.4	6.4	12.0	12.1	12.1
RETEN _{2YR}	0.3	0.9	0.9	1.5	2.3	2.4	4.5	4.5	5.9	5.9	7.2	8.7
Liquidity/Size												
MVTRADE	3.7	3.7	5.3	8.3	11.3	14.8	16.0	16.1	16.1	16.5	16.9	19.1
Change in Liquidity / Change in Size												
MVTRADE _{3M}	0.1	4.9	5.1	5.2	5.7	5.9	6.1	6.2	7.7	7.8	7.8	8.2
Change in Size / Change in Performance												
EPS _{6M}	0.0	0.0	1.9	2.6	2.7	3.7	3.8	3.8	3.8	5.2	5.9	7.3

D.5. Ljung-Box p-values of Lags One to Twelve of Monthly Payoffs to Attributes

The p-values of the Ljung-Box (1978) Q-statistics of lags one to twelve of monthly payoffs to standardised attributes. The actual monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The Q-statistics test for the null hypothesis that there is no autocorrelation up to order k. If the null hypothesis holds, Q follows a chi-squared distribution with k degrees of freedom. P-values less than 0.05 indicate significance at the 5% level and are displayed in bold. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	LAGS											
	1	2	3	4	5	6	7	8	9	10	11	12
Liquidity												
TV	1.00	0.20	0.20	0.10	0.08	0.07	0.07	0.05	0.05	0.04	0.04	0.04
Momentum												
MOM_12M	1.00	1.00	0.99	0.99	0.95	0.90	0.90	0.89	0.88	0.62	0.61	0.60
MOM_3M	1.00	0.44	0.36	0.30	0.30	0.28	0.23	0.23	0.19	0.12	0.09	0.09
Performance												
ACCRU	1.00	0.98	0.98	0.81	0.81	0.80	0.72	0.70	0.66	0.63	0.50	0.40
CFTBORRREPDIV	0.97	0.33	0.32	0.06	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.01
Size												
LNP	1.00	1.00	0.96	0.95	0.86	0.14	0.13	0.13	0.12	0.10	0.10	0.05
Value												
BTMV	1.00	1.00	0.64	0.43	0.24	0.24	0.13	0.08	0.08	0.02	0.02	0.01
CFTP	1.00	1.00	1.00	0.99	0.98	0.95	0.95	0.94	0.86	0.84	0.65	0.55
Change in Liquidity												
MVTRADEM_1YR	1.00	0.99	0.98	0.98	0.95	0.92	0.91	0.82	0.79	0.77	0.74	0.73
MVTRADEM_2YR	1.00	0.98	0.98	0.96	0.92	0.91	0.91	0.79	0.75	0.67	0.66	0.66
TV_6M	1.00	1.00	1.00	0.99	0.77	0.77	0.75	0.73	0.71	0.56	0.55	0.33
MVTRADEM_1M	1.00	1.00	1.00	0.93	0.92	0.72	0.71	0.71	0.67	0.62	0.44	0.35
TV_2YR	1.00	0.94	0.94	0.86	0.85	0.82	0.82	0.82	0.81	0.81	0.80	0.80
TV_3M	0.78	0.77	0.67	0.57	0.57	0.30	0.23	0.22	0.22	0.22	0.20	0.18
Change in Performance												
DIV_2YR	1.00	1.00	1.00	1.00	1.00	0.95	0.94	0.84	0.73	0.70	0.57	0.53
DPS_6M	0.39	0.08	0.06	0.06	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03
ROCE_6M	1.00	1.00	1.00	1.00	0.93	0.92	0.91	0.89	0.63	0.59	0.59	0.54
CFTBORRREPDIV_2YR	0.89	0.88	0.88	0.87	0.72	0.69	0.68	0.57	0.05	0.01	0.00	0.00
DPS_1YR	1.00	1.00	0.98	0.84	0.73	0.72	0.72	0.72	0.71	0.68	0.64	0.55
Change in Size												
LNMV_1YR	1.00	0.98	0.96	0.93	0.70	0.64	0.64	0.58	0.52	0.50	0.33	0.31
LNMV_2YR	1.00	1.00	0.86	0.86	0.82	0.82	0.78	0.73	0.64	0.49	0.47	0.46
Change in Value												
RETEN_1YR	1.00	1.00	0.99	0.65	0.65	0.50	0.49	0.16	0.16	0.13	0.10	0.09
MTBV_2YR	1.00	1.00	0.98	0.98	0.96	0.96	0.95	0.90	0.90	0.45	0.44	0.44
RETEN_2YR	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.97	0.92	0.92	0.84	0.72
Liquidity/Size												
MVTRADE	0.99	0.99	0.95	0.76	0.50	0.26	0.19	0.19	0.19	0.17	0.15	0.09
Change in Liquidity / Change in Size												
MVTRADE_3M	1.00	0.96	0.96	0.95	0.93	0.92	0.91	0.91	0.81	0.80	0.80	0.77
Change in Size / Change in Performance												
EPS_6M	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.95	0.92	0.84

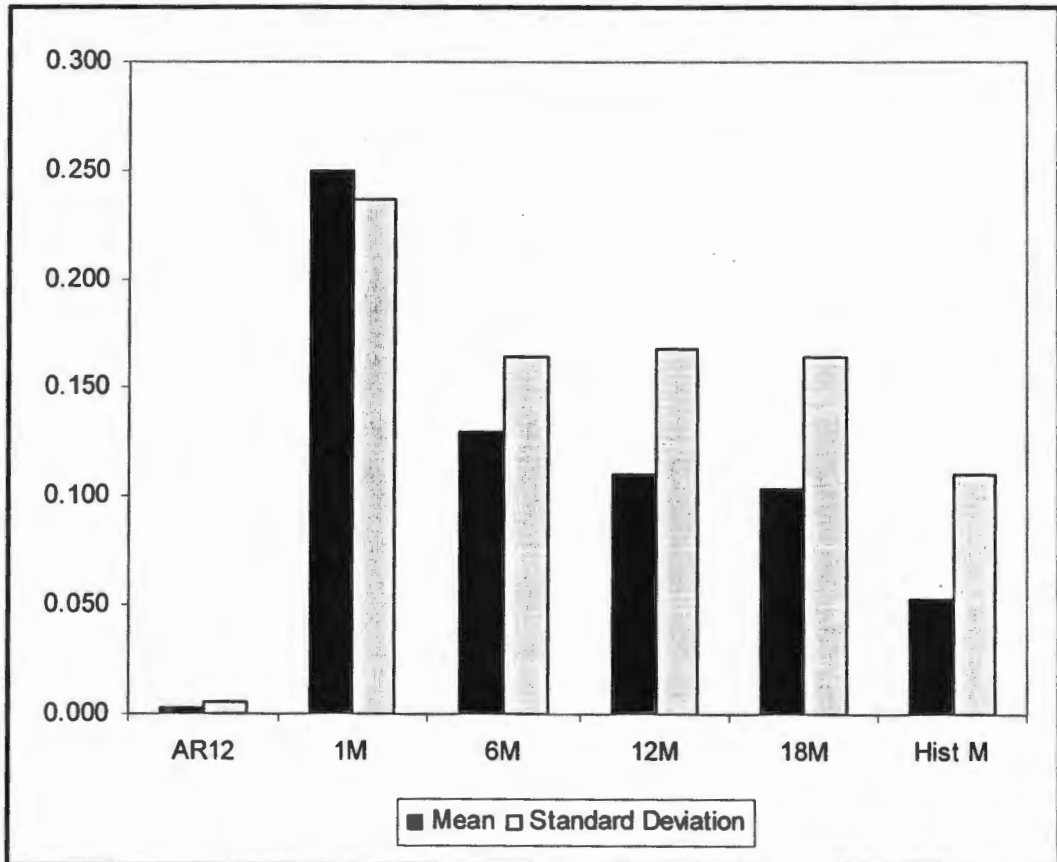
D.6. Sign Test p-values of Direction Ratios

Direction ratios displaying the number of times the payoff to a standardised attribute is correctly forecast to total forecasts are calculated for each style characteristic for each model. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The direction ratios are then subjected to the nonparametric Sign Test, which tests the null hypothesis that the models predict the correct sign less than 50% of the time. The related p-values are displayed. Figures displayed in bold are significant at the 5% level. The lower the p-value the better the style-timing model. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	AR12	1M	6M	12M	18M	Hist M
Liquidity						
TV	0.000	0.204	0.286	0.281	0.082	0.204
Momentum						
MOM_12M	0.000	0.017	0.019	0.000	0.000	0.000
MOM_3M	0.000	0.040	0.007	0.010	0.008	0.001
Performance						
ACCRU	0.012	0.010	0.066	0.220	0.082	0.116
CFTBORRREPDIV	0.020	0.609	0.286	0.423	0.500	0.156
Size						
LNP	0.000	0.026	0.007	0.002	0.001	0.001
Value						
BTMV	0.000	0.323	0.066	0.010	0.001	0.004
CFTP	0.002	0.116	0.019	0.026	0.014	0.000
Change in Liquidity						
MVTRADEM_V_1YR	0.000	0.323	0.012	0.000	0.000	0.000
MVTRADEM_V_2YR	0.000	0.084	0.030	0.010	0.003	0.000
TV_6M	0.007	0.844	0.066	0.041	0.014	0.017
MVTRADEM_V_1M	0.004	0.116	0.001	0.016	0.023	0.004
TV_2YR	0.000	0.116	0.045	0.220	0.421	0.006
TV_3M	0.007	0.609	0.066	0.167	0.055	0.040
Change in Performance						
DIV_2YR	0.000	0.001	0.004	0.002	0.000	0.000
DPS_6M	0.020	0.537	0.129	0.061	0.116	0.006
ROCE_6M	0.004	0.260	0.173	0.026	0.008	0.017
CFTBORRREPDIV_2YR	0.000	0.677	0.500	0.088	0.345	0.010
DPS_1YR	0.000	0.537	0.173	0.123	0.160	0.059
Change in Size						
LNMV_1YR	0.001	0.084	0.030	0.026	0.036	0.001
LNMV_2YR	0.000	0.059	0.353	0.719	0.579	0.084
Change in Value						
RETEN_1YR	0.000	0.084	0.066	0.016	0.036	0.116
MTBV_2YR	0.000	0.204	0.286	0.026	0.023	0.000
RETEN_2YR	0.004	0.260	0.647	0.350	0.213	0.537
Liquidity/Size						
MVTRADE	0.000	0.040	0.000	0.006	0.055	0.040
Change in Liquidity / Change in Size						
MVTRADE_3M	0.000	0.323	0.045	0.026	0.023	0.002
Change in Size / Change in Performance						
EPS_6M	0.000	0.260	0.129	0.088	0.005	0.004
Mean	0.003	0.250	0.130	0.110	0.104	0.053
Standard Deviation	0.006	0.237	0.165	0.168	0.164	0.111

D.7. Average Sign Test p-values of Direction Ratios

Direction ratios displaying the number of times the payoff to a standardised attribute is correctly forecast to total forecasts are calculated for each style characteristic for each model. The direction ratios are subjected to the nonparametric Sign Test, which tests the null hypothesis that the models predict the correct sign less than 50% of the time. The dark bars represent the mean (across the attributes) of the Sign Test p-values for each model, and the light bars display the related standard deviation of the p-values. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The lower the p-value the better the style-timing model.



D.8. Theil Inequality Coefficient for Style-timing Models

Theil (1958) Inequality Coefficients are calculated for each standardised style characteristic for each style-timing model. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The Theil Inequality Coefficient lies between zero and one, and the lower the coefficient, the better the style-timing model. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	AR12	1M	6M	12M	18M	Hist M
Liquidity						
TV	0.486	0.810	0.757	0.759	0.799	0.786
Momentum						
MOM_12M	0.458	0.639	0.626	0.625	0.621	0.633
MOM_3M	0.433	0.685	0.677	0.679	0.675	0.683
Performance						
ACCRU	0.485	0.771	0.769	0.797	0.780	0.764
CFTBORRREPDIV	0.639	0.767	0.762	0.818	0.873	0.836
Size						
LNP	0.412	0.618	0.598	0.605	0.611	0.616
Value						
BTMV	0.442	0.697	0.638	0.609	0.618	0.699
CFTP	0.542	0.752	0.767	0.784	0.759	0.762
Change in Liquidity						
MVTRADEMV_1YR	0.484	0.660	0.635	0.623	0.639	0.661
MVTRADEMV_2YR	0.468	0.676	0.702	0.709	0.745	0.694
TV_6M	0.506	0.699	0.663	0.665	0.690	0.696
MVTRADEMV_1M	0.461	0.749	0.759	0.747	0.736	0.754
TV_2YR	0.422	0.761	0.785	0.795	0.801	0.774
TV_3M	0.457	0.712	0.782	0.742	0.782	0.767
Change in Performance						
DIV_2YR	0.528	0.751	0.763	0.767	0.762	0.758
DPS_6M	0.371	0.662	0.718	0.763	0.786	0.782
ROCE_6M	0.618	0.796	0.735	0.783	0.741	0.784
CFTBORRREPDIV_2YR	0.404	0.725	0.780	0.787	0.792	0.803
DPS_1YR	0.501	0.817	0.777	0.795	0.858	0.825
Change in Size						
LNMV_1YR	0.500	0.743	0.760	0.726	0.668	0.731
LNMV_2YR	0.442	0.791	0.820	0.821	0.814	0.816
Change in Value						
RETEN_1YR	0.472	0.726	0.721	0.701	0.659	0.733
MTBV_2YR	0.513	0.790	0.773	0.754	0.793	0.781
RETEN_2YR	0.411	0.830	0.829	0.784	0.781	0.797
Liquidity/Size						
MVTRADE	0.467	0.758	0.710	0.750	0.780	0.809
Change in Liquidity / Change in Size						
MVTRADE_3M	0.480	0.729	0.713	0.722	0.744	0.715
Change in Size / Change in Performance						
EPS_6M	0.447	0.821	0.805	0.803	0.778	0.814
Mean	0.476	0.738	0.734	0.738	0.744	0.751
Standard Deviation	0.059	0.058	0.061	0.065	0.072	0.059

D.9. Root Mean Squared Error of Style-timing Models

Root Mean Squared Errors are calculated for each standardised style characteristic for each style-timing model. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The lower the Root Mean Squared Error the better the style-timing model. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	AR12	1M	6M	12M	18M	Hist M
Liquidity						
TV	0.013	0.016	0.016	0.017	0.016	0.016
Momentum						
MOM_12M	0.015	0.019	0.019	0.019	0.019	0.019
MOM_3M	0.016	0.020	0.020	0.021	0.021	0.020
Performance						
ACCRU	0.014	0.017	0.017	0.017	0.016	0.017
CFTBORRREPDIV	0.012	0.018	0.018	0.018	0.016	0.018
Size						
LNP	0.013	0.016	0.016	0.016	0.017	0.016
Value						
BTMV	0.012	0.016	0.014	0.014	0.014	0.016
CFTP	0.012	0.015	0.014	0.015	0.014	0.015
Change in Liquidity						
MVTRADEMV_1YR	0.009	0.011	0.011	0.010	0.010	0.011
MVTRADEMV_2YR	0.008	0.010	0.010	0.010	0.010	0.010
TV_6M	0.008	0.009	0.009	0.009	0.009	0.009
MVTRADEMV_1M	0.008	0.009	0.009	0.010	0.010	0.009
TV_2YR	0.007	0.011	0.009	0.009	0.009	0.011
TV_3M	0.009	0.011	0.011	0.011	0.012	0.011
Change in Performance						
DIV_2YR	0.008	0.010	0.010	0.010	0.010	0.010
DPS_6M	0.010	0.013	0.013	0.014	0.014	0.013
ROCE_6M	0.013	0.015	0.015	0.016	0.013	0.015
CFTBORRREPDIV_2YR	0.009	0.012	0.012	0.012	0.012	0.012
DPS_1YR	0.006	0.008	0.008	0.008	0.008	0.008
Change in Size						
LNMV_1YR	0.016	0.019	0.019	0.020	0.019	0.019
LNMV_2YR	0.013	0.016	0.016	0.017	0.017	0.016
Change in Value						
RETEN_1YR	0.006	0.007	0.007	0.007	0.007	0.007
MTBV_2YR	0.013	0.016	0.016	0.017	0.017	0.016
RETEN_2YR	0.005	0.007	0.007	0.007	0.007	0.007
Liquidity/Size						
MVTRADE	0.006	0.007	0.007	0.007	0.007	0.007
Change in Liquidity / Change in Size						
MVTRADE_3M	0.009	0.010	0.010	0.010	0.011	0.010
Change in Size / Change in Performance						
EPS_6M	0.007	0.009	0.009	0.010	0.010	0.009

D.10. Mean Absolute Percentage Error of Style-timing Models

Mean Absolute Percentage Errors are calculated for each standardised style characteristic for each style-timing model. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The lower the Mean Absolute Percentage Error the better the style-timing model. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	AR12	1M	6M	12M	18M	Hist M
Liquidity						
TV	587	394	408	370	338	455
Momentum						
MOM_12M	198	374	397	384	393	350
MOM_3M	181	265	397	366	362	290
Performance						
ACCRU	480	212	206	222	231	185
CFTBORRREPDIV	235	225	207	201	189	240
Size						
LNP	170	418	264	328	243	408
Value						
BTMV	215	232	216	219	212	252
CFTP	230	232	209	184	200	216
Change in Liquidity						
MVTRADEM_V_1YR	182	172	175	197	202	180
MVTRADEM_V_2YR	284	242	236	204	239	262
TV_6M	387	437	530	635	823	534
MVTRADEM_V_1M	334	289	283	213	320	304
TV_2YR	149	188	161	123	123	203
TV_3M	429	376	441	701	561	517
Change in Performance						
DIV_2YR	314	199	197	184	195	181
DPS_6M	294	226	181	162	168	152
ROCE_6M	508	341	537	359	409	318
CFTBORRREPDIV_2YR	940	505	346	402	451	422
DPS_1YR	147	119	139	126	127	132
Change in Size						
LNMV_1YR	148	199	192	171	246	197
LNMV_2YR	200	201	170	195	204	207
Change in Value						
RETEN_1YR	310	236	226	236	272	231
MTBV_2YR	139	1224	118	131	128	1075
RETEN_2YR	1285	1783	1810	3108	2557	3133
Liquidity/Size						
MVTRADE	864	297	463	390	401	304
Change in Liquidity / Change in Size						
MVTRADE_3M	172	239	218	245	232	249
Change in Size / Change in Performance						
EPS_6M	160	125	121	128	138	123

D.12. Breakdown of Theil's Inequality Coefficient: Variance

Theil (1958) Inequality Coefficients are calculated for each standardised style characteristic for each style-timing model. They can be broken down into the proportions of Bias, Variance and Covariance. These proportions sum to one. The Variance proportion is displayed, and indicates the ability of the style-timing model to replicate the degree of variation of the actual payoffs. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The lower the Variance proportion, the better the style-timing model. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	AR12	1M	6M	12M	18M	Hist M
Liquidity						
TV	0.247	0.969	0.697	0.702	0.768	0.789
Momentum						
MOM_12M	0.293	0.947	0.934	0.905	0.825	0.833
MOM_3M	0.229	0.870	0.865	0.915	0.918	0.842
Performance						
ACCRU	0.261	0.789	0.760	0.965	0.988	0.761
CFTBORRREPDIV	0.412	0.677	0.669	0.808	0.961	0.973
Size						
LNP	0.233	0.990	0.685	0.834	0.821	0.912
Value						
BTMV	0.257	0.809	0.611	0.609	0.611	0.826
CFTP	0.324	0.835	0.780	0.805	0.694	0.939
Change in Liquidity						
MVTRADEM_1YR	0.304	0.820	0.679	0.697	0.719	0.828
MVTRADEM_2YR	0.251	0.745	0.832	0.797	0.960	0.908
TV_6M	0.328	0.765	0.650	0.688	0.817	0.746
MVTRADEM_1M	0.231	0.850	0.819	0.747	0.683	0.888
TV_2YR	0.188	0.804	0.878	0.870	0.827	0.887
TV_3M	0.222	0.605	0.816	0.681	0.773	0.758
Change in Performance						
DIV_2YR	0.304	0.801	0.864	0.981	0.967	0.844
DPS_6M	0.147	0.512	0.629	0.775	0.879	0.876
ROCE_6M	0.492	0.966	0.740	0.953	0.969	0.838
CFTBORRREPDIV_2YR	0.176	0.624	0.798	0.906	0.911	0.919
DPS_1YR	0.264	0.849	0.699	0.759	0.987	0.899
Change in Size						
LNMV_1YR	0.277	0.795	0.884	0.696	0.539	0.740
LNMV_2YR	0.206	0.783	0.849	0.943	0.838	0.918
Change in Value						
RETEN_1YR	0.296	0.851	0.821	0.781	0.828	0.936
MTBV_2YR	0.312	0.986	0.789	0.733	0.971	0.859
RETEN_2YR	0.185	0.909	0.996	0.843	0.994	0.760
Liquidity/Size						
MVTRADE	0.233	0.697	0.595	0.860	0.873	0.926
Change in Liquidity / Change in Size						
MVTRADE_3M	0.258	0.981	0.779	0.959	0.992	0.803
Change in Size / Change in Performance						
EPS_6M	0.213	0.981	0.852	0.840	0.800	0.889
Mean	0.265	0.823	0.777	0.817	0.849	0.856
Standard Deviation	0.072	0.125	0.102	0.103	0.124	0.066

D.13. Breakdown of Theil's Inequality Coefficient: Covariance

Theil (1958) Inequality Coefficients are calculated for each standardised style characteristic for each style-timing model. They can be broken down into the proportions of Bias, Variance and Covariance. These proportions sum to one. The Covariance proportion is displayed, and measures the unsystematic forecasting errors after the Bias and Variance Proportions have been excluded. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. The higher the Covariance proportion, the better the style-timing model. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	AR12	1M	6M	12M	18M	Hist M
Liquidity						
TV	0.753	0.031	0.303	0.298	0.232	0.211
Momentum						
MOM_12M	0.707	0.053	0.066	0.095	0.175	0.167
MOM_3M	0.771	0.130	0.135	0.085	0.082	0.158
Performance						
ACCRU	0.739	0.211	0.240	0.035	0.012	0.239
CFTBORRREPDIV	0.588	0.323	0.331	0.192	0.039	0.027
Size						
LNP	0.767	0.010	0.315	0.166	0.179	0.088
Value						
BTMV	0.743	0.191	0.389	0.391	0.389	0.174
CFTP	0.676	0.165	0.220	0.195	0.306	0.061
Change in Liquidity						
MVTRADEM_1YR	0.696	0.180	0.321	0.303	0.281	0.172
MVTRADEM_2YR	0.749	0.255	0.168	0.203	0.040	0.092
TV_6M	0.672	0.235	0.350	0.312	0.183	0.254
MVTRADEM_1M	0.769	0.150	0.181	0.253	0.317	0.112
TV_2YR	0.812	0.196	0.122	0.130	0.173	0.113
TV_3M	0.778	0.395	0.184	0.319	0.227	0.242
Change in Performance						
DIV_2YR	0.696	0.199	0.136	0.019	0.033	0.156
DPS_6M	0.853	0.488	0.371	0.225	0.121	0.124
ROCE_6M	0.508	0.034	0.260	0.047	0.031	0.162
CFTBORRREPDIV_2YR	0.824	0.376	0.202	0.094	0.089	0.081
DPS_1YR	0.736	0.151	0.301	0.241	0.013	0.101
Change in Size						
LNMV_1YR	0.723	0.205	0.116	0.304	0.461	0.260
LNMV_2YR	0.794	0.217	0.151	0.057	0.162	0.082
Change in Value						
RETEN_1YR	0.704	0.149	0.179	0.219	0.172	0.064
MTBV_2YR	0.688	0.014	0.211	0.267	0.029	0.141
RETEN_2YR	0.815	0.091	0.004	0.157	0.006	0.240
Liquidity/Size						
MVTRADE	0.767	0.303	0.405	0.140	0.127	0.074
Change in Liquidity / Change in Size						
MVTRADE_3M	0.742	0.019	0.221	0.041	0.008	0.197
Change in Size / Change in Performance						
EPS_6M	0.787	0.019	0.148	0.160	0.200	0.111
Mean	0.735	0.177	0.223	0.183	0.151	0.144
Standard Deviation	0.072	0.125	0.102	0.103	0.124	0.066

D.14. Forecasting Statistics for the Twelve-lag Auto-regressive Model (AR12)

The statistics calculated in assessing the ability of a twelve-lag auto-regressive model to forecast monthly payoffs to attributes are displayed. The parameters of each standardised style characteristic's autoregressive model are calculated each month by running Ordinary Least Squares regressions only on the monthly payoffs data before that month. This is known as an "expanding window". Given the autoregression's number of observations requirement, these lag coefficients and intercepts can only be calculated for the last 95 months. The expanding window results in 24 observations being used for the autoregression for month 25's payoff, and 118 observations being used for the last month's payoff. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Correlation	Direction Ratio	Direction Ratio: (p-value)	Theil's Inequality Coefficient	Bias	Variance	Covariance	RMSE	MAPE
Liquidity									
TV	0.604	0.695	0.000	0.466	0.000	0.247	0.753	0.013	587.268
Momentum									
MOM_12M	0.546	0.716	0.000	0.458	0.000	0.293	0.707	0.015	198.318
MOM_3M	0.628	0.768	0.000	0.433	0.000	0.229	0.771	0.016	180.536
Performance									
ACCRU	0.587	0.611	0.012	0.485	0.000	0.261	0.739	0.014	479.514
CFTBORRREPDIV	0.416	0.600	0.020	0.639	0.000	0.412	0.588	0.012	235.158
Size									
LNP	0.622	0.600	0.000	0.412	0.000	0.233	0.767	0.013	170.053
Value									
BTMV	0.591	0.747	0.000	0.442	0.000	0.257	0.743	0.012	214.832
CFTP	0.511	0.642	0.002	0.542	0.000	0.324	0.676	0.012	230.319
Change in Liquidity									
MVTRADEM_1YR	0.534	0.716	0.000	0.484	0.000	0.304	0.696	0.009	181.562
MVTRADEM_2YR	0.598	0.674	0.000	0.468	0.000	0.251	0.749	0.008	264.078
TV_6M	0.506	0.621	0.007	0.506	0.000	0.328	0.672	0.008	387.387
MVTRADEM_1M	0.625	0.632	0.004	0.461	0.000	0.231	0.769	0.008	334.228
TV_2YR	0.684	0.705	0.000	0.422	0.000	0.188	0.812	0.007	149.288
TV_3M	0.636	0.621	0.007	0.457	0.000	0.222	0.778	0.009	428.998
Change in Performance									
DIV_2YR	0.534	0.695	0.000	0.528	0.000	0.304	0.698	0.008	314.416
DPS_6M	0.743	0.600	0.020	0.371	0.000	0.147	0.853	0.010	293.695
ROCE_6M	0.340	0.632	0.004	0.618	0.000	0.492	0.508	0.013	508.102
CFTBORRREPDIV_2YR	0.700	0.695	0.000	0.404	0.000	0.176	0.824	0.009	940.170
DPS_1YR	0.583	0.705	0.000	0.501	0.000	0.264	0.736	0.006	147.440
Change in Size									
LNMV_1YR	0.566	0.653	0.001	0.500	0.000	0.277	0.723	0.016	147.707
LNMV_2YR	0.658	0.695	0.000	0.442	0.000	0.206	0.794	0.013	199.911
Change in Value									
RETEN_1YR	0.543	0.705	0.000	0.472	0.000	0.296	0.704	0.006	309.695
MTBV_2YR	0.525	0.684	0.000	0.513	0.000	0.312	0.688	0.013	139.198
RETEN_2YR	0.688	0.632	0.004	0.411	0.000	0.185	0.815	0.005	1284.656
Liquidity/Size									
MVTRADE	0.822	0.747	0.000	0.467	0.000	0.233	0.767	0.006	863.995
Change in Liquidity / Change in Size									
MVTRADE_3M	0.590	0.718	0.000	0.480	0.000	0.258	0.742	0.009	171.549
Change in Size / Change in Performance									
EPS_6M	0.648	0.726	0.000	0.447	0.000	0.213	0.787	0.007	160.376
Mean	0.586	0.683	0.003	0.478	0.000	0.265	0.735	0.010	353.424
Standard Deviation	0.085	0.053	0.006	0.059	0.000	0.072	0.072	0.003	278.554

D.15. Forecasting Statistics for the One-Month Model (1M)

The statistics calculated in assessing the ability of a one-lag auto-regressive model to forecast monthly payoffs to attributes are displayed. The model uses the previous month's payoff as an estimate of this month's payoff, and is a special case autoregressive model that does not include an intercept term or estimate of the lagged slope coefficient. The model's forecast data set contains 118 estimates. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The firm-specific attributes are standardised before the regressions are performed. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Correlation	Direction Ratio	Direction Ratio: (p-value)	Theil's Inequality Coefficient	Bias	Variance	Covariance	RMSE	MAPE
Liquidity									
TV	0.016	0.534	0.204	0.810	0.000	0.969	0.031	0.016	393.830
Momentum									
MOM_12M	0.027	0.593	0.017	0.639	0.000	0.947	0.053	0.019	373.621
MOM_3M	-0.070	0.576	0.040	0.685	0.000	0.870	0.130	0.020	264.673
Performance									
ACCRU	0.118	0.602	0.010	0.771	0.000	0.789	0.211	0.017	212.128
CFTBORRREPDIV	0.192	0.483	0.609	0.767	0.000	0.677	0.323	0.018	225.052
Size									
LNP	0.005	0.585	0.026	0.618	0.000	0.990	0.010	0.016	417.785
Value									
BTMV	-0.106	0.517	0.323	0.697	0.000	0.809	0.191	0.016	232.213
CFTP	-0.090	0.551	0.116	0.752	0.000	0.835	0.185	0.015	231.889
Change in Liquidity									
MVTRADEM_1YR	0.099	0.517	0.323	0.660	0.000	0.820	0.180	0.011	171.835
MVTRADEM_2YR	0.146	0.559	0.084	0.676	0.000	0.745	0.255	0.010	242.476
TV_6M	-0.133	0.449	0.844	0.699	0.000	0.765	0.235	0.009	437.375
MVTRADEM_1M	-0.081	0.551	0.116	0.749	0.000	0.650	0.150	0.009	288.568
TV_2YR	-0.108	0.551	0.116	0.781	0.000	0.804	0.198	0.011	188.412
TV_3M	-0.246	0.483	0.609	0.712	0.000	0.605	0.395	0.011	376.447
Change in Performance									
DIV_2YR	0.110	0.636	0.001	0.751	0.000	0.801	0.199	0.010	199.403
DPS_6M	0.323	0.492	0.537	0.662	0.000	0.512	0.488	0.013	225.507
ROCE_6M	-0.018	0.525	0.260	0.796	0.000	0.966	0.034	0.015	341.250
CFTBORRREPDIV_2YR	-0.232	0.475	0.677	0.725	0.000	0.624	0.376	0.012	505.216
DPS_1YR	0.082	0.492	0.537	0.817	0.000	0.849	0.151	0.008	119.170
Change in Size									
LNMV_1YR	0.114	0.559	0.084	0.743	0.000	0.795	0.205	0.019	199.186
LNMV_2YR	0.122	0.568	0.059	0.791	0.000	0.783	0.217	0.016	201.250
Change in Value									
RETEN_1YR	-0.081	0.559	0.084	0.726	0.000	0.851	0.149	0.007	236.481
MTBV_2YR	-0.007	0.534	0.204	0.790	0.000	0.966	0.014	0.016	1224.267
RETEN_2YR	-0.047	0.525	0.260	0.830	0.000	0.909	0.091	0.007	1783.374
Liquidity/Size									
MVTRADE	0.179	0.576	0.040	0.758	0.000	0.697	0.303	0.007	296.612
Change in Liquidity / Change in Size									
MVTRADE_3M	-0.010	0.517	0.323	0.729	0.000	0.981	0.019	0.010	239.250
Change in Size / Change in Performance									
EPS_6M	-0.010	0.525	0.260	0.821	0.000	0.981	0.019	0.009	125.261
Mean	0.011	0.538	0.250	0.738	0.000	0.823	0.177	0.013	361.205
Standard Deviation	0.131	0.043	0.237	0.058	0.000	0.125	0.125	0.004	351.527

D.16. Forecasting Statistics for the Six-Month Trailing Moving Average Model (6M)

The statistics calculated in assessing the ability of a six-month trailing moving average model to forecast monthly payoffs to attributes are displayed. The model's forecast data set contains 113 estimates. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The firm-specific attributes are standardised before the regressions are performed. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Correlation	Direction Ratio	Direction Ratio: (p-value)	Theil's Inequality Coefficient	Bias	Variance	Covariance	RMSE	MAPE
Liquidity									
TV	0.179	0.522	0.286	0.757	0.000	0.697	0.303	0.016	407.718
Momentum									
MOM_12M	0.034	0.593	0.019	0.626	0.000	0.934	0.066	0.019	397.165
MOM_3M	0.072	0.611	0.007	0.677	0.000	0.865	0.135	0.020	397.349
Performance									
ACCRU	0.136	0.586	0.066	0.769	0.000	0.760	0.240	0.017	205.862
CFTBORRRREPDIV	0.198	0.522	0.286	0.762	0.000	0.669	0.331	0.018	206.782
Size									
LNP	0.187	0.611	0.007	0.598	0.000	0.685	0.315	0.016	264.335
Value									
BTMV	0.241	0.586	0.066	0.838	0.000	0.611	0.389	0.014	216.026
CFTP	-0.123	0.593	0.019	0.767	0.000	0.780	0.220	0.014	208.722
Change in Liquidity									
MVTRADEM_V_1YR	0.191	0.602	0.012	0.635	0.000	0.879	0.321	0.011	175.238
MVTRADEM_V_2YR	0.092	0.584	0.030	0.702	0.000	0.832	0.168	0.010	236.356
TV_6M	-0.212	0.566	0.066	0.663	0.000	0.650	0.350	0.009	530.265
MVTRADEM_V_1M	-0.100	0.637	0.001	0.759	0.000	0.819	0.181	0.009	282.507
TV_2YR	-0.065	0.575	0.045	0.785	0.000	0.878	0.122	0.009	160.731
TV_3M	-0.102	0.566	0.066	0.782	0.000	0.816	0.184	0.011	441.401
Change in Performance									
DIV_2YR	0.073	0.619	0.004	0.763	0.000	0.884	0.136	0.010	197.321
DPS_6M	0.228	0.549	0.129	0.718	0.000	0.629	0.371	0.013	181.198
ROCE_6M	-0.149	0.540	0.173	0.735	0.000	0.740	0.260	0.015	536.702
CFTBORRRREPDIV_2YR	-0.112	0.496	0.500	0.780	0.000	0.798	0.202	0.012	346.111
DPS_1YR	0.177	0.540	0.173	0.777	0.000	0.699	0.301	0.008	139.157
Change in Size									
LNMV_1YR	-0.062	0.584	0.030	0.760	0.000	0.884	0.116	0.019	192.373
LNMV_2YR	0.082	0.513	0.353	0.820	0.000	0.849	0.151	0.016	169.610
Change in Value									
RETEN_1YR	0.098	0.586	0.066	0.721	0.000	0.821	0.179	0.007	225.814
MTBV_2YR	0.118	0.522	0.286	0.773	0.000	0.789	0.211	0.016	117.793
RETEN_2YR	-0.002	0.478	0.647	0.829	0.000	0.996	0.004	0.007	1809.988
Liquidity/Size									
MVTRADE	0.254	0.655	0.000	0.710	0.000	0.595	0.405	0.007	463.349
Change in Liquidity / Change in Size									
MVTRADE_3M	0.124	0.575	0.045	0.713	0.000	0.779	0.221	0.010	218.178
Change in Size / Change in Performance									
EPS_6M	-0.080	0.549	0.129	0.805	0.000	0.652	0.148	0.009	121.496
Mean	0.055	0.567	0.130	0.734	0.000	0.777	0.223	0.013	327.761
Standard Deviation	0.136	0.042	0.165	0.061	0.000	0.102	0.102	0.004	320.908

D.17. Forecasting Statistics for the Twelve-Month Trailing Moving Average Model (12M)

The statistics calculated in assessing the ability of a twelve-month trailing moving average model to forecast monthly payoffs to attributes are displayed. The model's forecast data set contains 107 estimates. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The firm-specific attributes are standardised before the regressions are performed. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Correlation	Direction Ratio	Direction Ratio: (p-value)	Theil's Inequality Coefficient	Bias	Variance	Covariance	RMSE	MAPE
Liquidity									
TV	0.175	0.523	0.281	0.759	0.000	0.702	0.298	0.017	370.319
Momentum									
MOM_12M	-0.050	0.692	0.000	0.625	0.000	0.905	0.095	0.019	383.757
MOM_3M	0.044	0.607	0.010	0.679	0.000	0.915	0.085	0.021	366.010
Performance									
ACCRU	0.018	0.533	0.220	0.797	0.000	0.965	0.035	0.017	222.443
CFTBORRREPDIV	0.106	0.505	0.423	0.818	0.000	0.808	0.192	0.018	200.959
Size									
LNP	0.090	0.636	0.002	0.605	0.000	0.834	0.166	0.016	328.282
Value									
BTMV	0.243	0.607	0.010	0.809	0.000	0.609	0.391	0.014	219.045
CFTP	-0.108	0.589	0.026	0.784	0.000	0.805	0.195	0.015	184.239
Change in Liquidity									
MVTRADEM_1YR	0.179	0.664	0.000	0.623	0.000	0.697	0.303	0.010	196.690
MVTRADEM_2YR	0.113	0.607	0.010	0.709	0.000	0.797	0.203	0.010	204.119
TV_6M	-0.185	0.579	0.041	0.665	0.000	0.688	0.312	0.009	635.160
MVTRADEM_1M	-0.145	0.598	0.018	0.747	0.000	0.747	0.253	0.010	213.126
TV_2YR	-0.069	0.533	0.220	0.795	0.000	0.870	0.130	0.009	122.536
TV_3M	-0.190	0.542	0.167	0.742	0.000	0.681	0.319	0.011	700.679
Change in Performance									
DIV_2YR	-0.010	0.636	0.002	0.767	0.000	0.981	0.019	0.010	183.512
DPS_6M	0.127	0.570	0.061	0.763	0.000	0.775	0.225	0.014	162.473
ROCE_6M	0.024	0.589	0.026	0.763	0.000	0.953	0.047	0.018	358.578
CFTBORRREPDIV_2YR	-0.049	0.561	0.088	0.787	0.000	0.906	0.094	0.012	402.383
DPS_1YR	0.137	0.551	0.123	0.795	0.000	0.759	0.241	0.008	125.680
Change in Size									
LNMV_1YR	-0.179	0.589	0.026	0.726	0.000	0.898	0.304	0.020	171.486
LNMV_2YR	0.030	0.467	0.719	0.821	0.000	0.943	0.057	0.017	194.860
Change in Value									
RETN_1YR	0.123	0.598	0.018	0.701	0.000	0.781	0.219	0.007	236.226
MTBV_2YR	0.154	0.589	0.026	0.754	0.000	0.733	0.267	0.017	131.072
RETN_2YR	-0.085	0.514	0.350	0.784	0.000	0.843	0.157	0.007	3107.998
Liquidity/Size									
MVTRADE	0.075	0.817	0.006	0.750	0.000	0.860	0.140	0.007	389.875
Change in Liquidity / Change in Size									
MVTRADE_3M	0.021	0.589	0.026	0.722	0.000	0.959	0.041	0.010	245.472
Change in Size / Change in Performance									
EPS_6M	-0.087	0.561	0.088	0.803	0.000	0.840	0.160	0.010	126.014
Mean	0.019	0.579	0.110	0.738	0.000	0.817	0.183	0.013	377.223
Standard Deviation	0.122	0.050	0.168	0.065	0.000	0.103	0.103	0.004	564.532

D.18. Forecasting Statistics for the Eighteen-Month Trailing Moving Average Model (18M)

The statistics calculated in assessing the ability of an eighteen-month trailing moving average model to forecast monthly payoffs to attributes are displayed. The model's forecast data set contains 101 estimates. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The firm-specific attributes are standardised before the regressions are performed. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Correlation	Direction Ratio	Direction Ratio: (p-value)	Theil's Inequality Coefficient	Bias	Variance	Covariance	RMSE	MAPE
Liquidity									
TV	0.131	0.564	0.082	0.799	0.000	0.768	0.232	0.018	337.881
Momentum									
MOM_12M	-0.096	0.703	0.000	0.821	0.000	0.825	0.175	0.019	393.031
MOM_3M	-0.043	0.614	0.008	0.675	0.000	0.918	0.082	0.021	361.673
Performance									
ACCRU	0.006	0.564	0.082	0.780	0.000	0.988	0.012	0.018	231.179
CFTBORRREPDIV	0.020	0.495	0.500	0.873	0.000	0.961	0.039	0.018	189.283
Size									
LNP	0.099	0.653	0.001	0.611	0.000	0.821	0.179	0.017	243.495
Value									
BTMV	0.241	0.653	0.001	0.618	0.000	0.611	0.389	0.014	211.973
CFTP	-0.181	0.604	0.014	0.759	0.000	0.694	0.306	0.014	199.683
Change in Liquidity									
MVTRADEM_1YR	0.163	0.673	0.000	0.839	0.000	0.719	0.281	0.010	202.139
MVTRADEM_2YR	-0.021	0.634	0.003	0.745	0.000	0.960	0.040	0.010	238.713
TV_6M	-0.101	0.604	0.014	0.690	0.000	0.817	0.183	0.009	823.041
MVTRADEM_1M	-0.188	0.594	0.023	0.736	0.000	0.683	0.317	0.010	319.746
TV_2YR	-0.095	0.505	0.421	0.801	0.000	0.827	0.173	0.009	123.214
TV_3M	-0.128	0.574	0.055	0.782	0.000	0.773	0.227	0.012	581.070
Change in Performance									
DIV_2YR	0.017	0.733	0.000	0.762	0.000	0.967	0.033	0.010	195.466
DPS_6M	0.064	0.554	0.116	0.786	0.000	0.679	0.121	0.014	167.518
ROCE_6M	0.018	0.614	0.008	0.741	0.000	0.969	0.031	0.013	409.012
CFTBORRREPDIV_2YR	-0.047	0.515	0.345	0.792	0.000	0.911	0.089	0.012	450.536
DPS_1YR	-0.006	0.545	0.180	0.858	0.000	0.987	0.013	0.008	126.547
Change in Size									
LNMV_1YR	-0.299	0.584	0.036	0.668	0.000	0.539	0.461	0.019	245.794
LNMV_2YR	-0.088	0.465	0.579	0.814	0.000	0.838	0.162	0.017	204.319
Change in Value									
RETEN_1YR	0.094	0.584	0.036	0.659	0.000	0.828	0.172	0.007	272.247
MTBV_2YR	0.015	0.594	0.023	0.793	0.000	0.971	0.029	0.017	127.709
RETEN_2YR	0.003	0.535	0.213	0.761	0.000	0.994	0.006	0.007	2557.389
Liquidity/Size									
MVTRADE	0.068	0.574	0.055	0.780	0.000	0.873	0.127	0.007	401.375
Change in Liquidity / Change in Size									
MVTRADE_3M	-0.004	0.594	0.023	0.744	0.000	0.992	0.008	0.011	232.347
Change in Size / Change in Performance									
EPS_6M	-0.111	0.624	0.005	0.776	0.000	0.800	0.200	0.010	138.048
Mean	-0.017	0.591	0.104	0.744	0.000	0.849	0.151	0.013	369.053
Standard Deviation	0.116	0.060	0.164	0.072	0.000	0.124	0.124	0.004	463.366

D.19. Forecasting Statistics for the Historic Mean Model (HIST M)

The statistics calculated in assessing the ability of a historic-mean model to forecast monthly payoffs to attributes are displayed. The model's forecast data set contains 118 estimates. The realised monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The firm-specific attributes are standardised before the regressions are performed. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Correlation	Direction Ratio	Direction Ratio: (p-value)	Theil's Inequality Coefficient	Bias	Variance	Covariance	RMSE	MAPE
Liquidity									
TV	-0.118	0.534	0.204	0.786	0.000	0.789	0.211	0.016	455.028
Momentum									
MOM_12M	-0.091	0.678	0.000	0.633	0.000	0.833	0.167	0.019	350.223
MOM_3M	-0.086	0.644	0.001	0.683	0.000	0.842	0.158	0.020	290.260
Performance									
ACCRU	-0.136	0.551	0.116	0.764	0.000	0.761	0.239	0.017	185.039
CFTBORRREPDIV	0.013	0.542	0.158	0.836	0.000	0.973	0.027	0.018	240.489
Size									
LNP	-0.046	0.644	0.001	0.616	0.000	0.912	0.088	0.016	408.182
Value									
BTMV	-0.095	0.619	0.004	0.699	0.000	0.826	0.174	0.016	251.692
CFTP	-0.032	0.653	0.000	0.762	0.000	0.939	0.061	0.015	216.082
Change in Liquidity									
MVTRADEM_1YR	-0.094	0.669	0.000	0.661	0.000	0.828	0.172	0.011	180.125
MVTRADEM_2YR	0.048	0.678	0.000	0.694	0.000	0.908	0.092	0.010	262.164
TV_6M	-0.145	0.593	0.017	0.696	0.000	0.746	0.254	0.009	534.085
MVTRADEM_1M	-0.059	0.619	0.004	0.754	0.000	0.888	0.112	0.009	304.117
TV_2YR	0.060	0.610	0.008	0.774	0.000	0.887	0.113	0.011	203.030
TV_3M	-0.137	0.576	0.040	0.767	0.000	0.758	0.242	0.011	516.547
Change in Performance									
DIV_2YR	-0.085	0.712	0.000	0.758	0.000	0.844	0.156	0.010	181.117
DPS_6M	-0.066	0.610	0.008	0.782	0.000	0.876	0.124	0.013	151.772
ROCE_6M	-0.088	0.593	0.017	0.784	0.000	0.838	0.162	0.015	317.809
CFTBORRREPDIV_2YR	-0.042	0.602	0.010	0.803	0.000	0.919	0.081	0.012	421.536
DPS_1YR	-0.053	0.568	0.059	0.825	0.000	0.899	0.101	0.008	131.821
Change in Size									
LNMV_1YR	-0.149	0.636	0.001	0.731	0.000	0.740	0.260	0.019	197.238
LNMV_2YR	-0.043	0.559	0.084	0.816	0.000	0.918	0.082	0.016	207.496
Change in Value									
RETN_1YR	-0.033	0.551	0.116	0.733	0.000	0.936	0.064	0.007	230.948
MTBV_2YR	-0.076	0.661	0.000	0.781	0.000	0.859	0.141	0.016	1074.796
RETN_2YR	-0.137	0.492	0.537	0.797	0.000	0.760	0.240	0.007	3133.120
Liquidity/Size									
MVTRADE	0.038	0.576	0.040	0.809	0.000	0.926	0.074	0.007	303.761
Change in Liquidity / Change in Size									
MVTRADE_3M	-0.109	0.827	0.002	0.715	0.000	0.603	0.197	0.010	248.605
Change in Size / Change in Performance									
EPS_6M	-0.058	0.619	0.004	0.814	0.000	0.889	0.111	0.009	123.487
Mean	-0.067	0.608	0.053	0.751	0.000	0.856	0.144	0.013	411.872
Standard Deviation	0.058	0.052	0.111	0.059	0.000	0.066	0.066	0.004	575.712

Appendix E

E.1. Mean Monthly Payoff to Attributes in Each Calendar Month

The mean monthly payoff to standardised attributes for each calendar month is displayed. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Liquidity												
TV	0.015	-0.001	0.010	-0.004	0.005	-0.001	-0.001	-0.004	0.001	0.011	0.005	0.005
Momentum												
MOM_12M	0.003	0.013	0.015	-0.005	0.017	0.015	0.000	0.008	0.008	0.011	0.008	0.010
MOM_3M	0.007	0.011	0.014	0.002	0.021	0.012	-0.011	0.007	-0.001	0.012	0.005	0.010
Performance												
ACCRU	-0.004	0.002	0.000	-0.007	0.003	-0.003	-0.019	0.000	0.001	-0.004	-0.014	-0.003
CFTBORRREPDIV	-0.009	-0.004	-0.006	0.006	-0.006	0.004	-0.012	-0.001	0.001	-0.003	-0.010	0.000
Size												
LNP	-0.017	-0.005	0.000	-0.004	-0.004	0.004	-0.030	-0.008	-0.005	-0.008	-0.017	-0.006
Value												
BTMV	0.012	0.007	0.002	0.006	0.003	0.003	0.012	0.003	0.013	0.005	0.007	-0.004
CFTP	0.003	0.010	0.004	0.004	0.004	0.004	-0.003	0.006	0.010	-0.002	0.003	0.005
Change in Liquidity												
MVTRADEMV_1YR	0.008	0.003	0.006	0.005	-0.004	0.002	0.003	0.006	0.005	0.008	0.005	0.004
MVTRADEMV_2YR	0.006	0.000	0.002	0.000	0.001	-0.001	0.015	0.004	0.005	0.008	0.004	0.004
TV_6M	0.004	0.006	0.006	0.006	0.006	-0.001	0.008	0.001	0.002	0.002	0.001	-0.001
MVTRADEMV_1M	0.000	0.007	0.004	0.000	-0.001	-0.004	0.004	0.002	0.007	0.002	0.009	0.001
TV_2YR	0.004	0.001	-0.001	-0.005	0.000	-0.003	0.012	0.002	0.005	0.014	0.000	0.005
TV_3M	0.011	0.000	0.005	-0.002	0.002	-0.002	0.012	0.006	0.000	0.003	-0.002	-0.001

E.1. Mean Monthly Payoff to Attributes in Each Calendar Month

- continued

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Change in Performance												
DIV_2YR	0.003	0.001	-0.001	-0.008	-0.002	0.001	-0.006	-0.002	-0.005	-0.005	-0.009	0.000
DPS_6M	0.009	0.003	0.005	-0.001	0.002	0.005	0.001	0.006	0.002	-0.004	0.002	0.009
ROCE_6M	-0.005	-0.006	0.001	-0.004	-0.004	-0.003	-0.003	-0.001	-0.001	-0.003	-0.015	0.001
CFTBORRREPDIV_2YR	0.000	0.006	-0.002	0.004	0.001	0.008	-0.003	0.002	0.009	0.005	0.001	0.000
DPS_1YR	0.003	0.002	0.000	0.000	0.003	0.006	0.000	0.005	0.000	0.000	-0.003	0.003
Change in Size												
LNMV_1YR	0.001	0.003	0.004	0.003	0.014	0.014	-0.007	0.006	0.005	0.008	0.009	0.004
LNMV_2YR	0.001	0.008	0.008	-0.006	0.008	0.011	-0.004	0.004	0.001	0.004	0.003	0.001
Change in Value												
RETEN_1YR	-0.001	-0.003	-0.002	-0.002	-0.004	-0.003	0.000	-0.001	-0.004	-0.003	-0.002	-0.001
MTBV_2YR	-0.004	-0.003	0.006	-0.010	0.005	-0.002	-0.006	-0.002	-0.008	-0.006	-0.011	-0.005
RETEN_2YR	0.003	0.000	0.000	-0.001	-0.003	0.002	-0.004	-0.004	-0.001	-0.002	-0.004	-0.003
Liquidity/Size												
MVTRADE	-0.005	-0.002	0.001	0.003	-0.001	0.004	-0.007	-0.005	-0.004	0.000	-0.002	0.000
Change in Liquidity /												
Change in Size												
MVTRADE_3M	0.005	0.003	0.004	-0.001	0.006	0.003	0.007	0.008	-0.002	0.008	0.001	0.000
Change in Size / Change in												
Performance												
EPS_6M	0.000	0.006	-0.001	0.001	0.005	0.009	-0.006	0.004	-0.001	-0.003	0.004	0.002

E.2. Median Monthly Payoff to Attributes in Each Calendar Month

The median monthly payoff to standardised attributes for each calendar month is displayed. The monthly payoffs are derived from univariate cross-sectional regressions on unadjusted total monthly returns data over the period July 1994 to May 2004. The data were extracted from DataStream International Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Liquidity												
TV	0.006	0.000	0.005	-0.002	0.000	-0.003	0.003	-0.004	-0.002	0.012	0.002	0.002
Momentum												
MOM_12M	0.008	0.013	0.008	-0.001	0.011	0.018	0.002	0.007	0.005	0.011	-0.001	0.000
MOM_3M	0.003	0.012	0.006	0.001	0.013	0.014	-0.006	0.011	-0.007	0.010	0.000	0.008
Performance												
ACCRU	-0.002	0.003	0.003	-0.002	0.005	0.002	-0.012	0.002	-0.001	-0.002	-0.006	-0.002
CFTBORRREPDIV	-0.001	0.001	0.002	0.003	-0.002	0.000	-0.010	0.002	-0.001	-0.001	-0.006	0.002
Size												
LNP	-0.012	-0.005	0.005	-0.007	-0.010	0.003	-0.028	-0.008	-0.003	-0.005	-0.011	-0.002
Value												
BTMV	0.005	0.008	0.004	0.008	0.004	0.000	0.007	0.002	0.013	0.000	0.005	0.000
CFTP	0.003	0.006	0.005	0.006	0.005	0.005	-0.003	0.005	0.009	-0.007	-0.002	0.005
Change in Liquidity												
MVTRADEMV_1YR	0.004	0.006	0.004	0.006	-0.003	0.001	0.004	0.010	0.001	0.007	0.004	0.004
MVTRADEMV_2YR	0.005	-0.001	0.001	-0.001	0.003	0.001	0.010	0.002	0.005	0.009	0.000	0.001
TV_6M	0.003	0.008	0.002	0.000	0.004	-0.001	0.006	0.003	0.003	0.002	0.000	0.000
MVTRADEMV_1M	0.001	0.006	0.002	-0.002	-0.001	-0.005	0.004	0.002	0.004	0.004	0.006	0.001
TV_2YR	0.003	0.003	0.000	-0.003	0.000	-0.002	0.007	0.002	0.005	0.010	-0.001	0.004
TV_3M	0.007	0.000	-0.003	-0.004	0.005	-0.001	0.007	0.006	0.000	0.003	-0.002	0.000

E.2. Median Monthly Payoff to Attributes in Each Calendar Month

- continued

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Change in Performance												
DIV_2YR	-0.003	-0.002	-0.004	-0.009	0.000	-0.001	-0.003	-0.002	-0.004	-0.004	-0.008	-0.001
DPS_6M	0.004	0.003	0.003	0.000	0.003	0.003	0.003	0.004	0.005	-0.003	-0.004	0.005
ROCE_6M	-0.005	-0.004	-0.003	-0.006	-0.004	-0.002	-0.003	-0.001	0.000	-0.003	-0.007	0.002
CFTBORRREPDIV_2YR	-0.002	0.004	0.001	0.003	0.000	0.003	-0.001	0.006	0.003	0.005	0.000	0.001
DPS_1YR	0.005	0.005	-0.001	0.000	0.004	0.005	-0.003	0.010	0.001	-0.002	-0.003	0.002
Change in Size												
LNMV_1YR	0.002	0.002	0.008	-0.001	0.012	0.015	0.006	0.005	0.007	0.004	-0.001	0.004
LNMV_2YR	0.003	0.005	0.001	0.001	0.008	0.008	-0.002	0.004	0.002	0.003	0.001	0.000
Change in Value												
RETEN_1YR	-0.002	-0.003	-0.002	-0.002	-0.005	0.000	0.000	-0.003	-0.002	-0.002	0.000	-0.002
MTBV_2YR	-0.005	-0.006	-0.001	-0.006	-0.004	0.001	-0.009	0.000	-0.006	-0.008	-0.005	-0.004
RETEN_2YR	0.002	0.001	0.000	-0.001	0.000	0.001	-0.003	-0.004	0.000	0.001	-0.002	-0.001
Liquidity/Size												
MVTRADE	-0.006	-0.002	0.003	0.003	-0.001	0.002	-0.002	-0.006	-0.005	-0.001	-0.002	-0.001
Change in Liquidity /												
Change in Size												
MVTRADE_3M	0.004	0.003	0.001	-0.002	0.008	0.004	0.003	0.006	-0.002	0.006	0.003	-0.002
Change in Size / Change in												
Performance												
EPS_6M	0.000	0.008	-0.001	0.000	0.005	0.003	-0.007	0.006	0.002	-0.004	0.002	0.001

E.3. Results of Univariate Cross-sectional Regressions after Excluding Seasonal Months

Univariate cross-sectional regressions of standardised firm-specific attributes on unadjusted total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of regression slope coefficients for each characteristic. The share sample comprises ASX All Ordinary Index constituents as at 31 May 2004, and has been filtered for thin trading, excludes preference shares and shares with insufficient returns data, and has been adjusted for outliers. The data were extracted from DataStream International. The table displays the average monthly coefficient for each attribute with the related Student's (1908) t-statistic before and after certain months (historically found to exhibit seasonality in share returns) are individually and jointly excluded. Attributes significant at the 5% level are displayed in bold. The sample size changes through the exclusion of data thus the t-value indicating significance at the 5% level changes. However, the differences in the t-distributions are very small given the high number of observations in all the tests. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

	t-statistics															
	Original	Excl. Jan	Excl. Dec	Excl. Jul	Excl. Aug	Excl. Jan	Excl. Dec	Excl. Jul	Excl. Aug	Excl. Jan	Excl. Dec	Excl. Jul	Excl. Aug			
Liquidity																
TV	2.38	1.72	2.15	2.55	2.64	1.45	1.90	2.31	2.32	2.41	2.84	1.62	1.74	2.21	2.61	1.93
Momentum																
MOM_12M	5.05	5.04	4.86	5.33	4.67	4.85	5.34	5.17	5.17	4.45	4.93	5.19	4.43	4.93	4.74	4.74
MOM_3M	4.18	3.97	3.84	5.05	3.99	3.61	4.86	4.93	4.72	3.63	4.89	4.51	3.39	4.70	4.55	4.34
Performance																
ACCRU	-2.59	-2.46	-2.47	-1.86	-2.61	-2.34	-1.70	-1.80	-1.73	-2.50	-1.89	-1.55	-2.37	-1.72	-1.74	-1.57
CFTBORRREPDI	-1.99	-1.68	-2.03	-1.50	-1.98	-1.72	-1.13	-1.15	-1.53	-2.01	-1.48	-1.15	-1.70	-1.10	-1.51	-1.13
Size																
LNP	-5.48	-4.70	-5.33	-4.69	-5.14	-4.52	-3.79	-3.50	-4.51	-4.98	-4.29	-3.56	-4.14	-3.34	-4.09	-3.09
Value																
BTMV	3.80	3.28	4.52	3.33	3.74	3.99	2.78	2.82	4.04	4.50	3.25	3.47	3.95	2.68	4.00	3.41
CFTP	2.87	2.84	2.63	3.14	2.57	2.59	3.13	2.96	2.90	2.32	2.84	2.88	2.27	2.82	2.59	2.56

E.3. Results of Univariate Cross-sectional Regressions after Excluding Seasonal Months

- continued

	t-statistics																							
	Original		Excl. Jan		Excl. Dec		Excl. Jan		Excl. Dec		Excl. Jan		Excl. Dec		Excl. Jan		Excl. Dec		Excl. Jan		Excl. Dec		Excl. Jan	
	Jan	Dec	Jan	Dec	Jan	Dec	Jan	Dec	Jan	Dec	Jan	Dec	Jan	Dec	Jan	Dec	Jan	Dec	Jan	Dec	Jan	Dec	Jan	Dec
Change in Liquidity																								
MVTRADEMV_1YR	4.40	4.39	4.59	4.09	4.22	4.47	4.09	4.42	3.89	4.09	4.30	3.65	3.90	3.89	4.09	4.30	3.65	3.90	3.89	4.09	4.30	3.65	3.90	3.89
MVTRADEMV_2YR	4.12	3.64	3.93	3.37	3.88	3.43	2.82	3.15	3.68	3.09	2.55	3.17	2.51	2.84	3.09	2.55	3.17	2.51	2.84	3.09	2.55	3.17	2.51	2.84
TV_6M	3.74	3.41	3.90	3.25	3.80	3.56	2.89	3.40	3.98	3.30	3.04	3.63	2.93	3.47	3.30	3.04	3.63	2.93	3.47	3.30	3.04	3.63	2.93	3.47
MVTRADEMV_1M	3.05	3.34	2.98	2.83	2.88	3.27	3.13	2.75	2.81	2.65	3.05	3.09	2.94	2.57	2.65	3.05	3.09	2.94	2.57	2.65	3.05	3.09	2.94	2.57
TV_2YR	2.82	2.53	2.42	2.13	2.73	2.11	1.80	1.77	1.68	2.02	1.34	2.01	1.69	1.56	2.02	1.34	2.01	1.69	1.56	2.02	1.34	2.01	1.69	1.56
TV_3M	2.56	1.81	2.68	1.90	2.13	1.92	1.02	2.02	2.25	1.40	1.14	1.45	0.45	1.53	1.40	1.14	1.45	0.45	1.53	1.40	1.14	1.45	0.45	1.53
Change in Performance																								
DIV_2YR	-2.90	-3.49	-3.05	-2.53	-2.76	-3.71	-3.12	-2.68	-2.91	-2.39	-3.32	-3.57	-2.96	-2.53	-2.39	-3.32	-3.57	-2.96	-2.53	-2.39	-3.32	-3.57	-2.96	-2.53
DPS_6M	2.66	2.33	2.31	2.67	2.32	1.93	2.34	2.32	1.93	2.32	1.94	1.46	1.94	1.93	2.32	1.94	1.46	1.94	1.93	2.32	1.94	1.46	1.94	1.93
ROCE_6M	-2.56	-2.35	-2.65	-2.41	-2.52	-2.44	-2.19	-2.25	-2.61	-2.37	-2.28	-2.40	-2.15	-2.46	-2.37	-2.28	-2.40	-2.15	-2.46	-2.37	-2.28	-2.40	-2.15	-2.46
CFTBORRREPDIV_2YR	2.42	2.47	2.41	2.71	2.33	2.46	2.78	2.83	2.70	2.31	2.63	2.77	2.70	2.62	2.31	2.63	2.77	2.70	2.62	2.31	2.63	2.77	2.70	2.62
DPS_1YR	2.13	1.89	1.91	2.24	1.63	1.66	2.00	1.53	2.02	1.38	1.73	1.76	1.10	1.48	1.73	1.76	1.10	1.46	1.48	1.73	1.76	1.10	1.46	1.48
Change in Size																								
LNMV_1YR	3.04	3.13	2.99	3.67	2.79	3.09	3.83	3.73	3.67	2.73	3.41	3.85	2.82	3.39	3.41	3.85	2.82	3.55	3.39	3.41	3.85	2.82	3.55	
LNMV_2YR	2.22	2.19	2.24	2.53	2.04	2.21	2.50	2.43	2.56	2.06	2.35	2.53	2.02	2.38	2.35	2.53	2.02	2.31	2.38	2.35	2.53	2.02	2.31	
Change in Value																								
RETEN_1YR	-3.46	-3.56	-3.51	-3.65	-3.45	-3.63	-3.80	-4.05	-3.73	-3.52	-3.68	-3.91	-3.67	-3.78	-3.52	-3.68	-3.91	-3.67	-3.78	-3.52	-3.68	-3.91	-3.67	
MTBV_2YR	-2.56	-2.35	-2.33	-2.34	-2.46	-2.12	-2.12	-2.10	-2.23	-2.24	-1.88	-2.01	-2.02	-1.77	-2.24	-1.88	-2.01	-2.02	-2.00	-2.24	-1.88	-2.01	-2.02	
RETEN_2YR	-2.07	-2.59	-1.75	-1.71	-1.60	-2.28	-2.26	-1.82	-1.36	-1.26	-1.91	-1.78	-1.74	-0.82	-1.26	-1.91	-1.78	-1.74	-0.82	-1.26	-1.91	-1.78	-1.74	
Liquidity/Size																								
MVTRADE	-2.21	-1.59	-2.19	-1.51	-1.61	-1.56	-0.81	-0.05	-1.47	-1.58	-0.82	-0.76	-0.90	-0.77	-1.58	-0.82	-0.76	-0.90	-0.77	-1.58	-0.82	-0.76	-0.90	
Change in Liquidity / Change in Size																								
MVTRADE_3M	3.56	3.21	3.73	3.25	3.01	3.37	2.87	2.34	3.43	3.17	2.65	3.04	2.78	2.82	3.17	2.65	3.04	2.78	2.82	3.17	2.65	3.04	2.78	
Change in Size / Change in Performance																								
EPS_6M	2.00	2.10	1.80	2.64	1.67	1.89	2.77	2.56	2.44	1.47	2.32	2.56	1.55	2.44	2.32	2.56	1.55	2.44	2.11	2.32	2.56	1.55	2.44	

E.4. Correlations between the Means and Variances of Payoffs in Calendar Months

Univariate cross-sectional regressions of standardised firm-specific attributes on unadjusted total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of regression slope coefficients for each characteristic. The data were extracted from DataStream International. The payoffs to attributes are divided into calendar months, and the mean and variance of the payoffs for each calendar month is calculated. The Pearson (1896) correlation coefficients between the means and variances of the calendar months are calculated for each attribute. The attributes are displayed in descending order of absolute correlation, and correlation coefficients above 0.7 and below -0.7 are displayed in bold. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Characteristic	Correlation
LNP	-0.850
ACCRU	-0.754
TV_2YR	0.727
DPS_6M	0.712
MVTRADEM_2YR	0.653
CFTBORRREPDIV	-0.645
TV	0.592
TV_6M	0.570
BTMV	-0.476
TV_3M	0.460
ROCE_6M	-0.449
MTBV_2YR	0.444
RETEN_2YR	-0.418
CFTBORRREPDIV_2YR	0.402
DIV_2YR	0.387
EPS_6M	0.385
MVTRADEM_1M	0.363
CFTP	-0.356
RETEN_1YR	0.328
DPS_1YR	-0.313
MVTRADE_3M	0.307
LNMV_1YR	-0.295
MOM_12M	-0.289
MVTRADEM_1YR	0.188
MOM_3M	-0.172
MVTRADE	-0.159
LNMV_2YR	-0.055

Appendix F

F.1. Results of Multivariate Cross-Sectional Regressions: Tests of Average Slopes

Multivariate cross-sectional regressions of univariately significant standardised firm-specific attributes on unadjusted total monthly returns data over the period July 1994 to May 2004 are performed and give rise to a time-series of controlled slope coefficients for each characteristic. The sets of multivariate regressions start with the most univariately significant characteristic, and thereafter characteristics are included in the regressions one at a time (in order of univariate significance) until the least significant variable displays an insignificant mean (using Student's (1908) t-test at the 5% level) of the time-series of controlled slopes. The variable is then removed (displayed with a grey background) and the regression repeated (indicated by "repeat"). Some repeats are not necessary as they have been tested earlier in the procedure. The process of incorporating more variables in the regressions continues until all variables have been tested. The average controlled slope and related t-statistic of each explanatory variable is shown for each set of multivariate regressions. Significant t-statistics are displayed in bold. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Regression Number	Characteristic	Average slope	t-statistic
1	LNP	-0.008	-5.481
2	LNP	-0.008	-5.572
	MOM_12M	0.009	5.516
3	LNP	-0.007	-4.671
	MOM_12M	0.009	5.435
	MVTRADEM_1YR	0.003	3.525
4	LNP	-0.007	-4.829
	MOM_12M	0.008	5.033
	MVTRADEM_1YR	0.003	3.331
	MOM_3M	0.001	0.487
5	LNP	-0.007	-4.255
	MOM_12M	0.011	4.978
	MVTRADEM_1YR	-0.001	-0.259
	MVTRADEM_2YR	0.004	1.243
6	LNP	-0.006	-3.382
	MOM_12M	0.012	5.911
	MVTRADEM_2YR	0.002	0.919
	BTMV	0.012	3.897
7	LNP	-0.005	-3.038
	MOM_12M	0.011	5.484
	BTMV	0.009	3.338
	TV_6M	0.002	2.624
8	LNP	-0.005	-3.010
	MOM_12M	0.011	5.402
	BTMV	0.008	2.751
	TV_6M	0.003	2.485
	MVTRADE_3M	-0.002	-0.488
9	LNP	-0.005	-2.864
	MOM_12M	0.011	5.505
	BTMV	0.009	3.297
	TV_6M	0.003	2.853
	RETEN_1YR	-0.001	-2.230

F.1. Results of Multivariate Cross-Sectional Regressions

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Regression Number	Characteristic	Average slope	t-statistic
10	LNP	-0.005	-2.815
	MOM_12M	0.011	5.524
	BTMV	0.009	3.156
	TV_6M	0.004	2.209
	RETEN_1YR	-0.001	-2.061
	MVTRADEM_1M	0.001	0.391
11	LNP	-0.004	-2.635
	MOM_12M	0.010	3.624
	BTMV	0.009	3.180
	TV_6M	0.002	1.973
	RETEN_1YR	-0.001	-2.123
	LNMV_1YR	0.003	0.875
12	LNP	-0.002	-1.168
	MOM_12M	0.025	4.573
	BTMV	0.018	3.450
	TV_6M	0.001	0.648
	RETEN_1YR	0.000	-0.562
	DIV_2YR	-0.002	-1.738
13 (repeat)	LNP	-0.002	-1.175
	MOM_12M	0.026	4.547
	BTMV	0.019	3.556
	TV_6M	0.001	0.822
	DIV_2YR	-0.003	-2.804
14 (repeat)	LNP	-0.002	-1.181
	MOM_12M	0.025	4.494
	BTMV	0.019	3.587
	DIV_2YR	-0.003	-2.821
15	MOM_12M	0.024	4.407
	BTMV	0.018	3.583
	DIV_2YR	-0.003	-2.841
	CFTP	0.006	3.538
16	MOM_12M	0.024	4.358
	BTMV	0.017	3.309
	DIV_2YR	-0.003	-2.346
	CFTP	0.006	3.574
	TV_2YR	0.001	1.356
17	MOM_12M	0.026	4.719
	BTMV	0.016	3.335
	DIV_2YR	-0.003	-3.280
	CFTP	0.022	3.783
	DPS_6M	0.002	1.171
18	MOM_12M	0.026	4.876
	BTMV	0.015	2.820
	DIV_2YR	-0.002	-1.343
	CFTP	0.023	2.973
	ACCRU	-0.002	-1.218
19	MOM_12M	0.024	4.376
	BTMV	0.017	3.543
	DIV_2YR	-0.003	-2.648
	CFTP	0.006	3.709
	TV_3M	0.002	1.300
20	MOM_12M	0.023	4.205
	BTMV	0.012	3.124
	DIV_2YR	-0.003	-2.415
	CFTP	0.005	3.018
	MTBV_2YR	-0.007	-2.452

F.1. Results of Multivariate Cross-Sectional Regressions

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Regression Number	Characteristic	Average slope	t-statistic
21	MOM_12M	0.024	4.445
	BTMV	0.013	3.263
	DIV_2YR	-0.003	-2.274
	CFTP	0.005	2.866
	MTBV_2YR	-0.007	-2.206
	ROCE_6M	0.000	-0.073
22	MOM_12M	0.022	4.076
	BTMV	0.011	2.746
	DIV_2YR	-0.003	-1.780
	CFTP	0.015	3.808
	MTBV_2YR	-0.007	-2.581
	CFTBORRREPDIV_2YR	0.256	1.072
23	MOM_12M	0.024	4.464
	BTMV	0.012	3.146
	DIV_2YR	-0.004	-2.405
	CFTP	0.005	3.260
	MTBV_2YR	-0.007	-2.565
	TV	0.002	0.660
24	MOM_12M	0.027	4.545
	BTMV	0.012	3.022
	DIV_2YR	-0.003	-2.397
	CFTP	0.005	2.914
	MTBV_2YR	-0.006	-1.429
	LNMV_2YR	0.005	0.766
25	MOM_12M	0.023	4.218
	BTMV	0.013	3.164
	DIV_2YR	-0.003	-2.368
	CFTP	0.005	3.055
	MTBV_2YR	-0.007	-2.390
	MVTRADE	0.000	-0.042
26	MOM_12M	0.025	4.475
	BTMV	0.010	2.570
	DIV_2YR	-0.003	-1.609
	CFTP	0.014	3.663
	MTBV_2YR	-0.009	-2.866
	DPS_1YR	0.000	-0.307
27	MOM_12M	0.023	4.000
	BTMV	0.012	3.070
	DIV_2YR	-0.004	-1.680
	CFTP	0.005	3.139
	MTBV_2YR	-0.007	-2.450
	RETEN_2YR	-0.001	-0.615
28	MOM_12M	0.024	4.078
	BTMV	0.012	3.041
	DIV_2YR	0.052	1.914
	CFTP	0.020	3.729
	MTBV_2YR	-0.007	-2.204
	EPS_6M	0.003	1.560
29	MOM_12M	0.022	4.096
	BTMV	0.012	2.893
	DIV_2YR	-0.004	-2.404
	CFTP	0.015	3.683
	MTBV_2YR	-0.006	-2.388
	CFTBORRREPDIV	0.054	1.363

F.2. Expected Return Model Created from a 1-Month Moving Average Timing Model

The Haugen and Baker (1996) forecasting methodology is applied in a stepwise procedure to derive expected return models using nonstandardised attributes. The procedure starts by applying the Haugen and Baker (1996) methodology using one explanatory variable. A one-month trailing moving average model is used to predict the slopes of the variables. The forecasting ability of the variable is tested using the Information Coefficient (IC) of Grinold (1989), and the variable that displays the highest IC is taken to the next step where the above procedure is repeated using two variables, the first being that from the first step. The second attribute to remain in the model is that which combines with the first attribute to produce the highest IC. The stepwise procedure continues until the multifactor expected return model derived at a stage displays an IC lower than that of the previous stage's model. The Information Ratio (IR) calculated is that of Qian and Hua (2004) and is the mean monthly IC divided by the standard deviation of the IC over the months. The mean IC and IR statistic of the multifactor models tested at each step in the procedure are displayed. The statistics refer to the multifactor model consisting of the variables that remained in the expected return model from previous steps and the variable next to which the statistic is displayed. Variables that remain in the model are displayed in white on a black background, and the mean IC and IR of the model with that variable's addition are similarly displayed. In the last step of the procedure, the variable that combines with those that remained in the model from previous steps to give the highest mean IC is displayed in bold on a grey background, as this model is inferior that created at the previous step. The variables are listed in descending order of the univariately calculated mean IC statistic (in other words, the mean IC statistic calculated at the first step in the stepwise procedure). The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Attributes	1 Variable		2 Variables		3 Variables		4 Variables		5 Variables	
	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR
MOM_12M	0.041	0.247								
MOM_6M	0.037	0.226	0.037	0.239	0.057	0.344	0.096	0.560	0.102	0.595
LNMV	0.036	0.256	0.056	0.345	0.076	0.464	0.099	0.574	0.103	0.599
BVPS	0.036	0.364	0.053	0.316	0.084	0.523	0.102	0.615	0.108	0.635
RETEN	0.034	0.214	0.055	0.311	0.096	0.570	0.113	0.659		
MOM_18M	0.033	0.238	0.054	0.358	0.080	0.519	0.102	0.626	0.109	0.649
DPS	0.031	0.349	0.047	0.308	0.076	0.484	0.106	0.646	0.111	0.671
P_1YR	0.031	0.181	0.053	0.349	0.077	0.463	0.100	0.597	0.099	0.592
MVTRADE_1YR	0.029	0.261	0.041	0.275	0.069	0.463	0.090	0.560	0.096	0.606
DIV_2YR	0.029	0.210	0.053	0.300	0.056	0.317	0.075	0.399	0.070	0.380
P_6M	0.028	0.169	0.033	0.209	0.056	0.328	0.091	0.513	0.098	0.554
SALEPEMPLOY_1YR	0.028	0.145	0.043	0.180	0.028	0.122	0.064	0.304	0.063	0.297
P_3M	0.027	0.164	0.033	0.200	0.068	0.406	0.096	0.532	0.104	0.579
LNP	0.027	0.197	0.056	0.356	0.075	0.496	0.103	0.616	0.108	0.650
DPS_6M	0.026	0.196	0.078	0.483	0.054	0.327	0.079	0.449	0.085	0.487
OBOS_6MMA	0.025	0.141	0.035	0.192	0.055	0.319	0.089	0.482	0.097	0.528
DY_6M	0.023	0.160	0.081	0.489						
NS	0.023	0.302	0.057	0.322	0.081	0.494	0.100	0.586	0.105	0.608
ECANDRES	0.023	0.299	0.058	0.332	0.083	0.502	0.102	0.600	0.107	0.618
LNMV_1YR	0.022	0.140	0.039	0.245	0.077	0.448	0.101	0.585	0.109	0.628
MOM_3M	0.022	0.127	0.028	0.168	0.068	0.406	0.096	0.537	0.105	0.584
ECANDRES_1YR	0.022	0.183	0.053	0.282	0.069	0.448	0.089	0.558	0.089	0.564
P	0.022	0.234	0.043	0.299	0.068	0.442	0.096	0.582	0.102	0.617
ROCE_1YR	0.021	0.134	0.035	0.197	0.048	0.280	0.075	0.410	0.073	0.399
LNMV_2YR	0.021	0.157	0.037	0.238	0.082	0.474	0.100	0.552	0.103	0.575
P_2YR	0.021	0.154	0.035	0.233	0.082	0.514	0.096	0.547	0.101	0.590
DIV	0.021	0.304	0.054	0.297	0.080	0.486	0.101	0.586	0.106	0.612
MOM_24M	0.021	0.159	0.039	0.270	0.083	0.509	0.094	0.534	0.101	0.583
CFTP	0.020	0.156	0.049	0.285	0.108	0.633				
DY_1YR	0.019	0.172	0.057	0.397	0.059	0.399	0.088	0.557	0.092	0.579
MVTRADE_2YR	0.019	0.154	0.027	0.179	0.070	0.438	0.083	0.497	0.095	0.589
EPS_2YRAV	0.019	0.213	0.042	0.286	0.079	0.525	0.104	0.631	0.110	0.665
MTBV	0.018	0.149	0.049	0.287	0.081	0.503	0.098	0.590	0.104	0.623
ACCRU	0.018	0.124	0.057	0.280	0.064	0.380	0.089	0.501	0.091	0.512
ACCREC_1YR_CH	0.018	0.110	0.059	0.308	0.061	0.356	0.090	0.511	0.092	0.546
EPS	0.018	0.205	0.044	0.287	0.077	0.502	0.106	0.647	0.112	0.674
MVTRADEMV_2YR	0.017	0.177	0.032	0.214	0.073	0.460	0.087	0.519	0.096	0.580
P_1M	0.017	0.109	0.041	0.245	0.075	0.457	0.098	0.571	0.103	0.582
LNMV_6M	0.016	0.108	0.027	0.161	0.058	0.343	0.086	0.477	0.093	0.512
MTBV_2YR	0.015	0.094	0.058	0.304	0.060	0.336	0.074	0.402	0.075	0.415
ICBT_2YR	0.015	0.104	0.042	0.235	0.050	0.274	0.071	0.394	0.072	0.407
BTMV	0.015	0.099	0.054	0.303	0.096	0.584	0.105	0.609	0.112	0.656

F.2. Expected Return Model Created from a 1-Month Moving Average Timing Model

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Attributes	1 Variable		2 Variables		3 Variables		4 Variables		5 Variables	
	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR
CEPS	0.014	0.146	0.048	0.279	0.082	0.503	0.101	0.608	0.107	0.640
CHSALE_LES_CHACRE	0.013	0.120	0.048	0.314	0.058	0.324	0.086	0.470	0.086	0.488
CFTBORRREPDIV	0.013	0.073	0.047	0.248	0.069	0.424	0.087	0.520	0.094	0.550
DIV_6M	0.012	0.131	0.076	0.471	0.074	0.448	0.080	0.486	0.079	0.483
TV_1YR	0.012	0.096	0.045	0.249	0.067	0.415	0.083	0.498	0.086	0.514
LNMV_3M	0.012	0.069	0.034	0.202	0.079	0.452	0.104	0.540	0.108	0.559
CEPS_6M	0.011	0.137	0.050	0.299	0.077	0.451	0.099	0.571	0.098	0.562
MVTRADEMV	0.011	0.085	0.028	0.172	0.065	0.393	0.094	0.560	0.099	0.587
TLTTA	0.010	0.105	0.046	0.264	0.080	0.480	0.098	0.592	0.106	0.632
MVTRADE_3M	0.009	0.100	0.035	0.231	0.076	0.491	0.097	0.601	0.101	0.621
OBOS_3MMA	0.009	0.053	0.034	0.204	0.063	0.358	0.093	0.513	0.101	0.545
INTANMV_1YR	0.008	0.070	0.047	0.263	0.041	0.230	0.066	0.380	0.068	0.390
SALEPEMPLOY_2YR	0.008	0.044	0.030	0.123	0.008	0.033	0.038	0.163	0.040	0.175
MVTRADEMV_1M	0.008	0.097	0.032	0.217	0.074	0.491	0.103	0.650	0.107	0.664
A_TURN	0.008	0.095	0.051	0.288	0.083	0.506	0.101	0.599	0.106	0.622
MVTRADE	0.007	0.116	0.041	0.263	0.066	0.420	0.096	0.570	0.101	0.595
RETEN_1YR	0.007	0.105	0.046	0.277	0.072	0.487	0.094	0.610	0.086	0.567
GROW_2YR	0.007	0.054	0.008	0.045	0.033	0.177	0.059	0.324	0.058	0.325
CFTBORRREP_6M	0.007	0.058	0.055	0.308	0.073	0.408	0.095	0.525	0.090	0.518
MTBV_6M	0.007	0.040	0.049	0.273	0.076	0.453	0.095	0.533	0.102	0.570
MVTRADEMV_1YR	0.006	0.061	0.031	0.211	0.077	0.489	0.098	0.585	0.105	0.618
ROCE_6M	0.006	0.041	0.052	0.262	0.055	0.308	0.073	0.421	0.071	0.413
CROSS3_MOM12M	0.006	0.093	0.044	0.301	0.061	0.391	0.090	0.558	0.091	0.560
MVTRADEMV_3M	0.006	0.077	0.031	0.204	0.072	0.470	0.098	0.605	0.103	0.632
EPSCH_P_6M	0.006	0.057	0.032	0.204	0.065	0.425	0.102	0.595	0.106	0.615
INTANMV_6M	0.006	0.044	0.044	0.247	0.072	0.372	0.092	0.496	0.088	0.472
DPS_1YR	0.005	0.053	0.053	0.401	0.057	0.414	0.082	0.539	0.084	0.547
LNP_2YR	0.005	0.049	0.031	0.220	0.081	0.533	0.099	0.614	0.106	0.652
MVTRADE_6M	0.004	0.038	0.029	0.190	0.070	0.454	0.100	0.620	0.101	0.620
SALESTP_2YR	0.004	0.028	0.035	0.196	0.040	0.197	0.067	0.342	0.067	0.353
MVTRADE_1M	0.004	0.047	0.031	0.207	0.074	0.493	0.101	0.639	0.104	0.650
TV	0.004	0.029	0.039	0.207	0.066	0.375	0.090	0.512	0.096	0.544
NPMTTP	0.004	0.020	0.032	0.165	0.072	0.432	0.087	0.527	0.094	0.576
CFTBORRREPDIV_1YR	0.004	0.024	0.042	0.238	0.060	0.374	0.078	0.466	0.082	0.495
CF_1YR	0.003	0.021	0.042	0.245	0.062	0.401	0.081	0.505	0.082	0.502
CFTTL_6M	0.002	0.016	0.046	0.290	0.047	0.292	0.060	0.350	0.057	0.327
WC_1YR	0.002	0.017	0.057	0.324	0.053	0.310	0.079	0.451	0.080	0.473
RETEN_2YR	0.001	0.019	0.044	0.240	0.050	0.297	0.074	0.426	0.072	0.408
TV_2YR	0.000	0.003	0.032	0.210	0.026	0.166	0.055	0.335	0.056	0.347
CROSS1_MOM3M	0.000	0.004	0.035	0.236	0.077	0.509	0.101	0.631	0.106	0.658
CFTBORRREPDIV_6M	0.000	0.002	0.050	0.287	0.072	0.438	0.094	0.537	0.100	0.567
EPS_6M	0.000	0.000	0.028	0.168	0.059	0.375	0.087	0.521	0.089	0.551
BORROW	-0.001	-0.011	0.037	0.203	0.086	0.486	0.101	0.562	0.106	0.580
TV_1M	-0.002	-0.017	0.035	0.214	0.077	0.490	0.098	0.615	0.106	0.649
ECANDRES_2YR	-0.002	-0.018	0.015	0.091	0.050	0.296	0.072	0.416	0.071	0.421
ICBT	-0.003	-0.030	0.054	0.313	0.085	0.513	0.101	0.599	0.107	0.615
OPMTTP	-0.003	-0.022	0.041	0.226	0.065	0.386	0.084	0.497	0.091	0.538
MVTRADEMV_6M	-0.004	-0.044	0.033	0.222	0.075	0.500	0.100	0.613	0.104	0.639
BORROW_1YR	-0.005	-0.047	0.030	0.190	0.048	0.309	0.070	0.424	0.075	0.450
SALESTP	-0.007	-0.050	0.043	0.235	0.073	0.427	0.087	0.510	0.095	0.565
WC	-0.007	-0.053	0.055	0.281	0.081	0.447	0.110	0.640	0.112	0.658
EPSCH_P_12M	-0.007	-0.072	0.032	0.222	0.073	0.489	0.097	0.577	0.105	0.621
BTMV_2YR	-0.007	-0.046	0.042	0.256	0.063	0.346	0.078	0.446	0.082	0.468
TV_3M	-0.008	-0.080	0.040	0.246	0.073	0.456	0.093	0.567	0.098	0.599
CFTBORRREPDIV_2YR	-0.009	-0.075	0.004	0.024	0.054	0.300	0.076	0.444	0.074	0.440
CROSS6_MOM12M	-0.011	-0.187	0.040	0.277	0.080	0.548	0.099	0.617	0.103	0.630
GEAR_6M	-0.013	-0.140	0.039	0.215	0.064	0.386	0.084	0.482	0.087	0.496
FOUR_YREARNGROWA	-0.014	-0.118	0.023	0.127	0.010	0.057	0.021	0.113	0.020	0.100
TV_6M	-0.014	-0.133	0.038	0.229	0.068	0.398	0.092	0.544	0.093	0.558
QUICK	-0.015	-0.120	0.054	0.278	0.078	0.429	0.103	0.598	0.106	0.620
CF_6M	-0.017	-0.129	0.028	0.169	0.073	0.440	0.091	0.514	0.095	0.542
ACCRES_6M_CH	-0.020	-0.153	0.042	0.222	0.073	0.425	0.103	0.598	0.105	0.621
SALESTP_6M	-0.022	-0.143	0.022	0.132	0.046	0.253	0.066	0.363	0.068	0.380

F.3. Expected Return Model Created from a 6-Month Moving Average Timing Model

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Attributes	1 Variables		2 Variables		3 Variables		4 Variables		5 Variables		6 Variables		7 Variables		8 Variables		9 Variables		10 Variables		11 Variables		12 Variables		13 Variables		14 Variables	
	MEAN	IR	MEAN	IR	MEAN	IR	MEAN	IR	MEAN	IR	MEAN	IR	MEAN	IR	MEAN	IR	MEAN	IR	MEAN	IR	MEAN	IR	MEAN	IR	MEAN	IR	MEAN	IR
AVTRADEMV_3M	0.016	0.214	0.046	0.362	0.087	0.428	0.100	0.478	0.111	0.509	0.122	0.569	0.129	0.712	0.125	0.708	0.133	0.736	0.138	0.766	0.140	0.786	0.140	0.787	0.142	0.805	0.140	0.799
AVTRADEW	0.018	0.120	0.050	0.306	0.075	0.460	0.101	0.495	0.110	0.550	0.126	0.616	0.133	0.724	0.138	0.772	0.141	0.784	0.141	0.788	0.141	0.788	0.140	0.786	0.142	0.805	0.140	0.799
AVTRADE_6M	0.015	0.131	0.037	0.251	0.066	0.360	0.100	0.481	0.110	0.549	0.126	0.616	0.133	0.724	0.138	0.772	0.141	0.784	0.141	0.788	0.141	0.788	0.140	0.786	0.142	0.805	0.140	0.799
AVTRADE_3M	0.015	0.167	0.042	0.328	0.063	0.386	0.100	0.487	0.112	0.562	0.124	0.683	0.136	0.732	0.126	0.720	0.130	0.740	0.137	0.775	0.140	0.805	0.143	0.821	0.144	0.832	0.144	0.824
AVTRADE_1M	0.015	0.176	0.036	0.280	0.071	0.442	0.102	0.494	0.113	0.562	0.129	0.703	0.136	0.766	0.135	0.766	0.135	0.766	0.135	0.766	0.133	0.749	0.133	0.762	0.133	0.762	0.133	0.759
ECANDRES_7YR	0.014	0.185	0.041	0.365	0.072	0.494	0.102	0.494	0.113	0.562	0.129	0.703	0.136	0.766	0.135	0.766	0.135	0.766	0.135	0.766	0.133	0.749	0.133	0.762	0.133	0.762	0.133	0.759
ECANDRES_3YR	0.014	0.119	0.041	0.365	0.072	0.494	0.102	0.494	0.113	0.562	0.129	0.703	0.136	0.766	0.135	0.766	0.135	0.766	0.135	0.766	0.133	0.749	0.133	0.762	0.133	0.762	0.133	0.759
SALESTRP_2YR	0.014	0.081	0.058	0.317	0.085	0.311	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326
CFTBORREPDI	0.014	0.081	0.058	0.317	0.085	0.311	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326
EPSCHEP_6M	0.014	0.081	0.058	0.317	0.085	0.311	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326	0.111	0.326
GETP	0.013	0.111	0.064	0.389	0.082	0.457	0.120	0.535	0.129	0.598	0.124	0.671	0.129	0.709	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712
RETEN	0.012	0.072	0.054	0.341	0.082	0.457	0.120	0.535	0.129	0.598	0.124	0.671	0.129	0.709	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712
EPSCHEP_12M	0.012	0.119	0.062	0.435	0.087	0.518	0.120	0.535	0.129	0.598	0.124	0.671	0.129	0.709	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712
AVTRADE_2YR	0.012	0.115	0.048	0.312	0.065	0.435	0.087	0.518	0.120	0.535	0.129	0.598	0.129	0.709	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712
DPS_1YR	0.010	0.098	0.033	0.235	0.070	0.378	0.089	0.470	0.101	0.535	0.108	0.556	0.116	0.593	0.121	0.643	0.121	0.643	0.121	0.643	0.121	0.643	0.121	0.643	0.121	0.643	0.121	0.643
CFTBORREP_6M	0.009	0.072	0.052	0.320	0.085	0.465	0.101	0.477	0.117	0.552	0.129	0.676	0.135	0.729	0.140	0.779	0.140	0.779	0.140	0.779	0.140	0.779	0.140	0.779	0.140	0.779	0.140	0.779
TV_1YR	0.009	0.082	0.036	0.292	0.062	0.453	0.091	0.524	0.117	0.617	0.127	0.689	0.135	0.766	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814
LNVA_2YR	0.009	0.086	0.036	0.292	0.062	0.453	0.091	0.524	0.117	0.617	0.127	0.689	0.135	0.766	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814
LNVA_1YR	0.009	0.086	0.036	0.292	0.062	0.453	0.091	0.524	0.117	0.617	0.127	0.689	0.135	0.766	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814
ACGRU	0.009	0.086	0.036	0.292	0.062	0.453	0.091	0.524	0.117	0.617	0.127	0.689	0.135	0.766	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814
MTBV_6M	0.009	0.062	0.039	0.266	0.075	0.462	0.102	0.535	0.129	0.598	0.124	0.671	0.129	0.709	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712
CEPS_6M	0.009	0.062	0.039	0.266	0.075	0.462	0.102	0.535	0.129	0.598	0.124	0.671	0.129	0.709	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712
KCBT	0.009	0.062	0.039	0.266	0.075	0.462	0.102	0.535	0.129	0.598	0.124	0.671	0.129	0.709	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712
MTBV	0.009	0.062	0.039	0.266	0.075	0.462	0.102	0.535	0.129	0.598	0.124	0.671	0.129	0.709	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712	0.125	0.712
CFTBORREPDI_2YR	0.008	0.066	0.044	0.330	0.088	0.548	0.107	0.479	0.112	0.548	0.123	0.637	0.124	0.650	0.129	0.682	0.134	0.732	0.137	0.722	0.141	0.751	0.141	0.751	0.141	0.751	0.141	0.751
FOUR_YEAR_GROWA	0.008	0.066	0.044	0.330	0.088	0.548	0.107	0.479	0.112	0.548	0.123	0.637	0.124	0.650	0.129	0.682	0.134	0.732	0.137	0.722	0.141	0.751	0.141	0.751	0.141	0.751	0.141	0.751
LNVA_2YR	0.008	0.066	0.044	0.330	0.088	0.548	0.107	0.479	0.112	0.548	0.123	0.637	0.124	0.650	0.129	0.682	0.134	0.732	0.137	0.722	0.141	0.751	0.141	0.751	0.141	0.751	0.141	0.751
LNVA_1YR	0.008	0.066	0.044	0.330	0.088	0.548	0.107	0.479	0.112	0.548	0.123	0.637	0.124	0.650	0.129	0.682	0.134	0.732	0.137	0.722	0.141	0.751	0.141	0.751	0.141	0.751	0.141	0.751
TV_1M	0.008	0.077	0.043	0.358	0.089	0.516	0.103	0.495	0.114	0.576	0.128	0.671	0.130	0.675	0.123	0.722	0.128	0.714	0.125	0.711	0.127	0.746	0.130	0.748	0.135	0.775	0.131	0.767
SALESTRP_6M	0.007	0.049	0.018	0.123	0.048	0.284	0.075	0.384	0.106	0.500	0.108	0.568	0.107	0.598	0.103	0.596	0.112	0.622	0.113	0.644	0.118	0.724	0.119	0.729	0.119	0.726	0.117	0.723
EPS_6M	0.006	0.045	0.012	0.123	0.048	0.284	0.075	0.384	0.106	0.500	0.108	0.568	0.107	0.598	0.103	0.596	0.112	0.622	0.113	0.644	0.118	0.724	0.119	0.729	0.119	0.726	0.117	0.723
MOM_24M	0.006	0.045	0.012	0.123	0.048	0.284	0.075	0.384	0.106	0.500	0.108	0.568	0.107	0.598	0.103	0.596	0.112	0.622	0.113	0.644	0.118	0.724	0.119	0.729	0.119	0.726	0.117	0.723
TV_6M	0.006	0.056	0.030	0.240	0.059	0.368	0.095	0.463	0.106	0.538	0.124	0.708	0.131	0.747	0.128	0.747	0.128	0.747	0.128	0.747	0.128	0.747	0.128	0.747	0.128	0.747	0.128	0.747
DIV_6M	0.006	0.056	0.030	0.240	0.059	0.368	0.095	0.463	0.106	0.538	0.124	0.708	0.131	0.747	0.128	0.747	0.128	0.747	0.128	0.747	0.128	0.747	0.128	0.747	0.128	0.747	0.128	0.747
BORROW_1YR	0.006	0.051	0.046	0.312	0.073	0.475	0.079	0.479	0.114	0.590	0.129	0.682	0.133	0.732	0.140	0.779	0.140	0.779	0.140	0.779	0.140	0.779	0.140	0.779	0.140	0.779	0.140	0.779
WC_1YR	0.005	0.046	0.049	0.332	0.068	0.442	0.087	0.496	0.107	0.535	0.126	0.689	0.133	0.732	0.140	0.779	0.140	0.779	0.140	0.779	0.140	0.779	0.140	0.779	0.140	0.779	0.140	0.779
AVTRADEMV_2YR	0.004	0.034	0.042	0.288	0.079	0.420	0.101	0.473	0.108	0.520	0.122	0.626	0.126	0.650	0.132	0.720	0.136	0.766	0.142	0.756	0.145	0.796	0.147	0.814	0.148	0.818	0.148	0.818
SALESTRP	0.004	0.072	0.038	0.330	0.067	0.413	0.108	0.518	0.115	0.599	0.127	0.716	0.134	0.763	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814	0.140	0.814
OPMTP	0.004	0.025	0.038	0.263	0.070	0.409	0.068	0.359	0.107	0.568	0.109	0.645	0.120	0.688	0.123	0.734	0.129	0.742	0.124	0.704	0.119	0.704	0.119	0.704	0.119	0.704	0.119	0.704
CROSS3_MOM12M	0.002	0.035	0.033	0.296	0.064	0.400	0.087	0.470	0.107	0.568	0.109	0.645	0.120	0.688	0.123	0.734	0.129	0.742	0.124	0.704	0.119	0.704	0.119	0.704	0.119	0.704	0.119	0.704</

F.4. Expected Return Model Created from a 12-Month Moving Average Timing Model

The Haugen and Baker (1996) forecasting methodology is applied in a stepwise procedure to derive expected return models using nonstandardised attributes. The procedure starts by applying the Haugen and Baker (1996) methodology using one explanatory variable. A twelve-month trailing moving average model is used to predict the slopes of the variables. The forecasting ability of the variable is tested using the Information Coefficient (IC) of Grinold (1989), and the variable that displays the highest IC is taken to the next step where the above procedure is repeated using two variables, the first being that from the first step. The second attribute to remain in the model is that which combines with the first attribute to produce the highest IC. The stepwise procedure continues until the multifactor expected return model derived at a stage displays an IC lower than that of the previous stage's model. The Information Ratio (IR) calculated is that of Qian and Hua (2004) and is the mean monthly IC divided by the standard deviation of the IC over the months. The mean IC and IR statistic of the multifactor models tested at each step in the procedure are displayed. The statistics refer to the multifactor model consisting of the variables that remained in the expected return model from previous steps and the variable next to which the statistic is displayed. Variables that remain in the model are displayed in white on a black background, and the mean IC and IR of the model with that variable's addition are similarly displayed. In the last step of the procedure, the variable that combines with those that remained in the model from previous steps to give the highest mean IC is displayed in bold on a grey background, as this model is inferior that created at the previous step. The variables are listed in descending order of the univariately calculated mean IC statistic (in other words, the mean IC statistic calculated at the first step in the stepwise procedure). The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Attributes	1 Variable		2 Variables		3 Variables		4 Variables		5 Variables		6 Variables		7 Variables	
	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR
MOM_12M	0.074	0.468												
P_1YR	0.068	0.407	0.064	0.409	0.094	0.570	0.126	0.618	0.145	0.669	0.162	0.668	0.068	0.258
MOM_3M	0.061	0.361	0.062	0.389	0.103	0.617	0.117	0.569	0.133	0.608	0.151	0.613	0.133	0.558
P_6M	0.058	0.358	0.069	0.445	0.097	0.590	0.122	0.597	0.136	0.626	0.154	0.634	0.124	0.475
P_3M	0.058	0.352	0.062	0.398	0.103	0.618	0.117	0.568	0.134	0.606	0.150	0.608	0.134	0.560
OBOS_6MMA	0.057	0.323	0.059	0.358	0.096	0.553	0.115	0.536	0.131	0.577	0.149	0.591	0.142	0.569
LNP	0.056	0.431	0.084	0.541	0.108	0.637	0.124	0.602	0.141	0.625	0.156	0.612	0.049	0.192
MOM_6M	0.051	0.310	0.070	0.456	0.097	0.587	0.120	0.587	0.135	0.624	0.153	0.632	0.125	0.483
LNMV	0.044	0.313	0.073	0.446	0.102	0.572	0.128	0.610	0.144	0.633	0.160	0.612	0.014	0.058
BVPS	0.042	0.438	0.083	0.481	0.108	0.629	0.125	0.630	0.140	0.643	0.156	0.633	0.023	0.119
TV_1YR	0.040	0.333	0.092	0.539	0.116	0.695	0.123	0.602	0.132	0.576	0.151	0.646	0.037	0.175
MVTRADEM_V_1YR	0.039	0.407	0.064	0.476	0.097	0.679	0.112	0.582	0.123	0.566	0.152	0.657	0.044	0.215
BTMV	0.037	0.293	0.101	0.613										
MOM_18M	0.035	0.249	0.056	0.395	0.092	0.584	0.129	0.670	0.147	0.682	0.155	0.665	0.101	0.414
LNMV_3M	0.032	0.194	0.067	0.428	0.098	0.594	0.126	0.588	0.137	0.636	0.157	0.628	0.155	0.609
MVTRADE_1YR	0.032	0.285	0.063	0.422	0.098	0.643	0.112	0.565	0.126	0.577	0.157	0.659	0.030	0.158
GROW_2YR	0.031	0.253	0.056	0.334	0.076	0.466	0.103	0.501	0.120	0.564	0.121	0.535	0.013	0.066
CFTP	0.029	0.243	0.079	0.483	0.100	0.620	0.145	0.665						
DPS_6M	0.026	0.200	0.096	0.663	0.122	0.858	0.126	0.626	0.141	0.688	0.152	0.619	0.100	0.459
INTANMV_6M	0.027	0.225	0.085	0.568	0.107	0.757	0.095	0.508	0.111	0.574	0.117	0.515	0.007	0.033
DIV_2YR	0.027	0.187	0.084	0.443	0.119	0.685	0.136	0.587	0.134	0.528	0.133	0.474	0.030	0.122
ICBT	0.026	0.276	0.077	0.449	0.101	0.606	0.123	0.548	0.129	0.549	0.134	0.508	0.025	0.092
LNMV_6M	0.025	0.165	0.073	0.481	0.100	0.610	0.132	0.606	0.139	0.617	0.157	0.596	0.156	0.598
MVTRADE_2YR	0.025	0.202	0.057	0.382	0.106	0.696	0.113	0.580	0.133	0.630	0.137	0.587	0.036	0.239
INTANMV_1YR	0.024	0.204	0.085	0.503	0.114	0.711	0.121	0.589	0.143	0.706	0.131	0.526	0.004	0.020
P	0.024	0.256	0.072	0.489	0.102	0.619	0.122	0.606	0.136	0.626	0.153	0.617	-0.001	-0.004
CFTBORRREPDIV	0.023	0.141	0.085	0.444	0.107	0.589	0.120	0.637	0.140	0.681	0.152	0.681	0.019	0.075
MVTRADEM_V_6M	0.023	0.285	0.061	0.404	0.101	0.661	0.120	0.602	0.132	0.615	0.160	0.664	0.056	0.286
TV	0.023	0.172	0.073	0.391	0.104	0.590	0.119	0.626	0.133	0.629	0.156	0.659	0.163	0.651
SALESTP_2YR	0.022	0.151	0.063	0.331	0.080	0.461	0.097	0.469	0.124	0.641	0.141	0.639	0.081	0.320
FOUR_YREARNGROWA	0.022	0.197	0.054	0.293	0.090	0.501	0.080	0.350	0.073	0.308	0.087	0.339	0.022	0.100
CHSALE_LES_CHACRE	0.022	0.208	0.072	0.529	0.090	0.674	0.098	0.459	0.136	0.598	0.145	0.600	0.039	0.162
EPS_2YRAV	0.021	0.245	0.058	0.386	0.097	0.627	0.116	0.590	0.137	0.635	0.156	0.629	0.104	0.450
SALEPEMPLY_2YR	0.021	0.122	0.062	0.276	0.101	0.466	0.121	0.547	0.142	0.656	0.154	0.638	0.062	0.343
EPS	0.020	0.232	0.063	0.402	0.095	0.567	0.119	0.605	0.139	0.646	0.156	0.634	0.103	0.463
SALEPEMPLY_1YR	0.019	0.103	0.089	0.391	0.129	0.644								
TV_6M	0.019	0.190	0.062	0.360	0.105	0.656	0.114	0.569	0.131	0.612	0.157	0.652	0.052	0.274
ICBT_2YR	0.018	0.124	0.063	0.381	0.091	0.582	0.112	0.586	0.134	0.652	0.141	0.575	-0.029	-0.125
RETEN	0.017	0.106	0.070	0.371	0.099	0.558	0.124	0.547	0.143	0.632	0.162	0.630	0.003	0.012
MVTRADEM_V_2YR	0.017	0.192	0.070	0.477	0.105	0.657	0.115	0.608	0.135	0.660	0.146	0.652	0.038	0.261
EPS_6M	0.017	0.154	0.084	0.456	0.108	0.621	0.126	0.667	0.137	0.676	0.154	0.658	0.040	0.196
DPS	0.016	0.170	0.060	0.372	0.095	0.570	0.124	0.633	0.140	0.661	0.160	0.655	0.109	0.500

F.4. Expected Return Model Created from a 12-Month Moving Average Timing Model

- continued

Attributes	1 Variable		2 Variables		3 Variables		4 Variables		5 Variables		6 Variables		7 Variables	
	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR
CEPS	0.016	0.163	0.085	0.485	0.105	0.626	0.127	0.631	0.142	0.651	0.158	0.629	0.082	0.392
EPSCH_P_6M	0.016	0.160	0.066	0.426	0.096	0.575	0.135	0.669	0.147	0.681	0.166	0.670		
MVTRADE_6M	0.016	0.133	0.056	0.375	0.094	0.614	0.115	0.593	0.130	0.620	0.156	0.655	0.040	0.229
DY_1YR	0.016	0.137	0.082	0.548	0.109	0.748	0.115	0.552	0.126	0.577	0.151	0.629	0.035	0.141
WC_1YR	0.015	0.141	0.088	0.472	0.115	0.661	0.116	0.577	0.148	0.645	0.154	0.657	0.093	0.433
CFTBORRREPDIV_2YR	0.015	0.129	0.053	0.299	0.083	0.496	0.088	0.480	0.121	0.634	0.131	0.610	0.022	0.100
RETEN_1YR	0.015	0.220	0.078	0.483	0.106	0.670	0.116	0.579	0.133	0.639	0.146	0.604	0.039	0.191
MVTRADEMV_1M	0.015	0.186	0.063	0.442	0.103	0.651	0.111	0.591	0.124	0.604	0.150	0.647	0.041	0.222
DPS_1YR	0.014	0.152	0.086	0.589	0.110	0.751	0.125	0.613	0.137	0.642	0.165	0.694	0.094	0.451
MVTRADE	0.014	0.222	0.067	0.431	0.104	0.643	0.126	0.634	0.142	0.644	0.158	0.642	-0.013	-0.102
QUICK	0.013	0.101	0.072	0.389	0.098	0.525	0.126	0.631	0.159	0.691	0.163	0.660	0.045	0.197
CF_1YR	0.013	0.102	0.081	0.446	0.100	0.567	0.093	0.490	0.114	0.534	0.120	0.509	0.044	0.181
MVTRADE_1M	0.012	0.148	0.063	0.416	0.102	0.635	0.109	0.577	0.123	0.604	0.151	0.646	0.037	0.217
SALESTP_6M	0.012	0.062	0.055	0.363	0.076	0.533	0.112	0.480	0.136	0.601	0.151	0.593	0.045	0.165
ECANDRES	0.012	0.154	0.075	0.427	0.100	0.564	0.127	0.651	0.145	0.658	0.159	0.634	-0.020	-0.137
TV_2YR	0.011	0.113	0.054	0.345	0.078	0.482	0.105	0.532	0.130	0.623	0.152	0.650	0.040	0.240
LNMV_1YR	0.011	0.068	0.051	0.324	0.098	0.611	0.112	0.506	0.138	0.623	0.151	0.605	0.153	0.645
ROCE_1YR	0.011	0.072	0.049	0.259	0.064	0.356	0.079	0.316	0.103	0.436	0.117	0.452	-0.005	-0.021
MVTRADE_3M	0.011	0.123	0.061	0.409	0.100	0.627	0.119	0.625	0.135	0.636	0.163	0.693	0.035	0.212
NS	0.011	0.145	0.075	0.427	0.101	0.589	0.123	0.626	0.141	0.641	0.159	0.634	-0.005	-0.040
CFTBORRREPDIV_6M	0.011	0.074	0.067	0.374	0.097	0.580	0.123	0.599	0.141	0.664	0.134	0.552	0.054	0.224
DIV	0.011	0.155	0.077	0.441	0.102	0.597	0.126	0.640	0.143	0.652	0.158	0.623	-0.010	-0.071
ACCREC_1YR_CH	0.011	0.067	0.077	0.395	0.113	0.628	0.090	0.429	0.123	0.546	0.127	0.508	0.092	0.403
BORROW	0.009	0.076	0.075	0.401	0.098	0.541	0.128	0.649	0.145	0.673	0.146	0.608	-0.008	-0.034
WC	0.009	0.072	0.072	0.386	0.098	0.522	0.127	0.614	0.157	0.679	0.157	0.653	0.027	0.115
BTMV_2YR	0.009	0.056	0.058	0.386	0.094	0.563	0.120	0.557	0.141	0.693	0.165	0.743	0.077	0.290
BORROW_1YR	0.009	0.081	0.060	0.401	0.084	0.574	0.120	0.612	0.137	0.690	0.138	0.659	0.029	0.124
TV_3M	0.008	0.087	0.074	0.441	0.099	0.615	0.112	0.579	0.130	0.591	0.162	0.673	0.031	0.175
MTBV_2YR	0.008	0.050	0.066	0.368	0.097	0.507	0.117	0.577	0.132	0.646	0.134	0.589	0.015	0.055
EPSCH_P_12M	0.008	0.083	0.057	0.386	0.087	0.564	0.115	0.589	0.137	0.638	0.154	0.633	0.149	0.612
MVTRADEMV	0.008	0.057	0.067	0.406	0.103	0.616	0.120	0.622	0.136	0.641	0.157	0.651	0.005	0.029
ECANDRES_1YR	0.007	0.062	0.088	0.497	0.109	0.626	0.119	0.571	0.120	0.585	0.132	0.574	0.098	0.402
OBOS_3MMA	0.007	0.040	0.056	0.374	0.085	0.491	0.099	0.513	0.116	0.510	0.129	0.496	0.141	0.560
SALESTP	0.006	0.050	0.070	0.381	0.093	0.524	0.121	0.536	0.136	0.604	0.151	0.596	0.055	0.220
P_2YR	0.005	0.039	0.052	0.330	0.096	0.569	0.113	0.557	0.131	0.610	0.141	0.611	0.082	0.394
ROCE_6M	0.005	0.034	0.065	0.425	0.095	0.473	0.099	0.429	0.110	0.492	0.123	0.462	0.021	0.081
CFTTL_6M	0.005	0.033	0.056	0.358	0.092	0.537	0.104	0.482	0.115	0.550	0.140	0.584	0.053	0.223
TV_1M	0.005	0.048	0.077	0.456	0.105	0.633	0.109	0.579	0.124	0.600	0.150	0.643	0.042	0.230
MVTRADEMV_3M	0.004	0.048	0.062	0.412	0.096	0.608	0.114	0.586	0.130	0.595	0.162	0.676	0.034	0.189
CFTBORRREPDIV_1YR	0.003	0.022	0.045	0.257	0.083	0.513	0.096	0.459	0.133	0.604	0.136	0.575	0.012	0.044
MOM_24M	0.003	0.021	0.047	0.301	0.090	0.530	0.112	0.559	0.131	0.612	0.140	0.609	0.083	0.395
CROSS3_MOM12M	0.003	0.041	0.065	0.433	0.093	0.562	0.120	0.660	0.137	0.654	0.148	0.629	0.021	0.136
CROSS1_MOM3M	0.003	0.045	0.066	0.436	0.100	0.629	0.112	0.593	0.125	0.586	0.141	0.572	0.003	0.024
CEPS_6M	0.002	0.030	0.067	0.414	0.099	0.648	0.121	0.612	0.136	0.622	0.124	0.522	0.037	0.149
MTBV	0.002	0.020	0.088	0.574	0.096	0.590	0.118	0.576	0.138	0.596	0.120	0.434	0.018	0.072
GEAR_6M	0.002	0.022	0.080	0.460	0.107	0.641	0.096	0.510	0.115	0.573	0.127	0.547	0.058	0.247
CFTBORRREP_6M	0.002	0.017	0.052	0.301	0.083	0.487	0.091	0.488	0.111	0.564	0.113	0.521	0.058	0.277
ACCRU	0.001	0.010	0.097	0.484	0.117	0.595	0.131	0.572	0.163	0.662				
A_TURN	0.001	0.019	0.075	0.434	0.102	0.604	0.126	0.650	0.143	0.649	0.164	0.671	0.078	0.453
RETEN_2YR	0.001	0.013	0.048	0.256	0.095	0.506	0.116	0.572	0.136	0.637	0.158	0.639	0.034	0.226
NPMT	0.001	0.004	0.026	0.144	0.074	0.440	0.102	0.415	0.123	0.510	0.141	0.539	0.028	0.093
LNMV_2YR	0.000	0.002	0.058	0.379	0.095	0.594	0.128	0.637	0.148	0.723	0.163	0.728	0.111	0.488
MTBV_6M	0.000	-0.001	0.087	0.532	0.103	0.629	0.086	0.421	0.099	0.432	0.129	0.481	0.063	0.250
CROSS6_MOM12M	0.000	-0.004	0.056	0.379	0.097	0.593	0.110	0.567	0.129	0.609	0.153	0.636	0.015	0.102
TLTA	-0.001	-0.014	0.077	0.459	0.100	0.602	0.126	0.629	0.144	0.660	0.162	0.663	0.112	0.479
DIV_6M	-0.001	-0.014	0.080	0.496	0.101	0.699	0.106	0.518	0.115	0.533	0.137	0.523	0.065	0.271
ECANDRES_2YR	-0.004	-0.032	0.024	0.146	0.055	0.334	0.108	0.533	0.127	0.638	0.121	0.539	0.035	0.143
CF_6M	-0.007	-0.056	0.050	0.281	0.074	0.431	0.123	0.613	0.134	0.641	0.152	0.636	0.068	0.272
LNP_2YR	-0.009	-0.097	0.055	0.368	0.091	0.563	0.110	0.543	0.121	0.559	0.132	0.567	0.026	0.128
P_1M	-0.012	-0.077	0.055	0.349	0.083	0.477	0.096	0.485	0.117	0.507	0.138	0.526	0.134	0.515
ACCREC_6M_CH	-0.013	-0.112	0.072	0.422	0.093	0.546	0.096	0.487	0.137	0.594	0.141	0.580	0.100	0.438
DY_6M	-0.013	-0.089	0.097	0.643	0.120	0.869	0.128	0.599	0.141	0.655	0.150	0.604	0.090	0.376
OPMTP	-0.025	-0.167	0.029	0.159	0.063	0.366	0.106	0.479	0.129	0.558	0.150	0.577	0.010	0.043

F.5. Expected Return Model Created from an 18-Month Moving Average Timing Model

The Haugen and Baker (1996) forecasting methodology is applied in a stepwise procedure to derive expected return models using nonstandardised attributes. The procedure starts by applying the Haugen and Baker (1996) methodology using one explanatory variable. An eighteen-month trailing moving average model is used to predict the slopes of the variables. The forecasting ability of the variable is tested using the Information Coefficient (IC) of Grinold (1989), and the variable that displays the highest IC is taken to the next step where the above procedure is repeated using two variables, the first being that from the first step. The second attribute to remain in the model is that which combines with the first attribute to produce the highest IC. The stepwise procedure continues until the multifactor expected return model derived at a stage displays an IC lower than that of the previous stage's model. The Information Ratio (IR) calculated is that of Qian and Hua (2004) and is the mean monthly IC divided by the standard deviation of the IC over the months. The mean IC and IR statistic of the multifactor models tested at each step in the procedure are displayed. The statistics refer to the multifactor model consisting of the variables that remained in the expected return model from previous steps and the variable next to which the statistic is displayed. Variables that remain in the model are displayed in white on a black background, and the mean IC and IR of the model with that variable's addition are similarly displayed. In the last step of the procedure, the variable that combines with those that remained in the model from previous steps to give the highest mean IC is displayed in bold on a grey background, as this model is inferior that created at the previous step. The variables are listed in descending order of the univariately calculated mean IC statistic (in other words, the mean IC statistic calculated at the first step in the stepwise procedure). The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Attributes	1 Variable		2 Variables		3 Variables		4 Variables		5 Variables		6 Variables		7 Variables		8 Variables		9 Variables	
	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR
MOM_12M	0.078	0.505																
P_1YR	0.071	0.441	0.060	0.390	0.094	0.466	0.112	0.511	0.146	0.579	0.164	0.667	0.172	0.739	0.175	0.797	0.185	0.843
LNP	0.090	0.454	0.092	0.608	0.120	0.607	0.135	0.648	0.146	0.580	0.167	0.691	0.173	0.718	0.170	0.768	0.179	0.817
BTMV	0.051	0.422	0.107	0.668	0.124	0.665	0.128	0.630	0.161	0.686	0.173	0.717	0.176	0.746	0.182	0.811	0.182	0.826
P_6M	0.051	0.304	0.072	0.444	0.114	0.550	0.132	0.605	0.156	0.592	0.177	0.715	0.186	0.746	0.187	0.772	0.189	0.797
P_3M	0.050	0.301	0.071	0.442	0.108	0.524	0.131	0.600	0.147	0.581	0.168	0.694	0.178	0.756	0.188	0.813	0.186	0.826
MOM_3M	0.050	0.290	0.069	0.424	0.108	0.509	0.130	0.598	0.147	0.562	0.169	0.697	0.179	0.760	0.189	0.817	0.187	0.833
OBOS_6MMA	0.046	0.255	0.071	0.422	0.108	0.514	0.128	0.583	0.148	0.573	0.169	0.690	0.173	0.706	0.186	0.780	0.191	0.811
LNMV	0.046	0.324	0.081	0.520	0.113	0.569	0.132	0.628	0.147	0.579	0.171	0.732	0.174	0.716	0.181	0.799	0.187	0.821
MOM_6M	0.045	0.268	0.073	0.446	0.115	0.557	0.133	0.616	0.155	0.591	0.176	0.717	0.186	0.746	0.186	0.767	0.188	0.791
MVTRADE_1YR	0.042	0.408	0.073	0.501	0.111	0.578	0.133	0.645	0.164	0.693	0.180	0.889	0.153	0.623	0.177	0.797	0.186	0.845
MOM_18M	0.040	0.282	0.065	0.475	0.109	0.564	0.127	0.621	0.158	0.624	0.183	0.772	0.190	0.835				
MVTRADEMV_1YR	0.036	0.379	0.068	0.498	0.106	0.575	0.127	0.647	0.162	0.699	0.156	0.831	0.159	0.629	0.173	0.748	0.182	0.796
TV_1YR	0.035	0.324	0.096	0.579	0.106	0.569	0.124	0.623	0.164	0.680	0.154	0.809	0.159	0.621	0.175	0.742	0.184	0.798
LNMV_1YR	0.035	0.211	0.063	0.427	0.080	0.413	0.118	0.574	0.156	0.568	0.170	0.689	0.183	0.738	0.181	0.747	0.183	0.823
DIV_2YR	0.034	0.257	0.087	0.509	0.097	0.524	0.141	0.680	0.147	0.493	0.153	0.541	0.147	0.534	0.149	0.575	0.150	0.570
DPS_6M	0.033	0.239	0.101	0.731	0.096	0.591	0.134	0.797	0.154	0.535	0.140	0.473	0.120	0.430	0.122	0.460	0.125	0.473
CFTP	0.030	0.277	0.063	0.509	0.132	0.631												
BVPS	0.029	0.290	0.085	0.498	0.111	0.563	0.131	0.620	0.146	0.584	0.173	0.714	0.183	0.754	0.182	0.800	0.189	0.826
LNMV_3M	0.029	0.189	0.076	0.491	0.100	0.487	0.124	0.573	0.146	0.571	0.164	0.654	0.160	0.641	0.170	0.699	0.179	0.750
TV_6M	0.028	0.268	0.086	0.511	0.112	0.585	0.130	0.648	0.157	0.632	0.165	0.682	0.176	0.711	0.180	0.749	0.182	0.783
LNMV_6M	0.025	0.165	0.076	0.495	0.089	0.438	0.117	0.543	0.149	0.539	0.156	0.614	0.156	0.613	0.166	0.675	0.178	0.746
SALEPEMPLY_1YR	0.024	0.137	0.095	0.418	0.108	0.430	0.152	0.562	0.155	0.600	0.172	0.724	0.180	0.734	0.181	0.785	0.188	0.826
MVTRADEMV_6M	0.024	0.283	0.073	0.494	0.112	0.589	0.130	0.652	0.150	0.619	0.158	0.658	0.168	0.680	0.174	0.724	0.177	0.742
INTANMV_1YR	0.024	0.205	0.087	0.514	0.088	0.499	0.116	0.614	0.129	0.566	0.134	0.551	0.134	0.591	0.142	0.646	0.151	0.693
P	0.023	0.253	0.077	0.533	0.114	0.582	0.132	0.631	0.148	0.593	0.170	0.711	0.179	0.741	0.184	0.814	0.191	0.847
CHSALE_LES_CHACRE	0.022	0.214	0.065	0.464	0.071	0.443	0.106	0.632	0.142	0.580	0.165	0.692	0.167	0.705	0.167	0.708	0.174	0.743
TV	0.022	0.174	0.077	0.435	0.112	0.558	0.129	0.611	0.149	0.603	0.161	0.695	0.163	0.623	0.177	0.750	0.179	0.746
MVTRADE_2YR	0.022	0.173	0.057	0.387	0.076	0.419	0.110	0.597	0.144	0.596	0.169	0.720	0.179	0.740	0.178	0.763	0.177	0.781
SALESTP_6M	0.021	0.145	0.056	0.374	0.091	0.507	0.125	0.657	0.139	0.534	0.159	0.656	0.161	0.645	0.167	0.685	0.166	0.703
GROW_2YR	0.020	0.161	0.070	0.416	0.088	0.470	0.125	0.603	0.122	0.515	0.131	0.535	0.126	0.480	0.140	0.562	0.154	0.688
MVTRADEMV_2YR	0.020	0.224	0.073	0.477	0.075	0.405	0.110	0.582	0.158	0.638	0.176	0.734	0.173	0.743	0.184	0.804	0.188	0.811
MVTRADE_3M	0.020	0.229	0.074	0.483	0.109	0.566	0.127	0.629	0.149	0.610	0.150	0.613	0.156	0.610	0.165	0.709	0.175	0.760
INTANMV_6M	0.020	0.157	0.074	0.494	0.079	0.444	0.110	0.593	0.134	0.536	0.136	0.522	0.126	0.500	0.121	0.517	0.133	0.567
ACCRU	0.019	0.143	0.114	0.531														
ICBT	0.019	0.200	0.085	0.513	0.100	0.533	0.124	0.603	0.096	0.349	0.117	0.419	0.135	0.493	0.173	0.687	0.154	0.600
ICBT_2YR	0.019	0.136	0.074	0.455	0.080	0.409	0.115	0.631	0.115	0.432	0.147	0.538	0.148	0.534	0.159	0.581	0.139	0.522
QUICK	0.019	0.157	0.076	0.437	0.099	0.497	0.117	0.552	0.146	0.566	0.168	0.704	0.173	0.700	0.181	0.801	0.184	0.818
EPS_2YRAV	0.019	0.211	0.072	0.526	0.092	0.562	0.127	0.728	0.146	0.574	0.170	0.718	0.176	0.730	0.178	0.784	0.186	0.823
SALESTP_2YR	0.018	0.138	0.074	0.448	0.081	0.440	0.112	0.591	0.146	0.602	0.152	0.572	0.136	0.495	0.126	0.494	0.149	0.580
MVTRADE_6M	0.018	0.150	0.059	0.397	0.108	0.558	0.128	0.620	0.153	0.621	0.159	0.655	0.156	0.604	0.166	0.707	0.177	0.742
MVTRADEMV_1M	0.017	0.221	0.067	0.479	0.108	0.559	0.126	0.612	0.129	0.528	0.148	0.630	0.159	0.680	0.173	0.731	0.168	0.731

F.5. Expected Return Model Created from an 18-Month Moving Average Timing Model

- continued

Attributes	1 Variable		2 Variables		3 Variables		4 Variables		5 Variables		6 Variables		7 Variables		8 Variables		9 Variables	
	MEAN	IC	IR	MEAN	IC	IR	MEAN	IC	IR	MEAN	IC	IR	MEAN	IC	IR	MEAN	IC	IR
WC	0.017	0.141	0.075	0.443	0.101	0.509	0.119	0.564	0.143	0.572	0.170	0.741	0.175	0.742	0.185	0.823	0.191	0.847
EPS_6M	0.017	0.154	0.087	0.466	0.105	0.555	0.136	0.738	0.143	0.549	0.125	0.468	0.113	0.429	0.122	0.487	0.124	0.485
DPS_1YR	0.016	0.182	0.090	0.625	0.090	0.570	0.143	0.814	0.162	0.570	0.154	0.560	0.147	0.548	0.145	0.586	0.153	0.598
EPS	0.016	0.185	0.075	0.510	0.109	0.555	0.129	0.618	0.141	0.559	0.168	0.711	0.177	0.733	0.178	0.792	0.185	0.820
NPMT	0.016	0.105	0.076	0.448	0.084	0.454	0.121	0.636	0.130	0.480	0.155	0.557	0.156	0.563	0.150	0.596	0.156	0.618
EPSCH_P_6M	0.016	0.171	0.069	0.476	0.099	0.505	0.124	0.630	0.149	0.586	0.164	0.701	0.154	0.622	0.162	0.689	0.174	0.724
RETEN_1YR	0.015	0.233	0.083	0.499	0.109	0.570	0.131	0.626	0.142	0.643	0.168	0.743	0.171	0.739	0.172	0.797	0.177	0.805
TV_3M	0.014	0.150	0.085	0.500	0.108	0.555	0.126	0.611	0.151	0.615	0.154	0.630	0.160	0.625	0.168	0.710	0.175	0.745
CFTBORRREP_6M	0.014	0.124	0.046	0.311	0.085	0.428	0.111	0.588	0.097	0.413	0.098	0.383	0.119	0.453	0.120	0.491	0.119	0.494
MVTRADEM	0.014	0.108	0.073	0.445	0.111	0.552	0.129	0.613	0.148	0.602	0.162	0.661	0.164	0.637	0.174	0.745	0.178	0.745
LNMV_2YR	0.013	0.094	0.062	0.398	0.090	0.482	0.121	0.614	0.166	0.683	0.186	0.775						
FOUR_YREARNGROWA	0.013	0.114	0.064	0.342	0.076	0.448	0.114	0.585	0.070	0.280	0.072	0.259	0.066	0.233	0.048	0.176	0.046	0.155
MOM_24M	0.012	0.094	0.062	0.412	0.083	0.463	0.118	0.647	0.149	0.590	0.176	0.759	0.183	0.730	0.180	0.771	0.184	0.809
NS	0.012	0.162	0.082	0.490	0.111	0.571	0.131	0.625	0.154	0.605	0.176	0.737	0.182	0.745	0.185	0.795	0.189	0.802
CFTTL_6M	0.012	0.093	0.058	0.355	0.088	0.435	0.121	0.588	0.114	0.461	0.135	0.527	0.134	0.558	0.167	0.531	0.124	0.573
DIV	0.012	0.178	0.085	0.506	0.110	0.562	0.130	0.620	0.150	0.591	0.175	0.728	0.181	0.749	0.178	0.796	0.183	0.817
SALEEMPLOY_2YR	0.011	0.065	0.073	0.328	0.104	0.430	0.154	0.612										
ACCREC_1YR_CH	0.011	0.075	0.087	0.480	0.105	0.552	0.122	0.568	0.121	0.491	0.144	0.572	0.144	0.568	0.151	0.598	0.158	0.624
WC_1YR	0.010	0.095	0.101	0.561	0.099	0.521	0.117	0.594	0.152	0.611	0.182	0.762	0.181	0.758	0.170	0.742	0.179	0.805
MVTRADE_1M	0.009	0.106	0.068	0.472	0.107	0.568	0.126	0.615	0.130	0.528	0.148	0.625	0.162	0.680	0.174	0.740	0.168	0.734
RETEN	0.008	0.051	0.073	0.417	0.107	0.508	0.125	0.570	0.148	0.547	0.165	0.672	0.172	0.693	0.173	0.718	0.181	0.752
CFTBORRREP_DIV_2YR	0.008	0.069	0.079	0.471	0.075	0.424	0.117	0.611	0.149	0.616	0.118	0.454	0.113	0.423	0.122	0.477	0.123	0.475
CFTBORRREP_DIV_6M	0.008	0.056	0.066	0.450	0.107	0.563	0.132	0.727	0.128	0.499	0.112	0.407	0.114	0.408	0.142	0.544	0.148	0.572
ROCE_1YR	0.008	0.054	0.060	0.351	0.083	0.358	0.100	0.537	0.138	0.530	0.157	0.619	0.141	0.561	0.150	0.609	0.168	0.694
ECANDRES	0.007	0.089	0.084	0.500	0.111	0.574	0.131	0.624	0.151	0.596	0.176	0.740	0.183	0.764	0.181	0.801	0.183	0.814
P_2YR	0.007	0.047	0.066	0.457	0.093	0.531	0.124	0.679	0.150	0.593	0.178	0.780	0.179	0.708	0.178	0.781	0.180	0.802
OBOS_3MMA	0.006	0.037	0.089	0.455	0.105	0.531	0.125	0.598	0.141	0.568	0.161	0.684	0.166	0.712	0.175	0.786	0.176	0.776
DPS	0.008	0.061	0.089	0.448	0.109	0.548	0.129	0.607	0.148	0.585	0.170	0.702	0.179	0.745	0.180	0.791	0.188	0.824
SALESTP	0.008	0.049	0.086	0.498	0.114	0.587	0.126	0.611	0.141	0.568	0.180	0.744	0.165	0.694	0.170	0.738	0.177	0.789
MVTRADE	0.006	0.088	0.077	0.509	0.112	0.577	0.131	0.630	0.154	0.611	0.171	0.710	0.179	0.741	0.177	0.781	0.179	0.793
MVTRADE_MOM_3M	0.008	0.074	0.074	0.479	0.110	0.562	0.127	0.618	0.150	0.617	0.154	0.634	0.161	0.631	0.168	0.717	0.175	0.754
DIV_6M	0.005	0.084	0.090	0.543	0.086	0.493	0.126	0.678	0.118	0.413	0.131	0.470	0.112	0.420	0.098	0.370	0.108	0.428
CEPS_6M	0.005	0.057	0.079	0.479	0.092	0.486	0.116	0.556	0.135	0.529	0.137	0.556	0.147	0.628	0.154	0.690	0.162	0.721
TV_2YR	0.005	0.045	0.063	0.376	0.083	0.455	0.120	0.600	0.180	0.640	0.174	0.725	0.184	0.694	0.179	0.778	0.180	0.774
CF_6M	0.005	0.039	0.069	0.439	0.091	0.476	0.111	0.552	0.132	0.487	0.146	0.521	0.150	0.544	0.153	0.615	0.153	0.606
DY_1YR	0.004	0.039	0.088	0.591	0.088	0.534	0.143	0.820	0.145	0.517	0.138	0.504	0.141	0.519	0.141	0.571	0.149	0.580
A_TURN	0.004	0.061	0.088	0.504	0.111	0.568	0.130	0.619	0.155	0.603	0.173	0.728	0.181	0.758	0.180	0.804	0.187	0.834
EPSCH_P_12M	0.004	0.044	0.067	0.449	0.089	0.549	0.129	0.749	0.155	0.625	0.181	0.780	0.187	0.786	0.193	0.847		
TV_1M	0.004	0.039	0.077	0.463	0.107	0.555	0.125	0.605	0.131	0.532	0.150	0.632	0.160	0.681	0.174	0.737	0.170	0.735
CEPS	0.003	0.028	0.082	0.471	0.110	0.546	0.128	0.599	0.141	0.563	0.189	0.719	0.179	0.783	0.178	0.810	0.183	0.838
CROSS1_MOM3M	0.001	0.024	0.071	0.478	0.105	0.562	0.125	0.611	0.137	0.573	0.152	0.653	0.158	0.683	0.160	0.737	0.169	0.772
ROCE_6M	0.001	0.010	0.102	0.581	0.089	0.427	0.105	0.499	0.145	0.542	0.145	0.572	0.147	0.602	0.114	0.453	0.114	0.448
CROSS3_MOM12M	0.000	0.006	0.070	0.466	0.105	0.550	0.124	0.618	0.132	0.562	0.162	0.706	0.167	0.733	0.172	0.801	0.180	0.815
RETEN_2YR	-0.001	-0.009	0.055	0.273	0.057	0.322	0.116	0.595	0.152	0.601	0.177	0.727	0.178	0.710	0.185	0.795	0.190	0.797
P_1M	-0.001	-0.004	0.068	0.444	0.097	0.489	0.132	0.655	0.143	0.569	0.169	0.714	0.176	0.740	0.177	0.790	0.176	0.787
MTBV	-0.002	-0.013	0.094	0.603	0.125	0.657	0.132	0.695	0.157	0.591	0.120	0.424	0.122	0.451	0.124	0.462	0.136	0.516
OPMTP	-0.002	-0.010	0.059	0.326	0.068	0.332	0.117	0.577	0.170	0.681	0.153	0.576	0.147	0.544	0.166	0.663	0.167	0.673
TLITA	-0.004	-0.051	0.083	0.487	0.109	0.557	0.128	0.617	0.153	0.602	0.172	0.722	0.176	0.747	0.180	0.813	0.187	0.830
CFTBORRREP_DIV_1YR	-0.005	-0.034	0.059	0.334	0.062	0.382	0.108	0.650	0.178	0.754								
BORROW	-0.005	-0.043	0.070	0.370	0.080	0.395	0.102	0.478	0.124	0.493	0.137	0.524	0.133	0.509	0.143	0.606	0.151	0.649
LNP_2YR	-0.005	-0.062	0.058	0.405	0.072	0.378	0.109	0.527	0.140	0.541	0.164	0.678	0.173	0.699	0.163	0.729	0.168	0.783
GEAR_6M	-0.009	-0.100	0.092	0.554	0.104	0.521	0.125	0.584	0.112	0.433	0.134	0.509	0.141	0.541	0.143	0.575	0.145	0.591
CROSS6_MOM12M	-0.009	-0.183	0.071	0.464	0.097	0.502	0.121	0.580	0.150	0.600	0.174	0.749	0.180	0.783	0.189	0.827	0.191	0.817
BTMV_2YR	-0.011	-0.086	0.073	0.439	0.096	0.523	0.130	0.796	0.157	0.673	0.178	0.806	0.151	0.607	0.144	0.636	0.141	0.623
MTBV_6M	-0.013	-0.076	0.081	0.478	0.085	0.434	0.107	0.525	0.122	0.440	0.121	0.430	0.122	0.429	0.128	0.463	0.141	0.499
DY_6M	-0.013	-0.069	0.100	0.673	0.102	0.614	0.139	0.798	0.151	0.510	0.139	0.457	0.117	0.411	0.119	0.427	0.120	0.435
ACCREC_6M_CH	-0.014	-0.132	0.079	0.493	0.096	0.538	0.120	0.623	0.137	0.567	0.146	0.611	0.145	0.567	0.159	0.668	0.163	0.698
CF_1YR	-0.014	-0.120	0.095	0.539	0.105	0.549	0.126	0.598	0.129	0.507	0.158	0.649	0.156	0.660	0.152	0.697	0.149	0.664
CFTBORRREP_DIV	-0.015	-0.098	0.083	0.489	0.094	0.474	0.122	0.581	0.189	0.671	0.170	0.834	0.170	0.853	0.179	0.717	0.184	0.769
BORROW_1YR	-0.017	-0.157	0.073	0.504	0.070	0.433	0.102	0.617	0.126	0.521	0.104	0.381	0.104	0.383	0.112	0.444	0.126	0.514
ECANDRES_1YR	-0.020	-0.173	0.095	0.533	0.108	0.513	0.127	0.592	0.137	0.533	0.141	0.547	0.141	0.530	0.154	0.621	0.153	0.618
ECANDRES_2YR	-0.022	-0.179	0.039	0.228	0.059	0.303	0.098	0.481	0.136	0.525	0.163	0.674	0.166	0.698	0.165	0.739	0.168	0.780

F.6. Expected Return Model Created from an Historic Mean Timing Model

The Haugen and Baker (1996) forecasting methodology is applied in a stepwise procedure to derive expected return models using nonstandardised attributes. The procedure starts by applying the Haugen and Baker (1996) methodology using one explanatory variable. An historic trailing mean model is used to predict the slopes of the variables. The forecasting ability of the variable is tested using the Information Coefficient (IC) of Grinold (1989), and the variable that displays the highest IC is taken to the next step where the above procedure is repeated using two variables, the first being that from the first step. The second attribute to remain in the model is that which combines with the first attribute to produce the highest IC. The stepwise procedure continues until the multifactor expected return model derived at a stage displays an IC lower than that of the previous stage's model. The Information Ratio (IR) calculated is that of Qian and Hua (2004) and is the mean monthly IC divided by the standard deviation of the IC over the months. The mean IC and IR statistic of the multifactor models tested at each step in the procedure are displayed. The statistics refer to the multifactor model consisting of the variables that remained in the expected return model from previous steps and the variable next to which the statistic is displayed. Variables that remain in the model are displayed in white on a black background, and the mean IC and IR of the model with that variable's addition are similarly displayed. In the last step of the procedure, the variable that combines with those that remained in the model from previous steps to give the highest mean IC is displayed in bold on a grey background, as this model is inferior that created at the previous step. The variables are listed in descending order of the univariately calculated mean IC statistic (in other words, the mean IC statistic calculated at the first step in the stepwise procedure). The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Attributes	1 Variable		2 Variables		3 Variables		4 Variables	
	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR
MOM_12M	0.072	0.463						
MOM_6M	0.066	0.415	0.071	0.481	0.068	0.510	0.067	0.383
LNMV	0.062	0.396	0.063	0.400	0.077	0.520	0.085	0.457
BVPS	0.062	0.379	0.063	0.400	0.076	0.503	0.083	0.433
RETEN	0.059	0.467	0.085	0.585	0.085	0.609	0.093	0.545
MOM_18M	0.059	0.371	0.063	0.412	0.073	0.508	0.073	0.388
DPS	0.056	0.349	0.064	0.423	0.072	0.506	0.072	0.383
P_1YR	0.052	0.301	0.063	0.406	0.074	0.477	0.078	0.398
MVTRADE_1YR	0.048	0.314	0.071	0.466	0.068	0.483	0.069	0.381
DIV_2YR	0.047	0.292	0.071	0.453	0.066	0.436	0.068	0.362
P_6M	0.042	0.308	0.057	0.410	0.060	0.429	0.066	0.366
SALEPEMPLOY_1YR	0.041	0.340	0.088	0.546	0.082	0.483	0.083	0.490
P_3M	0.040	0.295	0.079	0.452	0.090	0.571	0.086	0.568
LNP	0.039	0.272	0.086	0.504	0.089	0.506	0.089	0.469
DPS_6M	0.038	0.268	0.073	0.470	0.076	0.533	0.080	0.469
OBOS_6MMA	0.036	0.361	0.078	0.466	0.074	0.415	0.074	0.419
DY_6M	0.034	0.240	0.071	0.454	0.069	0.475	0.063	0.341
NS	0.034	0.350	0.066	0.470	0.068	0.526	0.069	0.450
ECANDRES	0.034	0.259	0.095	0.652	0.109	0.821		
LNMV_1YR	0.034	0.273	0.081	0.531	0.072	0.445	0.093	0.645
MOM_3M	0.034	0.307	0.062	0.413	0.063	0.462	0.071	0.421
ECANDRES_1YR	0.031	0.261	0.047	0.332	0.058	0.383	0.065	0.400
P	0.031	0.338	0.069	0.496	0.074	0.544	0.057	0.391
ROCE_1YR	0.031	0.270	0.064	0.420	0.071	0.512	0.066	0.467
LNMV_2YR	0.030	0.307	0.083	0.538	0.077	0.479	0.074	0.444
P_2YR	0.030	0.248	0.058	0.391	0.060	0.416	0.075	0.467
DIV	0.028	0.310	0.071	0.506	0.073	0.548	0.059	0.387
MOM_24M	0.028	0.156	0.048	0.225	0.049	0.256	0.078	0.453
CFTP	0.027	0.312	0.072	0.470	0.068	0.500	0.050	0.259
DY_1YR	0.025	0.147	0.069	0.355	0.077	0.398	0.068	0.416
MVTRADE_2YR	0.025	0.212	0.050	0.321	0.049	0.310	0.076	0.403
EPS_2YRAV	0.024	0.257	0.073	0.430	0.066	0.389	0.047	0.308
MTBV	0.024	0.195	0.084	0.578	0.085	0.549	0.066	0.363
ACCRU	0.023	0.260	0.067	0.448	0.071	0.535	0.085	0.512
ACCREC_1YR_CH	0.023	0.281	0.071	0.490	0.071	0.516	0.071	0.427
EPS	0.023	0.195	0.053	0.300	0.060	0.347	0.075	0.460
MVTRADEMV_2YR	0.023	0.173	0.062	0.411	0.066	0.468	0.055	0.327
P_1M	0.023	0.160	0.104	0.540				
LNMV_6M	0.023	0.300	0.072	0.509	0.096	0.482	0.062	0.364
MTBV_2YR	0.022	0.168	0.066	0.362	0.070	0.519	0.096	0.486
ICBT_2YR	0.021	0.194	0.041	0.327	0.069	0.371	0.074	0.449
BTMV	0.020	0.213	0.081	0.562	0.043	0.316	0.068	0.366

F.6. Expected Return Model Created from an Historic Mean Timing Model

- continued

Attributes	1 Variable		2 Variables		3 Variables		4 Variables	
	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR
CEPS	0.019	0.118	0.072	0.516	0.099	0.771	0.043	0.316
CHSALE_LES_CHACRE	0.018	0.138	0.066	0.412	0.069	0.471	0.083	0.564
CFTBORRREPDIV	0.016	0.103	0.051	0.303	0.072	0.491	0.068	0.389
DIV_6M	0.016	0.167	0.071	0.428	0.068	0.421	0.070	0.380
TV_1YR	0.016	0.141	0.079	0.472	0.066	0.393	0.067	0.425
LNMV_3M	0.015	0.123	0.056	0.360	0.071	0.405	0.066	0.398
CEPS_6M	0.015	0.204	0.074	0.477	0.060	0.372	0.071	0.405
MVTRADEMV	0.015	0.149	0.057	0.391	0.068	0.496	0.057	0.360
TLTTA	0.015	0.089	0.080	0.468	0.062	0.468	0.067	0.400
MVTRADE_3M	0.015	0.113	0.067	0.392	0.076	0.446	0.075	0.452
OBOS_3MMA	0.014	0.135	0.073	0.417	0.064	0.362	0.076	0.446
INTANMV_1YR	0.013	0.131	0.072	0.420	0.088	0.559	0.061	0.357
SALEPEMPLOY_2YR	0.013	0.082	0.024	0.149	0.074	0.443	0.076	0.463
MVTRADEMV_1M	0.013	0.111	0.086	0.595	0.023	0.139	0.072	0.430
A_TURN	0.012	0.135	0.063	0.423	0.103	0.806	0.022	0.137
MVTRADE	0.012	0.118	0.057	0.402	0.068	0.521	0.086	0.599
RETEN_1YR	0.011	0.088	0.055	0.305	0.059	0.454	0.064	0.396
GROW_2YR	0.011	0.086	0.080	0.423	0.051	0.291	0.063	0.378
CFTBORRREP_6M	0.011	0.082	0.055	0.313	0.075	0.403	0.052	0.298
MTBV_6M	0.011	0.071	0.013	0.082	0.051	0.288	0.072	0.396
MVTRADEMV_1YR	0.010	0.113	0.069	0.452	0.019	0.114	0.052	0.295
ROCE_6M	0.008	0.113	0.072	0.406	0.069	0.488	0.017	0.106
CROSS3_MOM12M	0.007	0.056	0.066	0.428	0.076	0.431	0.072	0.416
MVTRADEMV_3M	0.007	0.086	0.055	0.349	0.069	0.485	0.074	0.425
EPSCH_P_6M	0.007	0.057	0.039	0.221	0.054	0.322	0.063	0.384
INTANMV_6M	0.007	0.059	0.036	0.236	0.048	0.295	0.056	0.341
DPS_1YR	0.006	0.067	0.074	0.406	0.045	0.266	0.047	0.295
LNP_2YR	0.006	0.040	0.072	0.515	0.074	0.396	0.042	0.249
MVTRADE_6M	0.006	0.083	0.078	0.438	0.073	0.400	0.072	0.399
SALESTP_2YR	0.006	0.040	0.055	0.348	0.061	0.383	0.072	0.402
MVTRADE_1M	0.005	0.067	0.078	0.450	0.072	0.391	0.060	0.376
TV	0.005	0.058	0.078	0.441	0.073	0.402	0.073	0.407
NPMT	0.005	0.034	0.036	0.227	0.052	0.312	0.049	0.303
CFTBORRREPDIV_1YR	0.004	0.030	0.046	0.269	0.059	0.363	0.057	0.359
CF_1YR	0.004	0.024	0.061	0.314	0.045	0.238	0.046	0.248
CFTTL_6M	0.003	0.032	0.068	0.433	0.065	0.465	0.070	0.403
WC_1YR	0.003	0.031	0.062	0.406	0.062	0.447	0.064	0.388
RETEN_2YR	0.003	0.024	0.067	0.366	0.077	0.404	0.079	0.422
TV_2YR	0.003	0.019	0.068	0.450	0.072	0.516	0.068	0.416
CROSS1_MOM3M	0.003	0.021	0.085	0.486	0.082	0.462	0.082	0.464
CFTBORRREPDIV_6M	0.002	0.026	0.076	0.454	0.096	0.685	0.092	0.654
EPS_6M	0.002	0.015	0.078	0.433	0.074	0.429	0.072	0.422
BORROW	0.001	0.020	0.075	0.481	0.074	0.520	0.074	0.420
TV_1M	0.000	-0.003	0.074	0.493	0.073	0.532	0.069	0.422
ECANDRES_2YR	0.000	-0.001	0.086	0.371	0.069	0.330	0.068	0.324
ICBT	-0.001	-0.005	0.077	0.428	0.073	0.399	0.073	0.399
OPMT	-0.001	-0.020	0.068	0.447	0.064	0.448	0.067	0.396
MVTRADEMV_6M	-0.002	-0.020	0.043	0.219	0.080	0.440	0.078	0.433
BORROW_1YR	-0.003	-0.021	0.064	0.371	0.067	0.408	0.066	0.369
SALESTP	-0.004	-0.040	0.073	0.417	0.069	0.395	0.067	0.390
WC	-0.004	-0.029	0.078	0.382	0.073	0.394	0.054	0.288
EPSCH_P_12M	-0.005	-0.043	0.050	0.313	0.061	0.364	0.058	0.357
BTMV_2YR	-0.005	-0.033	0.053	0.298	0.076	0.475	0.076	0.473
TV_3M	-0.005	-0.067	0.076	0.412	0.072	0.398	0.070	0.394
CFTBORRREPDIV_2YR	-0.006	-0.082	0.028	0.138	0.050	0.279	0.051	0.289
CROSS6_MOM12M	-0.008	-0.049	0.053	0.313	0.084	0.498	0.086	0.507
GEAR_6M	-0.009	-0.064	0.096	0.660	0.108	0.837	0.092	0.648
FOUR_YREARNGROWA	-0.011	-0.196	0.071	0.466	0.068	0.478	0.059	0.361
TV_6M	-0.012	-0.076	0.003	0.018	0.009	0.047	0.008	0.044
QUICK	-0.019	-0.147	0.045	0.267	0.046	0.253	0.048	0.263
CF_6M	-0.022	-0.172	0.049	0.300	0.065	0.419	0.063	0.417
ACCREC_6M_CH	-0.025	-0.174	0.039	0.235	0.046	0.256	0.044	0.252
SALESTP_6M	-0.052	-0.286	0.045	0.225	0.060	0.298	0.059	0.297

F.7. Expected Return Model Created from a Twelve-lag Autoregressive Timing Model

The Haugen and Baker (1996) forecasting methodology is applied in a stepwise procedure to derive expected return models using nonstandardised attributes. The procedure starts by applying the Haugen and Baker (1996) methodology using one explanatory variable. A twelve-lag autoregressive model is used to predict the slopes of the variables. The autoregressive model calculates an intercept and lag coefficients for the lagged variables by running Ordinary Least Squares twelve-lag autoregressions only on the controlled monthly payoffs data before that month. (This is known as an “expanding window”, which results in 24 observations being used for the autoregression for month 25’s payoff, and 118 observations being used for the last month’s payoff.) The forecasting ability of the variable is tested using the Information Coefficient (IC) of Grinold (1989), and the variable that displays the highest IC is taken to the next step where the above procedure is repeated using two variables, the first being that from the first step. The second attribute to remain in the model is that which combines with the first attribute to produce the highest IC. The stepwise procedure continues until the multifactor expected return model derived at a stage displays an IC lower than that of the previous stage’s model. The Information Ratio (IR) calculated is that of Qian and Hua (2004) and is the mean monthly IC divided by the standard deviation of the IC over the months. The mean IC and IR statistic of the multifactor models tested at each step in the procedure are displayed. The statistics refer to the multifactor model consisting of the variables that remained in the expected return model from previous steps and the variable next to which the statistic is displayed. Variables that remain in the model are displayed in white on a black background, and the mean IC and IR of the model with that variable’s addition are similarly displayed. In the last step of the procedure, the variable that combines with those that remained in the model from previous steps to give the highest mean IC is displayed in bold on a grey background, as this model is inferior that created at the previous step. The variables are listed in descending order of the univariately calculated mean IC statistic (in other words, the mean IC statistic calculated at the first step in the stepwise procedure). The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Attributes	1 Variable		2 Variables		3 Variables		4 Variables		5 Variables		6 Variables		7 Variables		8 Variables		9 Variables		
	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	
LNP	0.061	0.463																	
MOM_12M	0.047	0.307	0.085	0.446	0.064	0.421	0.088	0.452	0.078	0.469	0.080	0.501	0.085	0.526	0.086	0.539	0.086	0.568	
BTMV	0.043	0.340	0.055	0.400	0.071	0.521	0.089	0.597	0.086	0.619	0.104	0.698							
LNMV_1YR	0.041	0.298	0.066	0.476															
SALEEMPLOY_1YR	0.040	0.299	0.030	0.158	0.046	0.209	0.001	0.003	0.034	0.174	0.039	0.209	0.027	0.129	0.027	0.116	0.031	0.148	
P_3M	0.034	0.219	0.060	0.429	0.033	0.229	0.064	0.406	0.081	0.462	0.095	0.647	0.101	0.730	0.101	0.693	0.080	0.538	
BVPS	0.034	0.365	0.034	0.259	0.070	0.449	0.071	0.490	0.094	0.662	0.095	0.618	0.078	0.530	0.079	0.519	0.084	0.590	
MTBV_6M	0.031	0.197	0.039	0.247	0.063	0.398	0.039	0.237	0.072	0.452	0.064	0.392	0.062	0.350	0.080	0.481	0.083	0.573	
P	0.030	0.337	0.036	0.269	0.060	0.425	0.070	0.459	0.088	0.580	0.091	0.599	0.086	0.639	0.086	0.635	0.102	0.702	
MOM_3M	0.030	0.185	0.058	0.381	0.031	0.200	0.064	0.407	0.083	0.488	0.098	0.649	0.100	0.718	0.101	0.681	0.080	0.545	
P_1YR	0.030	0.187	0.057	0.373	0.051	0.327	0.072	0.482	0.075	0.488	0.084	0.538	0.079	0.490	0.082	0.499	0.094	0.543	
CFTBORRREPDIV_2YR	0.029	0.249	0.043	0.307	0.050	0.281	0.054	0.318	0.047	0.280	0.067	0.386	0.082	0.399	0.065	0.421	0.050	0.309	
DPS_6M	0.028	0.206	0.037	0.249	0.068	0.413	0.057	0.380	0.067	0.386	0.085	0.534	0.092	0.576	0.086	0.526	0.077	0.470	
LNMV_3M	0.028	0.156	0.058	0.374	0.049	0.316	0.075	0.482	0.089	0.573	0.090	0.634	0.095	0.690	0.105	0.770	0.080	0.561	
NS	0.028	0.389	0.052	0.419	0.071	0.487	0.073	0.488	0.083	0.636	0.098	0.662	0.099	0.692	0.101	0.678	0.106	0.793	
LNMV	0.025	0.166	0.052	0.393	0.054	0.406	0.073	0.484	0.100	0.698	0.100	0.702	0.102	0.725	0.097	0.685	0.102	0.793	
MVTRADEMV_1YR	0.024	0.252	0.043	0.323	0.043	0.327	0.074	0.466	0.094	0.603	0.081	0.542	0.084	0.564	0.087	0.601	0.092	0.696	
OBOS_6MMA	0.024	0.133	0.082	0.403	0.043	0.275	0.048	0.273	0.073	0.457	0.087	0.587	0.087	0.633	0.099	0.730	0.082	0.524	
MVTRADE_1YR	0.023	0.215	0.045	0.307	0.049	0.370	0.071	0.432	0.089	0.516	0.079	0.482	0.081	0.470	0.083	0.479	0.083	0.542	
DV_1YR	0.022	0.193	0.027	0.215	0.055	0.341	0.039	0.255	0.070	0.447	0.080	0.382	0.071	0.468	0.081	0.405	0.085	0.340	
OPMTP	0.021	0.156	0.038	0.263	0.048	0.268	0.048	0.298	0.063	0.381	0.056	0.343	0.080	0.401	0.059	0.397	0.072	0.507	
DPS	0.021	0.220	0.046	0.411	0.063	0.501	0.082	0.579	0.097	0.681	0.098	0.673	0.093	0.669	0.100	0.701	0.095	0.722	
P_6M	0.020	0.127	0.059	0.388	0.033	0.209	0.089	0.417	0.088	0.561	0.101	0.686	0.105	0.770	0.107	0.751	0.085	0.329	
INTANMV_1YR	0.019	0.161	0.044	0.344	0.066	0.431	0.054	0.347	0.065	0.429	0.060	0.423	0.057	0.380	0.051	0.366	0.047	0.304	
TV_6M	0.018	0.188	0.039	0.265	0.059	0.397	0.086	0.569	0.103	0.685									
RETN	0.017	0.108	0.050	0.336	0.056	0.349	0.052	0.386	0.067	0.572	0.088	0.566	0.086	0.581	0.087	0.562	0.087	0.717	
CFTP	0.017	0.154	0.049	0.390	0.082	0.476	0.095	0.636											
MVTRADE	0.017	0.274	0.051	0.397	0.081	0.406	0.074	0.499	0.084	0.527	0.089	0.594	0.097	0.667	0.099	0.676	0.102	0.738	
MOM_24M	0.017	0.137	0.046	0.336	0.051	0.338	0.046	0.295	0.057	0.353	0.072	0.457	0.065	0.427	0.061	0.392	0.066	0.425	
DIV_2YR	0.017	0.142	0.018	0.143	0.051	0.320	0.058	0.385	0.084	0.503	0.075	0.434	0.084	0.523	0.080	0.499	0.082	0.374	
WC_1YR	0.016	0.168	0.038	0.300	0.054	0.419	0.062	0.390	0.043	0.283	0.072	0.438	0.074	0.446	0.077	0.467	0.086	0.544	
ECANDRES	0.016	0.214	0.047	0.370	0.084	0.432	0.088	0.458	0.090	0.615	0.091	0.595	0.093	0.630	0.101	0.667	0.104	0.735	
TV_1YR	0.015	0.141	0.029	0.218	0.062	0.429	0.074	0.479	0.088	0.570	0.086	0.622	0.094	0.689	0.094	0.721	0.087	0.572	
CFTBORRREPDIV_6M	0.015	0.101	0.037	0.271	0.074	0.540	0.083	0.536	0.099	0.640	0.089	0.629	0.087	0.586	0.093	0.629	0.100	0.666	
OBOS_3MMA	0.014	0.086	0.054	0.362	0.047	0.328	0.057	0.338	0.075	0.451	0.083	0.523	0.080	0.612	0.095	0.637	0.088	0.608	
CF_1YR	0.014	0.124	0.037	0.282	0.052	0.392	0.089	0.463	0.078	0.538	0.084	0.589	0.084	0.615	0.089	0.660	0.087	0.607	
MOM_18M	0.014	0.107	0.062	0.454	0.052	0.352	0.027	0.174	0.057	0.370	0.066	0.439	0.080	0.526	0.082	0.514	0.095	0.687	
BORROW_1YR	0.013	0.120	0.038	0.286	0.079	0.509													
ROCE_1YR	0.013	0.097	0.038	0.246	0.036	0.265	0.017	0.108	0.031	0.172	0.072	0.480	0.080	0.369	0.057	0.333	0.089	0.434	
CFTBORRREPDIV_1YR	0.013	0.086	0.017	0.101	0.034	0.207	0.041	0.252	0.063	0.362	0.075	0.479	0.072	0.479	0.078	0.530	0.089	0.415	
DIV	0.012	0.195	0.051	0.426	0.069	0.478	0.076	0.518	0.090	0.630	0.093	0.618	0.092	0.638	0.099	0.654	0.104	0.748	
MVTRADE_1M	0.012	0.144	0.048	0.373	0.053	0.373	0.066	0.434	0.075	0.493	0.089	0.644	0.093	0.692	0.096	0.698	0.092	0.673	

F.7. Expected Return Model Created from a Twelve-lag Autoregressive Timing Model

- continued

Attributes	1 Variable		2 Variables		3 Variables		4 Variables		5 Variables		6 Variables		7 Variables		8 Variables		9 Variables	
	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR	MEAN IC	IR
SALESTP	0.012	0.103	0.040	0.301	0.063	0.426	0.051	0.313	0.066	0.424	0.092	0.619	0.083	0.499	0.090	0.554	0.091	0.591
INTANMV_6M	0.012	0.100	0.019	0.154	0.071	0.445	0.055	0.352	0.067	0.420	0.062	0.409	0.054	0.420	0.056	0.349	0.013	0.092
EPS_2YRAV	0.012	0.136	0.051	0.425	0.062	0.482	0.072	0.480	0.084	0.547	0.090	0.619	0.084	0.599	0.084	0.603	0.083	0.585
ICBT	0.011	0.106	0.038	0.339	0.044	0.364	0.068	0.472	0.091	0.661	0.094	0.712	0.099	0.755	0.103	0.763	0.091	0.701
MTBV	0.010	0.082	0.039	0.284	0.048	0.350	0.076	0.501	0.077	0.499	0.084	0.487	0.088	0.540	0.090	0.544	0.102	0.695
TLTTA	0.009	0.108	0.046	0.360	0.066	0.486	0.070	0.437	0.090	0.579	0.093	0.596	0.107	0.701				
MVTRADE_6M	0.009	0.082	0.026	0.196	0.038	0.257	0.067	0.549	0.097	0.639	0.070	0.474	0.080	0.539	0.085	0.596	0.100	0.659
RETN_1YR	0.009	0.138	0.021	0.158	0.045	0.360	0.044	0.304	0.059	0.390	0.067	0.491	0.069	0.475	0.067	0.476	0.050	0.599
EPS_6M	0.008	0.079	0.017	0.126	0.045	0.271	0.031	0.176	0.042	0.236	0.056	0.355	0.063	0.458	0.061	0.438	0.048	0.328
MOM_6M	0.008	0.049	0.055	0.369	0.041	0.264	0.073	0.480	0.091	0.616	0.100	0.691	0.107	0.769	0.108	0.768		
MVTRADEMV_1M	0.008	0.097	0.046	0.389	0.052	0.384	0.058	0.388	0.075	0.513	0.089	0.655	0.094	0.728	0.098	0.732	0.095	0.701
TV	0.008	0.061	0.040	0.280	0.042	0.257	0.068	0.443	0.084	0.524	0.081	0.571	0.089	0.615	0.090	0.595	0.054	0.649
TV_3M	0.007	0.073	0.026	0.180	0.051	0.321	0.074	0.461	0.085	0.516	0.093	0.650	0.096	0.681	0.102	0.719	0.098	0.724
CHSALE_LES_CHACRE	0.007	0.071	0.019	0.141	0.041	0.279	0.030	0.212	0.062	0.474	0.056	0.410	0.043	0.303	0.040	0.278	0.056	0.504
GEAR_6M	0.007	0.074	0.015	0.136	0.034	0.278	0.058	0.398	0.048	0.293	0.068	0.458	0.070	0.492	0.070	0.477	0.084	0.581
EPS	0.007	0.075	0.043	0.331	0.059	0.450	0.074	0.511	0.093	0.652	0.089	0.615	0.092	0.645	0.098	0.656	0.101	0.715
MVTRADEMV_6M	0.006	0.066	0.034	0.258	0.047	0.321	0.065	0.607	0.097	0.662	0.089	0.685	0.072	0.522	0.079	0.567	0.081	0.533
MVTRADE_2YR	0.006	0.044	0.026	0.179	0.029	0.199	0.052	0.343	0.068	0.407	0.072	0.468	0.068	0.471	0.071	0.487	0.068	0.430
CEPS	0.005	0.056	0.053	0.405	0.072	0.497	0.065	0.414	0.085	0.559	0.084	0.557	0.085	0.591	0.085	0.584	0.087	0.613
WC	0.005	0.042	0.047	0.319	0.071	0.456	0.070	0.412	0.067	0.396	0.086	0.517	0.082	0.469	0.081	0.473	0.092	0.585
CFTBORRRREP_6M	0.004	0.038	0.024	0.209	0.042	0.341	0.046	0.306	0.063	0.410	0.065	0.416	0.063	0.412	0.073	0.530	0.062	0.386
FOUR_YREARNGROWA	0.004	0.036	0.005	0.033	0.024	0.135	0.042	0.225	0.069	0.407	0.049	0.280	0.056	0.315	0.041	0.232	0.034	0.196
TV_1M	0.004	0.044	0.036	0.290	0.050	0.318	0.055	0.349	0.069	0.451	0.090	0.657	0.094	0.726	0.098	0.739	0.095	0.697
CEPS_6M	0.004	0.046	0.033	0.269	0.044	0.318	0.056	0.348	0.073	0.467	0.082	0.590	0.092	0.646	0.092	0.615	0.091	0.667
ACCREC_1YR_CH	0.004	0.041	0.017	0.125	0.036	0.263	0.065	0.427	0.086	0.552	0.096	0.594	0.088	0.541	0.089	0.534	0.096	0.684
LNP_2YR	0.004	0.040	0.030	0.233	0.041	0.314	0.063	0.424	0.085	0.591	0.093	0.647	0.084	0.608	0.092	0.667	0.090	0.614
DY_6M	0.004	0.027	0.037	0.282	0.048	0.315	0.040	0.252	0.068	0.414	0.071	0.448	0.069	0.440	0.062	0.394	0.068	0.445
MVTRADE_3M	0.003	0.020	0.034	0.233	0.074	0.522	0.048	0.273	0.090	0.344	0.080	0.348	0.078	0.495	0.069	0.423	0.071	0.420
MVTRADEMV_2YR	0.003	0.034	0.049	0.386	0.055	0.404	0.075	0.468	0.085	0.534	0.099	0.726	0.102	0.745	0.106	0.780	0.103	0.746
P_1M	0.003	0.032	0.031	0.226	0.030	0.215	0.072	0.497	0.080	0.580	0.089	0.624	0.087	0.629	0.082	0.611	0.077	0.533
QUICK	0.003	0.018	0.056	0.378	0.042	0.289	0.059	0.395	0.080	0.537	0.094	0.645	0.097	0.674	0.100	0.715	0.093	0.667
BORROW	0.003	0.023	0.050	0.337	0.075	0.466	0.072	0.433	0.068	0.417	0.075	0.476	0.066	0.381	0.069	0.380	0.089	0.553
LNAV_6M	0.002	0.016	0.042	0.280	0.049	0.302	0.042	0.242	0.079	0.457	0.086	0.524	0.089	0.566	0.090	0.568	0.091	0.582
LNNAV_6M	0.002	0.012	0.041	0.305	0.051	0.391	0.053	0.303	0.073	0.446	0.079	0.507	0.089	0.565	0.083	0.500	0.089	0.521
ECANDRES_1YR	0.002	0.015	0.037	0.259	0.060	0.440	0.068	0.427	0.087	0.524	0.102	0.685	0.107	0.763	0.104	0.729	0.102	0.663
SALEPEMPLY_2YR	0.001	0.010	-0.028	-0.149	0.028	0.122	0.028	0.124	0.072	0.291	0.071	0.315	0.069	0.250	0.052	0.228	0.038	0.157
CF_6M	0.001	0.007	0.027	0.202	0.050	0.374	0.059	0.385	0.071	0.452	0.070	0.475	0.076	0.506	0.080	0.540	0.085	0.579
TV_2YR	0.001	0.007	0.023	0.159	0.052	0.348	0.067	0.392	0.079	0.517	0.078	0.529	0.079	0.579	0.077	0.581	0.068	0.453
LNAV_2YR	0.001	0.004	0.037	0.262	0.027	0.192	0.049	0.299	0.070	0.420	0.075	0.464	0.064	0.395	0.064	0.383	0.056	0.389
EPSCH_P_12M	0.000	0.004	0.041	0.350	0.047	0.350	0.061	0.422	0.072	0.439	0.088	0.583	0.083	0.553	0.086	0.594	0.092	0.570
SALESTP_2YR	0.000	0.002	0.002	0.016	0.002	0.012	0.004	0.032	0.014	0.114	0.025	0.213	0.015	0.130	0.017	0.149	0.031	0.296
A_TURN	0.000	0.003	0.049	0.396	0.060	0.412	0.075	0.481	0.087	0.571	0.104	0.708	0.099	0.688	0.097	0.665	0.090	0.648
CROSS6_MOM12M	0.000	-0.001	0.038	0.299	0.050	0.347	0.057	0.378	0.088	0.613	0.079	0.524	0.083	0.593	0.086	0.594	0.092	0.570
SALESTP_6M	-0.001	-0.004	0.036	0.252	0.051	0.405	0.054	0.352	0.064	0.405	0.071	0.460	0.070	0.450	0.071	0.469	0.060	0.380
CROSS1_MOM3M	-0.001	-0.015	0.044	0.371	0.057	0.437	0.071	0.481	0.084	0.562	0.083	0.651	0.097	0.672	0.099	0.656	0.095	0.656
ACCRU	-0.001	-0.009	0.041	0.253	0.072	0.438	0.067	0.398	0.067	0.401	0.069	0.420	0.059	0.337	0.068	0.381	0.050	0.336
DIV_6M	-0.001	-0.016	0.007	0.062	0.041	0.299	0.045	0.305	0.072	0.456	0.058	0.363	0.065	0.462	0.064	0.458	0.057	0.375
DPS_1YR	-0.002	-0.022	0.028	0.233	0.051	0.353	0.035	0.224	0.068	0.426	0.060	0.380	0.071	0.479	0.064	0.426	0.054	0.334
ACCREC_6M_CH	-0.004	-0.034	0.020	0.154	0.057	0.401	0.071	0.431	0.075	0.463	0.078	0.462	0.074	0.444	0.079	0.466	0.079	0.529
MTBV_2YR	-0.004	-0.024	0.007	0.037	0.065	0.386	0.051	0.295	0.073	0.394	0.096	0.583	0.100	0.637	0.096	0.601	0.099	0.587
CFTBORRRREP_DIV	-0.005	-0.046	0.048	0.353	0.066	0.380	0.052	0.345	0.067	0.423	0.089	0.631	0.096	0.712	0.094	0.681	0.087	0.586
MVTRADEMV	-0.005	-0.039	0.027	0.189	0.049	0.329	0.075	0.498	0.093	0.617	0.083	0.565	0.087	0.583	0.093	0.616	0.092	0.642
RETN_2YR	-0.006	-0.074	0.011	0.086	0.036	0.229	0.018	0.103	0.032	0.185	0.057	0.371	0.058	0.380	0.058	0.393	0.064	0.446
ROCE_6M	-0.007	-0.054	0.002	0.014	0.043	0.248	0.025	0.141	0.037	0.206	0.049	0.296	0.052	0.312	0.061	0.368	0.046	0.251
MVTRADEMV_3M	-0.006	-0.104	0.042	0.322	0.061	0.495	0.073	0.462	0.066	0.537	0.098	0.674	0.099	0.699	0.104	0.726	0.102	0.723
EPSCH_P_6M	-0.011	-0.126	0.032	0.250	0.027	0.215												

F.8. Derived Expected Return Models: Excluding Attributes with Too Few Observations

The Haugen and Baker (1996) forecasting methodology is applied in a stepwise procedure to derive expected return models. The procedure starts by applying the Haugen and Baker (1996) methodology using one nonstandardised explanatory variable. Instead of only using the twelve-month trailing moving average to predict slopes of the variables as in Haugen and Baker (1996), six timing models are used for slope prediction, namely one-month, six-month, twelve-month, and eighteen month trailing moving average models, an historic trailing mean model, and a twelve-lag autoregressive model, which calculates an intercept and lag coefficients for the lagged variables by running Ordinary Least Squares twelve-lag autoregressions only on the controlled monthly payoffs data before that month. (This is known as an “expanding window”, which results in 24 observations being used for the autoregression for month 25’s payoff, and 118 observations being used for the last month’s payoff.) The forecasting ability of the variable under each model is tested using the Information Coefficient (IC) of Grinold (1989). The variable for each timing model that displays the highest IC is taken to the next step where the above procedure is repeated using two variables, the first being that from the first step. The second attribute to remain in the model is that which combines with the first attribute to produce the highest IC. The stepwise procedure continues until the multifactor expected return model derived at a stage displays an IC lower than that of the previous stage’s model. Characteristics with fewer than 100 average monthly observations are then screened out of the models. The Information Ratio’s (IR) calculated are those of Qian and Hua (2004), which is the mean monthly IC divided by the standard deviation of the IC over the months, and Grinold (1989), which is the monthly IC multiplied by the number of forecasts made that month. The mean IC and IR statistic of the expected return models created at each step of the stepwise procedure are displayed for each of the six timing models. The attributes added as explanatory factors are shown for each model. The timing models are displayed in ascending order of the mean IC statistic of the final expected return model that they give rise to. The data were extracted from DataStream International. Refer to Table 4.2 in Chapter Four for the definitions of the firm-specific attributes.

Style-timing Model	Mean Monthly IC	IR (Qian and Hua, 2004)	IR (Grinold, 1989)	Variables			
AR12	0.108	0.768	1.526	LNP CFTP	BTMV BORROW_1YR	LMNV_1YR TLTTA	TV_6M MOM_6M
Hist M	0.109	0.821	1.059	MOM_12M	ECANDRES	P_1M	
1M	0.113	0.659	1.373	MOM_12M	RETEN	DY_6M	CFTP
6M	0.149	0.837	1.552	LMNV LMNV_3M CFTBORRRPDIV_6M TV	MOM_12M MVTRADEM_1YR CFTP ACCRU	ECANDRES_1YR P RETEN TV_1M	A_TURN
12M	0.126	0.626	1.427	MOM_12M ACCRU	BTMV	CFTP	EPSCH_P_6M
18M	0.101	0.633	1.082	MOM_12M LMNV_2YR	MOM_18M EPSCH_P_12M	CFTP CFTBORRRPDIV_1YR	ACCRU