Value and size investment strategies:

Evidence from the cross-section of returns

in the South African equity market

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Abstract

Value and size related equity investment strategies are supported by a large body of empirical research that shows a persistent premium, both longitudinally and cross-sectionally. However, the competing rational and behavioural finance explanations for the success of these strategies are a subject of debate. The rational explanation is that the premium earned on value shares or shares of small companies can be attributed to higher risk. Behaviouralists argue that such shares are not riskier and attribute the premium to cognitive errors and biases in human decision making.

The purpose of this study is to determine, firstly, whether the value and size premium exist in South Africa during the period July 2006 to June 2012, which includes one of the worst equity market crises in history. Secondly, this study sets out to determine whether the premium earned on value and size strategies are adequately explained by the principles of rational finance theory.

To provide evidence regarding the existence of the value premium and size effect, returns are analysed, cross-sectionally, on portfolios of shares sorted by value and size. For evidence of a rational explanation, returns are regressed on value and size variables, and the relative riskiness of value and small companies is analysed.

The results show evidence of a value premium in portfolios of small companies, but not big companies. The size effect is found not to be statistically significant. While regressions do show significant relationships between value and size variables and returns, these variables are found not to be associated with higher levels of risk. The conclusion is that the evidence does not support a rational, risk based explanation of the returns.

Key words: value premium, size effect, rational finance, behavioural finance.

Table of contents

Abstract **i**

Table of contents **ii**

List of figures **vi**

List of equations **vii**

List of tables **viii**

1 Chapter One - Introduction **1**

1.1 Research context 1

1.2 Research objectives 6

1.3 Structure of the thesis 7

2 Chapter Two – Value and size anomalies **9**

2.1 Introduction 9

2.2 Anomalies 9

2.2.1 Value anomalies 10

2.2.1.1 Price to earnings ratio 11

2.2.1.2 Book to market ratio 12

2.2.1.3 Other indicators of value 13

2.2.1.4 International studies of value anomalies 13

2.2.2 Anomalies based on company size and neglect 14

2.2.2.1 The size effect 14

2.2.2.2 The neglected companies effect 15

2.2.2.3 International studies of the size effect 16

2.2.3 Other anomalies 16

2.3 Conclusion 18

3 Chapter Three – South African studies of anomalies 19

3.1 Introduction 19

3.2 Value anomalies on the JSE 19

3.3 The size effect on the JSE 25

3.4 Other anomalies on the JSE 25

3.5 Conclusion 26

4 Chapter 4 – Rational finance theory 27

4.1 Introduction 27

4.2 The efficient markets hypothesis 28

4.3 Modern portfolio theory 32

4.4 The capital asset pricing model 34

4.5 Multifactor asset pricing models 40

4.6 The current state of the efficient markets hypothesis 42

4.7 Conclusion 44

5 Chapter Five – Behavioural finance theory 45

5.1 Introduction 45

5.2 Bounded rationality 47

5.3 Prospect theory 48

5.4 Adaptive markets hypothesis 50

5.5 The pillars of behavioural finance 53

5.5.1 Behavioural biases 53

5.5.1.1 Cognitive errors 53

5.5.1.2 Emotional biases 54

5.5.2 Limits to arbitrage 54

5.6 Behavioural asset pricing models 56

5.7 Conclusion 58

6 The rational-behaviouralist debate 59

6.1 Introduction 59

6.2 The debate in international research 59

6.3 The debate in South African research 62

6.4 Equity market bubbles and crashes 63

6.5 Research questions 66

6.6 Conclusion 67

7 Methodology and data 68

7.1 Introduction 68

7.2 Methodology: Evidence for the existence of the value premium and size effect 69

7.2.1 The collection of data and filtering of companies 70

7.2.1.1 The book value of equity 72

7.2.1.2 The market value of equity 74

7.2.1.3 Filtering and exclusions 75

7.2.2 The ranking and division of companies into two size groups based on ME 81

7.2.3 The division of each size group into three sub-groups based on BM 81

7.2.4 The measurement of company and portfolio returns 84

7.2.5 The calculation of the value premium and size effect 86

7.3 Methodology: Evidence for the conformity of the value premium and size effect to rational finance theory 89

7.3.1 Evidence for the relationships between the value and size variables and returns 90

7.3.2 Evidence for the relative riskiness of value and size investment strategies 94

7.4 Conclusion 98

8 Results, analysis and discussion 99

8.1 Introduction 99

8.2 Evidence for the existence of the value premium and size effect 99

8.3 Evidence for relationships between the value and size variables and returns 108

8.4 Evidence for the relative riskiness of value and size investment strategies 115

8.5 Conclusion 120

9 Conclusion 122

9.1 Introduction 122

9.2 Summary of results 122

9.3 Recommendations for further research 123

References 125

List of figures

Figure 1.1	Market risk premium, value premium and size effect during US bear markets	4
Figure 1.2	World, NYSE and JSE market capitalisations 2007 – 2012	5
Figure 4.1	Markowitz frontier and capital allocation line	33
Figure 4.2	Security market line	37
Figure 5.1	Prospect theory value function	49
Figure 7.1	Portfolio formation and return measurement process	71
Figure 8.1	Distribution of the market values of equity of JSE companies	102
Figure 8.2	Distribution of value-weighted portfolio monthly returns	106
Figure 8.3	Distribution of equal-weighted portfolio monthly returns	108
Figure 8.4	Value premium and increasing market returns, July 2006 to June 2012	117
Figure 8.5	Value premium and increasing quarters of GDP growth, July 2006 to June 2012	118
Figure 8.6	Size effect and increasing market returns, July 2006 to June 2012	119
Figure 8.7	Size effect and increasing quarters of GDP growth, July 2006 to June 2012	120

List of equations

Equation 4.1	Capital asset pricing model	36
Equation 7.1	Monthly return	85
Equation 7.2	Value premium	87
Equation 7.3	Size effect	88
Equation 7.4	Value premium - small companies	88
Equation 7.5	Value premium – big companies	89
Equation 7.6	Value premium – small companies minus big companies	89
Equation 7.7	Univariate regression model – BM	92
Equation 7.8	Univariate regression model – ln(ME)	93
Equation 7.9	Multivariate regression model – BM and ln(ME)	93
Equation 7.10	Return on value portfolios	95
Equation 7.11	Return on growth portfolios	96
Equation 7.12	Return on portfolios of small companies	96
Equation 7.13	Return on portfolios of big companies	96
Equation 7.14	Beta	97

List of tables

Table 7.1 The number of equity securities and exclusions 76

Table 7.2 The portfolio matrix 83

Table 8.1 The number of companies selected and allocated to each portfolio 100

Table 8.2 Descriptive statistics for the market value of equity of companies 101

Table 8.3 The book to market ratio by year 103

Table 8.4 Results of return calculations 104

Table 8.5 Descriptive statistics for each independent variable 109

Table 8.6 Results of correlations 110

Table 8.7 Breusch-Pagan tests for heteroskedasticity 110

Table 8.8 The results of regressions of returns on BM and ln(ME) of all companies 111

Table 8.9 Descriptive statistics for small and big company groups 112

Table 8.10 Results of regressions of returns on the BM of small and big companies 112

Table 8.11 Results of regressions of returns on the ln(ME) of small and big companies 113

Table 8.12 Results of the multivariate regression 114

Table 8.13 Returns and risk of value and growth portfolios, July 2006 to June 2012 116

Table 8.14 Returns and risk of small and big company portfolios, July 2006 to June 2012 119

Chapter One

Introduction

1.1 Research context

Value investment strategies can be traced back to Graham and Dodd (1934) who demonstrate that these strategies have the ability to yield above market returns. These strategies, which remain widely advocated by investors to the present day, favour investment in shares that are priced modestly relative to some measure of their value. The premium that can be realised by adopting a strategy that focuses on value shares rather than their antithesis, growth shares, is termed the value premium. A number of studies have found persistent evidence that value investment strategies, on average, outperform growth strategies (see for example, Fama and French (1998); Chan and Lakonishok (2004); Anderson and Brooks (2007); Ilmanen (2011)).

Another investment phenomenon, the size effect, describes the apparent excess expected returns available from companies with a small market capitalisation. One of the most important early papers on the size effect is Banz (1981), who finds that the effect is most significant with the very smallest companies. Subsequent studies, such as Reinganum (1981b), Chan and Chen (1991) and Fama and French (1992) also find persistent evidence in support of the size effect.

Both the value premium and size effect are examined in the seminal work of Fama and French (1992), which builds on earlier studies of stock market anomalies in the United States (US). They find that company size and the book-to-market ratio (a measure of value) are negatively and strongly positively related, respectively, to average returns. They also find that the theoretically expected positive relationship between beta (essentially a standardised measure of the covariance (systematic risk) of a security with the market) and average returns, central to the capital asset pricing model, does not exist during the period of that study.

The Fama and French (1992) study is considered to be important as the "results delivered a stunning blow to the explanatory power of the capital asset pricing model and sparked debates about the 'death of beta'" (Chan and Lakonishok 2004, p.71). In separate findings more relevant to this research, the Fama and French (1992) study also confirms that value and size related investment strategies yield returns that outperform the market.

The growing interest in international investment opportunities prompted the question whether this investment strategy could also be successfully applied to a cross-section of markets, other than the US and Japan, which were the focus of early studies (Chan and Lakonishok 2004). The studies have been extended to markets as diverse as Europe (Brouwer, van der Put and Veld (1997) and Bird and Whitaker (2003)), Taiwan (Chou and Johnson (1990)), New Zealand (Chin, Prevost and Gottesman (2002)), Canada (Athanassakos (2009)) and South Africa (Basiewicz and Auret 2009). Fama and French (1998) also study the value premium across thirteen developed markets and sixteen emerging markets. With few exceptions, these studies indicate that on average, value investment strategies outperform strategies favouring growth shares. It is significant that value strategies have been found to be cross-sectionally successful, in a range of markets representing varying financial reporting standards, statutes and regulations.

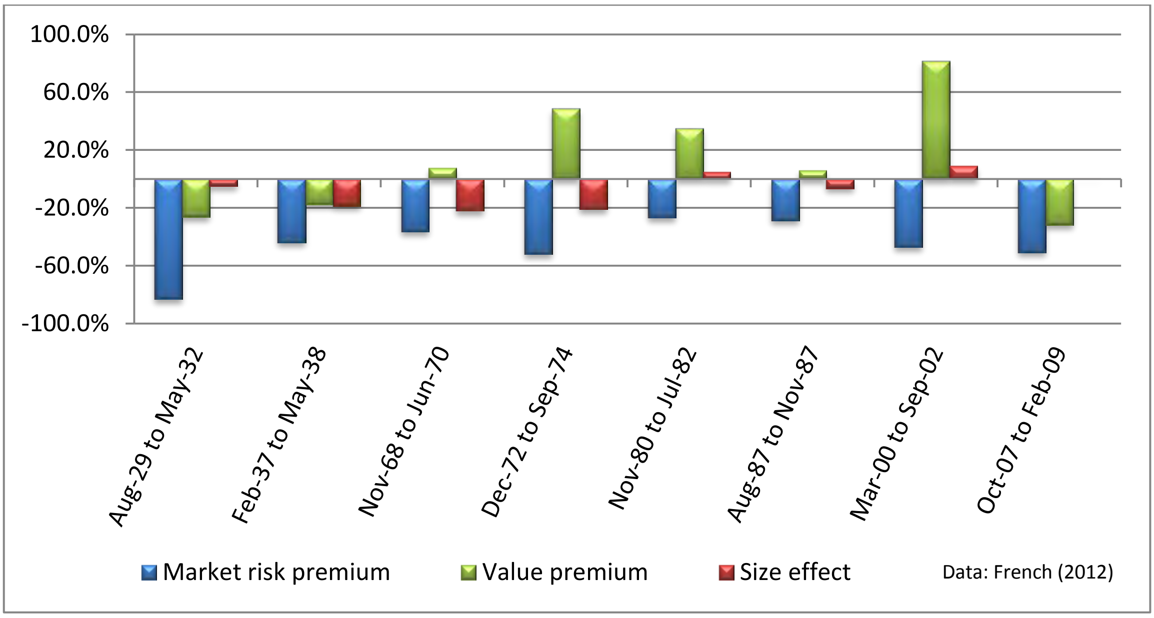
Studies of markets outside the US, both developed and emerging, also show a cross-sectional size effect. For example, studies of South-East Asia (Chui and Wei 1998), Europe (Heston, Rouwenhorst and Wessels 1999), China (Drew, Naughton and Veeraraghavan 2003) and the United Kingdom (Dimson, Nagel and Quigley 2003), all show evidence of the effect. Fama and French (1998) study the returns of sixteen emerging markets around the world between 1987 and 1995. They find a positive size effect in eleven of those markets and argue that these results confirm their positive findings on the size effect in the US. The results of studies of the size effect in the South African market have produced mixed results although there is more evidence of the anomaly in more recent studies, such as Basiewicz and Auret (2009).

There is much evidence to support a value premium from a longitudinal perspective as many studies encompass long periods of time. Fama and French (1992) find a value premium during the period 1963 to 1990, and in a later study, Davis, Fama and French (2000) find the premium also existed during the preceeding period, 1929 to 1963. Other important studies which find evidence supporting a value premium, Chan, Hamao and Lakonishok (1991) and Lakonishok, Shleifer and Vishny (1994), also study returns over a number of decades.

Like the value premium, there is also substantial support for a size effect longitudinally. Banz (1981) finds a size effect during the 40 year period 1936 to 1975. The studies of Reinganum (1981b), Chan and Chen (1991) and Fama and French (1992) also provide evidence of a size effect over long periods of time. Schwert (2003), amongst others, argues that the size effect disappeared in the 1980s, soon after it was discovered, as it was exploited by investors. However, van Dijk (2011) is of the view that the size effect was still significant in the 2000s and that there is not sufficient evidence to conclude that the phenomenon has disappeared.

Further longitudinal evidence of the value premium and size effect can be gleaned from Fama and French's Benchmark Factors (French 2012) during each of the US's eight major equity bear markets since 1929. The data shows that value and size strategies produced returns that outperformed the market in each of these periods. Figure 1.1 shows the average monthly value premium and size effect in the US during each of those markets. The value premium was positive in five of the eight bear markets. Only during the 1930s and the recent global financial crisis, where the market experienced broad losses, was the value premium negative (Ilmanen 2011). The performance of a strategy based on company size has been more mixed. In five of the eight US bear markets, the size effect was negative as large companies outperformed small companies. During two of the three periods that the size effect was positive, it was less significant than the value premium.

Figure 1.1 Market risk premium, value premium and size effect during US bear markets

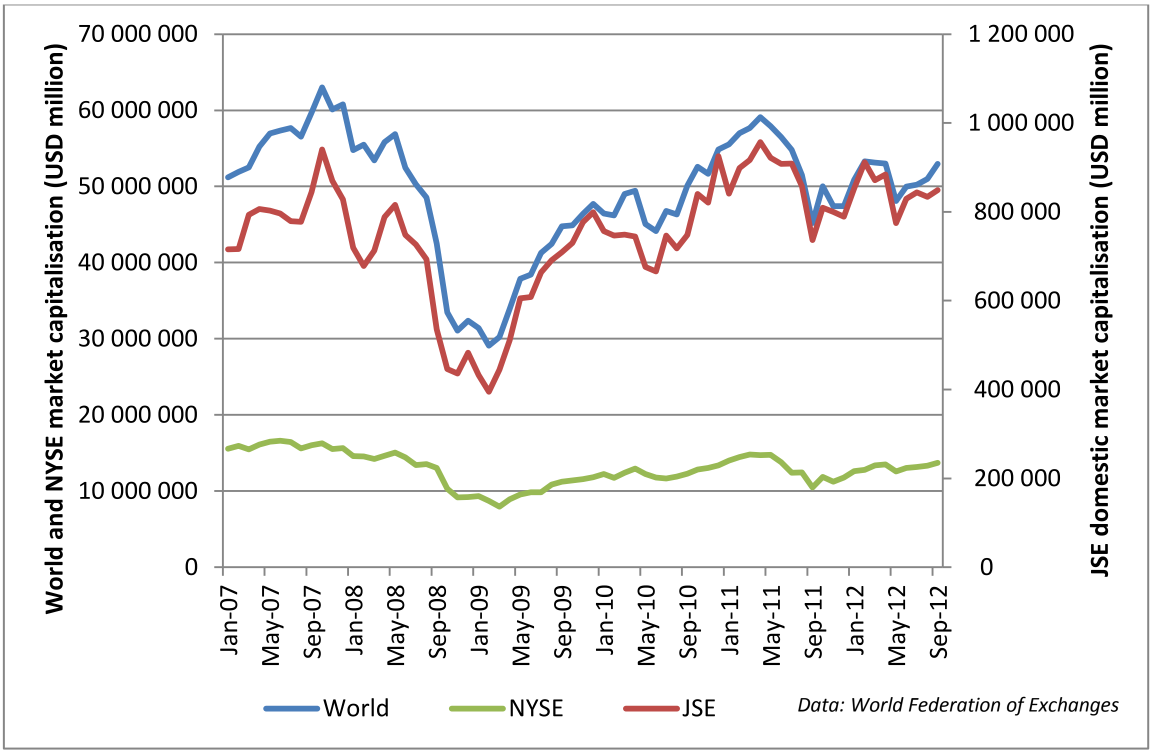


The most recent global financial crisis has its origins in a number of interrelated macroeconomic shocks in the US. The sharp fall in US housing prices from record levels in 2006 was against a backdrop of subprime lending practices, rising interest rates, increasingly complex mortgage-backed securities and a soaring demand for investment opportunities in developed countries (Jones 2009). The collapse of housing prices initially led to a liquidity crisis in the banking sector. However, in mid-September 2008, with the bankruptcy of Lehman Brothers, the crisis intensified and equity markets fell sharply (Bartram and Bodnar 2009). Bartram and Bodnar (2009, p.1247) describe the events that followed as "the largest destruction of equity value in history". The crisis spread rapidly to world equity markets, which, having reached record levels of market capitalisation in October 2007, lost 54% of their value during the seventeen months that followed (World Federation of Exchanges 2012). The JSE Securities Exchange's

(JSE) domestic market capitalisation, which also peaked in October 2007, lost 58% of its value during the crisis (World Federation of Exchanges 2012).

The US recession that followed the fall in equity markets began in December 2007 and lasted until June 2009 (National Bureau of Economic Research 2012). However, Figure 1.2 shows that, three years later, the markets have not yet regained the peak levels of market capitalisation of 2007. For example, at the end of September 2012 the World and New York Stock Exchange's (NYSE) domestic market capitalisation were still 16% and 17% respectively lower than their 2007 peaks. The JSE's domestic market capitalisation had recovered to within 10% of the 2007 peak value at the end of September 2012.

Figure 1.2 World, NYSE and JSE market capitalisations 2007 – 2012



Although the value and size effect premia have shown persistence across a number of bear markets since the 1920s, there are currently no published studies of the performance of value and size related investment strategies in the South African market during the most recent financial crisis. An opportunity thus exists to contribute to the body of work relevant to this subject.

The explanation of the value premium and size effect anomalies is the subject of ongoing debate. This debate is centred on the rational explanation of Fama and French (1992) and the behavioural explanation of Lakonishok et al. (1994).

Fama and French (1992) argue a risk based explanation for these abnormal returns. They base their position on the efficient markets hypothesis (EMH), arguing that the higher returns from strategies focused on value and small company shares are achieved because those shares are fundamentally riskier, i.e. the shares are underpriced relative to their risk. The risk, they suggest, is due to a higher exposure of these companies to financial distress costs.

In contrast, Lakonishok et al. (1994) argue that the value premium is not related to risk but is rather an opportunity arising from the sub-optimal behaviour of naïve (or noise) investors, and limited opportunities for arbitrage. In their essentially behaviouralist (irrational investor) explanation, Lakonishok et al. (1994) suggest that naïve strategies include extrapolating historical results too far into the future, assuming a trend in earnings and overreacting to company announcements. The resultant demand for growth stocks causes them to become overpriced while value stocks become relatively underpriced.

A study of the value premium and size effect during the recent equity crisis presents an opportunity to examine evidence of the underlying cause of the anomalies. In so doing, a contribution can be made to the rational-behavioural debate.

1.2 Research objectives

This thesis has two objectives. Firstly, the research sets out to establish whether there is evidence in support of the relative effectiveness of value and size related investment strategies in the South Africa equity market during the recent global financial crisis. In other words, the research aims to establish whether a value premium and size effect are robust to a major equity market crash in a South African context.

Secondly, the rational explanation for the relative success of value and size related strategies will be examined. In doing this, the research aims to establish whether the South African equity market data, in the context of the global financial crisis, provides evidence for the rational side of the rational-behavioural debate.

1.3 Structure of the thesis

This chapter sets out the research context, briefly introducing the theory and evidence for the value and size effect premia in both a cross-sectional and longitudinal context. In addition, the significance of the global financial crisis that began in 2007 to the goal of the research is described.

The next chapter introduces and describes the value premium and size effect anomalies and highlights the important studies and implications of these anomalies.

Chapter Three focuses on the findings of studies of the value premium and size effect in the South African market.

Chapter Four outlines theory and evidence for so called “rational” finance, and describes the relevance of this to both value and size related investment strategies. This chapter also presents an overview of the current state of the debate on EMH.

Chapter Five describes the most important theories of behavioural finance and discusses behavioural biases and limits to arbitrage, which offer an alternative to the rational explanation of the value premium and size effect.

Chapter Six discusses the debate between proponents of rational and behavioural finance regarding the explanation for the value premium and size effect. This chapter also introduces equity market bubbles and crashes and other anomalies. The chapter culminates with statements of the research questions for this thesis.

Chapter Seven describes the empirical methods and data used in this study to find evidence for the existence or otherwise of the value premium and size effect in South Africa between 2006 and 2012. The chapter also describes the methods used to find evidence for the conformity of these apparent anomalies with the rational risk based explanation.

Chapter Eight presents the results of the procedures described in Chapter Seven for the existence of the value premium and size effect and for evidence supporting the rational explanation of these anomalies.

Chapter Nine concludes on the evidence provided in this thesis for existence of the value premium and size effect in South Africa during the most recent financial crisis. It also concludes on the evidence relating to the rational explanation of the two anomalies and suggests areas for further research.

Chapter Two

Value and size anomalies

2.1 Introduction

The previous chapter provides a background to the research context and sets out the research objectives. The purpose of this chapter is to introduce and describe the value premium and size effect anomalies and to highlight important studies and implications of these phenomena.

2.2 Anomalies

Anomaly is a term describing a deviation from a model or theory. In the context of finance, anomalies are "empirical results that seem to be inconsistent with maintained theories of asset-pricing behavior" (Schwert 2003, p.939). One such theory is the efficient markets hypothesis (EMH) which argues that securities prices reflect their intrinsic value, and do not follow a predictable pattern. Lo (2008, p.7) describes an efficient market anomaly as "a regular pattern in an asset's returns which is reliable, widely known, and inexplicable." Lo's (2008) description emphasises the predictability of the phenomenon, as he argues that investors may only be able to profit from an anomaly if it is a reasonably predictable. If it is irregular or transient, investors may have difficulty in identifying and therefore capitalising on the phenomenon. In addition, while some anomalies are statistically significant, once trading costs have been taken into account they may be rendered economically insignificant.

There are two dominant and competing explanations for anomalies.

According to advocates of behavioural finance, markets are not efficient and securities prices regularly deviate from their underlying values. The anomalies, they argue, indicate inefficient markets formed around the “suboptimal behavior of the typical investor” (Lakonishok et al. 1994, p.1541). How limits to arbitrage and biases influence the behaviour of individuals and the decisions they make is described in Chapter Five.

Proponents of rational finance defend the EMH and argue that anomalies are apparent, rather than real phenomena, and that the hypothesis survives challenge from behaviouralists (Fama 1998). As many anomalies do not persist in the long-term, it raises the question as to whether those anomalies presented real profit opportunities which were subsequently arbitraged away, or whether they “were simply statistical aberrations” (Schwert 2003, p.940). Those that do persist are not necessarily an indication of inefficiency as they “may genuinely reflect rational behaviour that is not captured in rational pricing models” (Pompian 2012, p.150). This is the joint hypothesis problem described by Fama (1970)—apparent evidence in support of the existence of an anomaly (and therefore evidence for some form of market inefficiency) may instead be evidence of shortcomings in the asset pricing model. This problem “makes much of the debate on market efficiency futile” (Statman 2008, p.10).

The rational and behaviouralist arguments are described in more detail in Chapter Six.

For the purposes of this thesis, anomalies are categorised into a three-part taxonomy—value anomalies, anomalies based on company size and neglect, and other anomalies.

2.2.1 Value anomalies

Value anomalies are perhaps the most notable, as they persist despite being a well-documented phenomenon. These types of anomalies are linked to strategies that favour investment in value shares, which are shares priced modestly relative to their book value, earnings, cash flow, dividends or some other fundamental measure of value. The antithesis of a value share, one which is highly valued by the market, is termed a growth share. “A large body of evidence supports the premise that investors consistently overestimate the prospects of growth companies and underestimate the prospects of value companies. As a result, value stocks appear to generate anomalously high returns” (Pompian 2012, p.35). A value strategy seeks to exploit the higher returns yielded by investing in a portfolio of value shares rather than growth shares, or even by taking a long-short strategy in which a long position is taken in value shares, and growth shares are shorted. When excess returns are derived from a value strategy, the phenomenon is referred to as the value effect or value premium.

Value investment strategies have been advocated by investors for many years. More than 75 years ago, Graham and Dodd (1934) argued that these strategies yielded returns that outperformed the market. Widespread and persistent evidence has subsequently been found by researchers that value investment strategies, on average, outperform growth strategies (Fama and French (1998); Chan and Lakonishok (2004); Anderson and Brooks (2007); Ilmanen (2011)). Research during the last four decades has identified a number of different variables as indicators of value. The most prominent are described in the paragraphs below.

2.2.1.1 Price to earnings ratio

All else being equal, a value share has a lower price to earnings (PE) ratio than a growth share. Studies in the late 1960s suggest that PE ratios may indicate future investment performance (Breen 1968; Breen and Savage 1968; McWilliams 1966; Miller P.F. and Widmann 1966; Nicholson S.F. 1968). Basu’s (1977) study attempts to overcome limitations in these studies and ascertain whether shares with different PE ratios were priced appropriately. His study is based on the earnings announcements of 1 400 industrial companies listed on the NYSE during the 1956-1971 period. Basu finds that “low P/E portfolios seem to have, on average, earned higher absolute and risk-adjusted rates of return than the high P/E securities” (Basu 1977, p.680). This study presents evidence of an inefficiency in the market, the implication of which is that knowledgeable investors appear to be able to earn excess returns by focusing investment strategies on shares with lower PE ratios. Basu presents reinforcing evidence in his 1983 study.

Later studies by Ball (1978; 1992), Jaffe, Keim and Westerfield (1989), Chan et al. (1991), Fuller, Huberts and Levinson (1993) and Lakonishok et al. (1994) all find evidence that stocks with lower PE ratios earn higher returns. Ball (1992, p.319) describes the anomaly as "one of the most carefully and thoroughly researched areas of the empirical financial economics literature".

However, the 1986 study of Banz and Breen attributes the PE anomaly to look-ahead or ex-post-selection biases in the accounting data used. They contest that when bias-free data is employed, the anomaly is not evident. The seminal study of Fama and French (1992) further investigates the role of four fundamentals, including PE ratios, in share returns. They find that PE is not as significant as other studies indicate and contest that the "combination of size and book-to-market equity seems to absorb the roles of leverage and E/P in average stock returns" (Fama and French 1992, p.428).

2.2.1.2 Book to market ratio

All else being equal, a value share has a higher book to market value of equity (BM) ratio than a growth share. A number of studies provide evidence that shares with above-average BM ratios tend to outperform the market. Rosenberg and Marathe (1976) introduce BM as a factor in security returns in their multifactor econometric models. Stattman (1980), Rosenberg B.M., Reid and Lanstein (1985), Chan et al. (1991), Fama and French (1992), Lakonishok et al. (1994) and Reinganum (1988) all find a positive correlation between average returns and BM, which implies that returns are predictable and that this information can be used to earn abnormal returns.

The 1992 Fama and French study finds that BM has a consistently stronger role in average returns than the size of a company. The also find that, together, these two variables appear to absorb the roles that leverage and PE ratios have in securities returns. Kothari, Shanken and Sloan (1995) challenge the Fama and French findings, which they argue are affected by a data selection bias. Using an alternative data source, they find that "B/M is at best weakly related to average stock return" (Kothari et al. 1995, p.186).

2.2.1.3 Other indicators of value

Studies find that several other fundamental indicators may be used to identify value shares. The ratio of cash flow to price (Chan and Chen 1991; Lakonishok et al. 1994; Fama and French 1998), the degree of leverage (Bhandari 1988), the ratio of dividends to price (Fama and French 1998) and growth in sales (Lakonishok et al. 1994) are all found to be indicators of value which may form the basis of a value investment strategy. Chan, Lakonishok and Sougiannis (2001) find that incorporating intangible assets into the book value of a company enhances a value investment strategy. O'Shaughnessy (1998) finds that the ratio of price to sales is a strong determinant of excess returns.

2.2.1.4 International studies of value anomalies

Initially, most studies of value anomalies were focused on the US and Japanese markets. However, subsequent research shows that a value investment strategy could also be successfully applied to other markets (Chan and Lakonishok 2004).

Fama and French's (1998) study of the value premium included the US and twelve other countries in Europe and the Asia-Pacific region. Chan and Lakonishok (2004) research the value premium on the largest companies in the Morgan Stanley Capital International - Europe, Australasia, Far East Index (MSCI-EAFE). Studies of the anomaly have also been extended to Europe (Brouwer et al. 1997; Bird and Whitaker 2003), Taiwan and China (Chou and Johnson 1990), New Zealand (Chin et al. 2002) and South Africa, which is dealt with in the next chapter. With few exceptions, these studies indicate that on average, value investment strategies outperform strategies favouring growth shares. It is significant that value strategies have been found to be successful in a range of markets representing varying financial reporting standards, statutes and regulations.

2.2.2 Anomalies based on company size and neglect

2.2.2.1 The size effect

Banz (1981) describes the apparent excess expected returns earned by small capitalisation companies as the size effect. His study finds that "in the 1936-1975 period, the common stock of small firms had, on average, higher risk-adjusted returns than the common stock of large firms" (Banz 1981, p.3). Banz observes that the size effect is not linear, but that it is, instead, most significant with the smallest companies. He finds little difference in returns for medium and large companies. Studies by Reinganum (1981b), Chan, Chen and Hsieh (1985), Chan and Chen (1991) and Fama and French (1992) also find evidence in support of the size effect.

A number of studies consider the joint effect of size and PE ratio on returns. Reinganum (1981b) and Fama and French (1992) find that the effect of size subsumes the effect of the PE ratio while Basu (1983) argues that the reverse is true. Cook and Rozeff (1984) challenge the work of Reinganum (1981b) and Basu (1983), and argue that returns are jointly related to both size and PE.

Schwert (2003) finds that the size effect was not significant during the period between January 1982 and May 2002. He argues that this is either due to the anomaly being arbitraged away since its profile was raised or that the "the differential risk premium for small-capitalization stocks has been much smaller since 1982" (Schwert 2003, p.943). Van Dijk (2011) however, believes that it may be premature to conclude on the disappearance of the size effect. He argues that "[s]tock returns are very noisy and standard errors around estimates of the size premium are large, so it is not easy to tell whether the size effect is larger or smaller than it used to be" (van Dijk 2011, p.3263).

2.2.2.2 The neglected companies effect

Related to the size effect is the effect that relatively neglected companies have on earnings. Arbel, Carvell and Strebel (1983) argue that relatively illiquid companies often fail to attract significant institutional investment for both structural reasons and as a matter of preference for avoiding the greater risks associated with such companies. The lack of institutional interest limits scrutiny by analysts and results in an associated information deficiency. Arbel and Strebel (1982) find a strong negative relationship between the degree of security research and excess returns. Arbel et al. (1983) also argue that there is a strong negative relationship between excess returns and the degree of institutional ownership. They find that "firms neglected by institutions outperformed widely held firms on a risk-adjusted basis, even after correcting for the size effect" (Arbel et al. 1983, p.60). Carvell and Strebel (1987) extend the examination of neglected companies and form the same conclusions. These studies suggest that investors could earn excess returns by focusing on shares that analysts and institutional investors have overlooked.

More recent studies, such as Brennan, Chordia and Subrahmanyam (1997) and Sias, Starks and Tinic (1996) challenge the neglected firm effect. They find no relationship and a positive relationship respectively between the degree of institutional ownership and returns. Beard and Sias (1997, p.19) find that while neglected companies did outperform others, "the cause is the correlation between the degree of neglect and capitalization." Once they controlled for the size of companies, the neglected companies did not earn excess returns. Based on the evidence produced in these studies, it is assumed that the neglected companies' effect is subsumed by the size effect and is therefore not considered separately.

2.2.2.3 International studies of the size effect

Like the value premium, studies of the size effect were initially focussed in the US. Subsequent research in markets outside the US, both developed and emerging, also produce evidence supporting a size effect. These include markets in South-East Asia (Chui and Wei 1998), Europe (Heston, Rouwenhorst and Wessels 1999), China (Drew, Naughton and Veeraraghavan 2003) and the United Kingdom (Dimson, Nagel and Quigley 2003). Fama and French (1998) study the returns on companies in sixteen emerging markets between 1987 and 1995. They find a positive size effect in eleven of those markets.

Van Dijk (2011) examines recent evidence of the monthly size effect in nineteen countries and two groups of countries (Europe and Emerging Markets). His analysis shows a size effect in eighteen of the nineteen countries and both groups. This "suggests that the international evidence on the size premium is remarkably consistent"(van Dijk 2011, p.3264).

The results of studies of the size effect in the South African market are discussed in the next chapter.

2.2.3 Other anomalies

A number of other anomalies have been identified and debated in finance. Several of these are studied concurrently with the value premium and size effect and are also the subject of the rational-behavioural debate highlighted above. Although none of these anomalies is specifically investigated in this thesis, some of them are relevant to prior studies discussed in the remainder of the literature review. For the purposes of completeness, the most prominent are briefly introduced in the paragraphs below.

Technical analysis describes investment techniques which attempt to forecast securities prices by analysing patterns in historical prices, volumes and related statistics. This form of analysis does not concern itself with measuring a security's intrinsic value. A technical anomaly is an irregularity that emerges during this analysis that permits an investor to earn excess returns. Technical analysis is challenged by proponents of the EMH, who present evidence that such analysis does not provide investors with any advantage.

The momentum effect describes the tendency of security returns to exhibit a positive serial correlation—positive returns are followed by further positive returns. A negative serial correlation, where positive returns are followed by negative returns, is termed a reversal. Both momentum and reversals “reject the hypothesis that stock prices behave as random walks” (Malkiel 2003, p.7).

Calendar anomalies, also referred to as calendar effects or seasonal effects, are cyclical anomalies in returns, based on the calendar cycle. Studies have produced evidence of several calendar anomalies, including the January effect (Keim 1983; Reinganum 1983), turn of the month effect (Lakonishok and Smidt 1988), the weekend (or day of the week) effect (French 1980), intraday effect (Harris 1986) and holiday effect (Lakonishok and Smidt 1988).

The equity risk premium refers to the return of equity in excess of non-equity alternatives such as government bonds. The premium is a measure of the relative riskiness of equity and incorporates both the price of risk and the amount of risk. The puzzle referred to is that, in order to explain the much higher returns of equities in comparison to bonds, investors must have unrealistically higher levels of risk aversion than would be predicted by the models of rational finance. Kocherlakota (1996) and Mehra and Prescott (2003) analyse the explanations for the premium. They conclude that while it is a real phenomenon there is little consensus on its causes.

2.3 Conclusion

This chapter introduces and describes value premium and size effect anomalies and the implications of these anomalies. The anomalies are associated with a wide body of research, some which provides supporting evidence and some which provides evidence to the contrary. The unsettled rational-behaviouralist debate on an explanation for the value premium is also introduced. Chapter Three examines the findings of studies of the value premium and size effect in the South African context.

Chapter Three

South African studies of anomalies

3.1 Introduction

The previous chapter introduces the value premium and size effect anomalies. The purpose of this chapter is to examine the findings of studies of the value premium and size effect on the JSE.

The JSE is characterised by a lack of liquidity, relatively low turnover, dominance of institutional investors and extensive cross holdings (Robins, Sandler and Durand 1999, p.61). The findings of some authors suggest that this may not be conducive to an efficient market. Robins et al. (1999, p.53) reports that "South African research has become increasingly circumspect regarding market efficiency on the JSE". This is supported by research over the last three decades which produces evidence of the value, size effect, momentum, reversal, January-effect and other anomalies on the JSE. However, other research finds no evidence of these anomalies. Relevant aspects of supporting and contradictory research are discussed in the sections that follow.

3.2 Value anomalies on the JSE

Plaistowe and Knight (1986) were amongst the first to conduct studies of the value premium on the JSE. They allocate 35 industrial companies to portfolios based on their book to market value of equity (BM) ratio and use the Sharpe market model to evaluate returns between 1973 and 1980. They find that the portfolios comprising companies with a BM ratio of greater than one (i.e. the value portfolios) provide a small positive return, although this is not statistically significant. However, the portfolios with a BM of less than one (i.e. the growth portfolios) show an abnormal return of -8.9%. Plaistowe and Knight (1986, p.38) conclude that “a condition of premium to book value may be a contrary indicator in the mid-term”.

Klerck and Maritz (1997) use three of Graham’s criteria (discussed in Oppenheimer 1984) to select portfolios of value shares included in the JSE Industrial Index between 1977 and 1994:

1. An earnings yield at least twice the long term gilt yield.
2. A dividend yield of at least two thirds the long term gilt.
3. Total debt less than book value.

They find that portfolios constructed on the basis of these criteria “provided risk adjusted returns significantly above that which the asset pricing model suggests they should have” (Klerck and Maritz 1997, p.33). The compound monthly rates of return on value portfolios exceed those of the JSE Industrial Index by between 9% and 12% per annum. Klerck and Maritz (1997) conclude that by making use of Graham’s criteria, an investor can achieve above market returns.

A number of studies of the value anomaly also incorporate other anomalies due to the possibility of significant inter-relationships. Robins et al. (1999) investigate the value, size and January-effect anomalies on the JSE and their inter-relationships between 1986 and 1995. They find evidence that small companies tend to be companies with a higher BM but do not find support for the value or size effect anomalies. Robins et al. (1999, p.61) do however find support for the January effect and argue that “the January effect in South Africa is unrelated to the value and market capitalisation effects”. The lack of evidence supporting the value effect is contrary to the earlier findings of Plaistowe and Knight (1986) and Klerck and Maritz (1997). The authors concede their methodology may not detect the value and size effect if these effects are due to “extremes in value or market capitalisation” (Robins et al. 1999, p.61).

Asness (1997) tests the relationship between momentum and value strategies between 1963 and 1994 on NYSE, the American Stock Exchange (AMEX), and National Association of Securities Dealers Automated Quotations (NASDAQ) listed firms. He finds that "value and momentum strategies are [independently] effective, although value measures and momentum measures are negatively correlated" (Asness 1997, p.34). Fraser and Page (2000) follow Asness's work in analysing returns from industrial companies listed on the JSE between 1973 and 1997. Their objective is to determine whether value and momentum strategies are effective when applied to the JSE and to determine whether there is any interaction between the strategies. Like Asness (1997), the study finds that a value strategy based on the dividend to price ratio and BM can be used to earn abnormal returns in the short term. "The highest value (cheap) quintiles out-perform the lowest value (glamour) quintiles by approximately 0.6% per month for both strategies, approximately 8% per annum" (Fraser and Page 2000, p.27). They also find that a momentum strategy based on the last twelve months returns yields a difference in returns of approximately 10% per annum between the value and glamour quintiles. However, contrary to Asness (1997), the study finds no correlation between the two strategies.

The aim of Graham and Uliana's (2001) study is to determine if evidence supports a value premium on the JSE and to compare their findings with international studies. Following the methodology of Fama and French (1992) and Capaul, Rowley and Sharpe (1993), Graham and Uliana (2001) analyse 58 industrial companies trading on the JSE over a ten year period ending 31 December 1996. They find that before 1992 the portfolio of growth shares perform better than the portfolio of value shares. This is contrary to the international findings of Capaul et al. (1993). Graham and Uliana (2001) also find that after 1992, the value portfolio outperforms the growth portfolio which is consistent with the findings of Capaul et al. (1993). Graham and Uliana (2001) find a similar pattern of returns from value and growth portfolios after using the Sharpe ratio to adjust returns for risk, which indicates that the value portfolios are not riskier than the growth portfolios. They suggest that the turnaround from growth to value may be explained by the political and economic changes in the early 1990s. These include "South Africa's return to the international financial arena and significant changes in macro-economic factors such as a decrease in the rate of inflation" (M. Graham and Uliana 2001, p.17).

An equity style is defined by Christopherson and Williams (1997 in Mutooni and Muller 2007:15) as "an investment belief held by a group of managers who believe that following it will add value". The central concern of van Rensburg and Robertson's (2003b, p.7) study is "to discern the identity of the style-based factors that explain the cross-section of JSE returns". The style-based factors tested include 24 measures of value, future earnings growth, momentum and neglect. Following the methodology of Daniel and Titman (1997), van Rensburg and Robertson (2003b) cross-sectionally regress share returns of JSE listed companies between 1990 and 2000 on their selected style-based factors. Van Rensburg and Robertson (2003b) maintain that this is a more comprehensive approach than the studies of isolated anomalies which predated this work. They argue that the advantage of this approach is "not only the documentation of new anomalies but, more fundamentally, it is a prerequisite to achieve the aim of identifying a fully specified model of expected returns" (van Rensburg and Robertson 2003b, p.7). The study finds evidence of a value effect under the characteristics of the cash flow to price (CF), price to earnings (PE), dividend yield (DY), price to net asset (PNA) and price to profit (PP) ratios. It also finds evidence of the size effect. Van Rensburg and Robertson (2003b) contend that adjusting for risk does not materially affect these results.

Contrary to the findings of Fraser and Page (2000), van Rensburg and Robertson (2003b) do not find evidence supporting a momentum anomaly. The study shows that the CF, PE, DY, PNA and PP ratios are positively related and only one pair, size and PE ratio, is jointly significant. The study uses this pair to derive a two-factor characteristic-based model of the cross-section of JSE returns.

Auret and Sinclair (2006) analyse BM and five of the most significant variables identified by van Rensburg and Robertson (2003b) using the same data set. They find that, at a univariate level, the BM ratio “has a strong role in explaining stock returns” and that it subsumes the size and PE variables (Auret and Sinclaire 2006, p.36). However, BM does not add to the explanatory power of the two-factor characteristic-based model of van Rensburg and Robertson (2003b). Auret and Sinclair (2006, p.36) argue that this is largely due to the “correlation [of the BM ratio] with other attributes which have high explanatory power” while size and the PE ratio used by van Rensburg and Robertson (2003b) have a very low correlation.

Mutooni and Muller (2007, p.17) aim to determine whether the size effect occurs independently of the value premium, whether a low BM strategy outperforms a high BM strategy and whether “a strategy of timing the style turning points will outperform one of buying and holding the index”. Following the methodologies of Basu (1977), de Villiers, Lowing, Petit and Affleck-Graves (1986) and Fama and French (1992), they analyse JSE industrial shares between 1986 and 2006. Mutooni and Muller (2007, p.19) find that a BM value strategy outperforms a growth strategy in the long term but that there are “periods of persistent outperformance for one or other strategy—irrespective of company size”. Their study also finds evidence of the benefits of style timing. Using an econometric model to predict style turning points, they find that “timing the style spreads was a potentially more profitable strategy than buying and holding the index or [a] simple (fixed) style strategy” (Mutooni and Muller 2007, p.23).

Basiewicz and Auret (2009) take the impact of trading costs into consideration, and use a large sample of approximately 77 000 observations over a thirteen year period ending in July 2005. They confirm the existence of the size effect and value premia and find that they persist after adjusting for liquidity. They also find that the BM ratio has the strongest predictive power and the PE ratio the weakest. Basiewicz and Auret’s (2009) evidence indicates that the value premium is lower than what other research has established. This “may indicate that the illiquidity premium and trading costs may be a partial source of the excessively high value premium documented in previous studies" (Basiewicz and Auret 2009, p.35). Finally, they provide evidence that the value and size effect anomalies are independent of each other.

Basiewicz and Auret's (2010) next paper tests whether the size and value effects on the JSE could be explained by the Fama and French (1993) three-factor model. Using the same sample period as their 2009 study, and the BM ratio as a proxy for value, they find evidence supporting the three-factor model using both grouped and ungrouped data. In tests of grouped data, they find that the model explains the value effect and part of the size effect. However, in tests of grouped data, they find that the model captured "a substantial amount of time-series variation in most assets" (Basiewicz and Auret 2010, p.13).

Beukes (2010) studies the share price returns of all companies listed on the JSE between 1972 and 2001. Using the methodology employed by Lakonishok et al. (1994), Beukes (2010) forms size-adjusted portfolios and finds evidence of the value premium in South Africa during that period. The author also tracks and analyses four variables to test for extrapolation as an explanation for the persistence of the value premium. She argues that "naïve extrapolations and faulty expectations in relation to investment decisions (as exposed by behavioural finance) provide an explanation for the value premium" (Beukes 2010, p.11).

Auret and Cline (2011) update the study of Robins et al. (1999). Their study is divided into two periods, 1986 to 1995 and 1996 to 2006. Using the same methodology as Robins et al. (1999), they find no evidence of significant size effect and value anomalies during the 1986 to 1995 period. However, unlike the earlier study, they also do not find a January-effect during this period. For the period 1996 to 2006, Auret and Cline (2011) do not find any significant size effect, value or January-effect anomalies.

3.3 The size effect on the JSE

A number of studies have tested the JSE for evidence of the size effect which was first highlighted by Banz (1981). The findings are mixed. De Villiers et al.(1986) find no conclusive evidence of the size effect in their tests of JSE data during the period 1973 to 1982. Instead, they argue that large companies significantly outperformed smaller ones during this period. Bradfield, Barr and Affleck-Graves (1988) produce corroborating evidence. The studies of Page and Palmer (1991), Page (1996), Robins et al. (1999) and Auret and Cline (2011) also find no evidence of a size effect.

De Villiers et al. (1986 in Waelkens and Ward 1997) argue that the absence of a size effect on the JSE may be due to the dominance of institutional investors, restrictions on foreign investment, extensive cross holdings and the low turnover rate. However, van Rensburg and Robertson (2003a) argue that the size effect may not have been identified in this earlier research as the sample sizes used in this work were too small. They argue that "[s]maller firms have routinely been excluded from prior South African studies due to thin trading concerns" (van Rensburg and Robertson 2003a, p.8). Recent increases in the liquidity of the JSE may have led to more representative samples in recent studies and the identification of a size effect. For example, van Rensburg (2001), van Rensburg and Robertson (2003a), van Rensburg and Robertson (2003b) and Basiewicz and Auret (2009) all find evidence supporting the size effect on the JSE. The only recent study with findings to the contrary is Auret and Cline (2011).

3.4 Other anomalies on the JSE

The literature includes studies of a number of other anomalies. For example, the reversal and momentum studies of Page and Way (1992), Bailey and Gilbert (2007) and Fraser and Page (2000). The findings of these studies are mixed but do provide some evidence of a reversal and momentum on the JSE. The January effect anomaly has also been subject of a number of studies. Gultekin and Gultekin (1983), Page and Way (1992) and Robins et al. (1999) all find evidence of seasonality in returns. In contrast, Bradfield (1990), le Roux and Smit (2001) and Auret and Cline (2011) do not find evidence of a January effect.

3.5 Conclusion

This chapter examines the findings of studies of the value premium, size effect and other prominent anomalies on the JSE. Although there is some evidence of the existence of the two anomalies, the findings are mixed. The next chapter outlines theory and evidence for rational finance, and describes the relevance of this to both value and size related investment strategies.

Chapter Four

Rational finance theory

4.1 Introduction

The previous chapter reviews the findings of studies of the value premium, size effect and other prominent anomalies on the JSE. This chapter examines theory and evidence for so called “rational” finance, and describes the relevance of this to the explanation of the relative success of both value and size related investment strategies.

Rational finance is sometimes termed “traditional”, "conventional" or "modern" finance. It is built on what Statman (1999) describes as the pillars of modern portfolio theory, the capital asset pricing model (CAPM), principles of arbitrage and option-pricing theory. The discipline, at least in its modern form, only dates back to the 1950s but has already generated a vast body of research (Miller 1999). It is grounded in neoclassical economics which is characterised by several assumptions regarding the “motivations and preferences of market participants, and how these direct the functioning of financial markets” (Beukes 2010, p.17). The assumptions relate to the financial market participants and the financial markets themselves.

Rational investors are assumed to be self-interested utility maximisers that adhere to the axioms of utility theory. They seek to maximise their utility by maximising the value of their financial assets (Beukes 2010). However, rational investors are also assumed to be risk–averse and exhibit a diminishing marginal utility of wealth. This governs the risk these investors are prepared to accept when maximising their assets or profits.

At a “micro” level, rational finance theory assumes that rational investors follow a Bayesian approach towards incorporating new information into their decision making and that they base their expectations on normal probability distributions of return. Finally, rational investors are assumed to have access to complete information which they can process to choose "the course of action that will result in the best possible outcome" (Pompian 2012, p.13).

At a "macro" level, rational financial markets are assumed to be efficient. This means that all financial assets are assumed to be perfect substitutes, and securities prices incorporate and reflect all available information accurately and fully. In a rational market, each security's price equates to its intrinsic value, which in turn represents the present value of future cash flows. As prices reflect intrinsic value, rational markets do not, in theory, allow excess returns to be earned. Any value premium or size effect is thus only an apparent anomaly as such returns are attributed to higher risk.

4.2 The efficient markets hypothesis

Efficiency in economic terms is a measure of waste, friction or other undesirable economic features. An efficient market fully, accurately and instantaneously incorporates and reflects all available and relevant information into market prices. The efficient markets hypothesis (EMH), developed in the 1960s by Paul Samuelson and Eugene Fama, remains a central proposition in finance. It has been applied extensively in theoretical and empirical studies of financial asset pricing. These applications however, have generated "considerable controversy as well as fundamental insights into the price-discovery process" (Lo 2008, p.1). This issue is examined in more detail in Chapter Six.

The EMH is formed around two ideas. First, financial markets have the ability to assemble information efficiently. Second, market prices exhibit no serial dependencies and follow an unpredictable path about their intrinsic values, called a random walk.

An efficient market will move rapidly to incorporate all available and expected information on both past and future events. As rational, profit driven investors are motivated to take advantage of even the smallest arbitrage opportunity arising from a temporary mispricing, they quickly incorporate the information into market prices. The arbitrage eliminates any profit opportunities and keeps the market in equilibrium. “If this occurs instantaneously, which it must in an idealized world of ‘frictionless’ markets and costless trading, then prices must always fully reflect all available information” (Lo 2008, p.3).

Not all investors will act rationally. Some may underreact to information while others may overreact. The EMH allows for this. If irrational reactions are random and normally distributed, such reactions will offset each other and prices will not be affected. On the other hand, if irrational reactions are not normally distributed, “they are met in the market by rational arbitrageurs who eliminate their influence on prices” (Shleifer 2000, p.2).

Although the price of a perfectly rationally priced security should, in theory, equate to its intrinsic value, even an efficient market is unlikely to reach consensus on the precise intrinsic value of a share. This uncertainty causes the market price to wander about the intrinsic value as investors respond to news. As news is by definition unpredictable, all price movements will be unpredictable and random in nature. The price movements describe a “random walk” about their intrinsic values which is “a term loosely used in finance literature to characterize a price series where all subsequent price changes represent random departures from previous prices” (Malkiel 2003, p.3). As Lo (2008) observes, mathematically this is termed a martingale. The EMH maintains that if there are any systematic discrepancies, these will quickly be recognised as an opportunity by intelligent investors and neutralised by arbitrage. So, excess profits “inevitably carry with them the seeds of their own decay” (Miller M.H. 1999:99), and systematic anomalies will not persist.

There are two key implications of the EMH. These are described by Thaler (2009) as “The Price is Right” and “No Free Lunch”.

Firstly, in an efficient market a security price always approximates its intrinsic value i.e. the price is always right. The intrinsic value of a security is determined by considering all available information. Fama (1965) argues that as an efficient market's securities prices, by definition, reflect such information, the prices are considered to be a good estimate of intrinsic values at any point in time. If a share appears to be under or over-valued in such a market, the EMH postulates that it is just an illusion (Shiller 2000).

The second implication is that changes in market prices cannot be predicted and reliably exploited by investors to earn excess returns at the same level of risk (see, for example, Samuelson 1965; Fama 1965; Malkiel 1973). "Price changes must be unforecastable if they are properly anticipated, that is, if they fully incorporate the information and expectations of all market participants" (Lo 2008, p.2). Future price movements can only be determined by information not already incorporated into the price. Hence, investors cannot profit based on information currently available. Malkiel (1973) reasons that under these conditions any technical or fundamental analyses of share prices are largely without value and, at the extreme, stocks may as well be selected at random. Investors can only attempt to earn higher returns by raising the level of risk of their investment. It follows that, in accordance with rational finance theory, the apparent excess returns earned from value and size related investment strategies can be attributed to higher levels of risk for the investor. In other words, there is no such thing as excess returns, and the risk-return relationship complies fully with rational finance pricing models.

Grossman and Stiglitz (1980) argue that the conflict between the efficient spread of information and incentives to acquire the information gives rise to a paradox. "[B]ecause information is costly, prices cannot perfectly reflect the information which is available, since if it did, those who spent resources to obtain it would receive no compensation" (Grossman and Stiglitz 1980, p.405). In other words, if prices reflect all the available information, then there is nothing to gain by gathering it and so no one will. It follows that efficient market prices must offer a return for the gathering of information since if this were not the case, information would not be gathered and the markets could not be efficient. Beukes (2010, p.28) suggests that a non-degenerate equilibrium is only possible when “there are sufficient profit opportunities (i.e. inefficiencies) to compensate investors for the costs of trading and information gathering.” However, only an inefficient market would allow returns in excess of such costs.

In support of the EMH, empirical evidence finds that after trading costs and fees are taken into account, active investment management does not earn an excess return. In most cases active management is found to underperform the market (see, for example, Jensen 1968; Malkiel 1995; Ilmanen 2011). This has driven many rational investors to a range of products that mimic, not challenge, markets and indices. However, a significant number of irrational or noise investors remain in the market, trading actively in an attempt to secure abnormal returns.

Proponents of the EMH concede that the hypothesis is not statistically perfect. In 1970 Fama suggests a taxonomy of efficient markets that he regards as serving “the useful purpose of allowing us to pinpoint the level of information at which the hypothesis breaks down” (Fama 1970, p.388). In this study he concludes “that, with but a few exceptions, the efficient markets model stands up well” (Fama 1970, p.383). However he concedes that like any other extreme null hypothesis, it is not expected to be literally and absolutely true.

As reported by Wharton School (2002), Malkiel concedes that the market is not perfectly efficient and that patterns in stock prices can be discerned. He also acknowledges that psychological factors can affect the market and create a situation where prices differ from intrinsic values. However, his view is that the patterns are not dependable or are too small to take advantage of.

The EMH, key to the rational explanation of the value premium and size effect, has been the subject of decades of research and testing resulting in numerous published studies. Yet it remains “surprisingly resilient to empirical proof or refutation” (Lo 2008, p.1) and is not universally accepted. The EMH is strongly opposed by academics who subscribe to behavioural finance as an explanation for market behaviour. Behavioural finance is addressed in detail below, in Chapter Five.

4.3 Modern portfolio theory

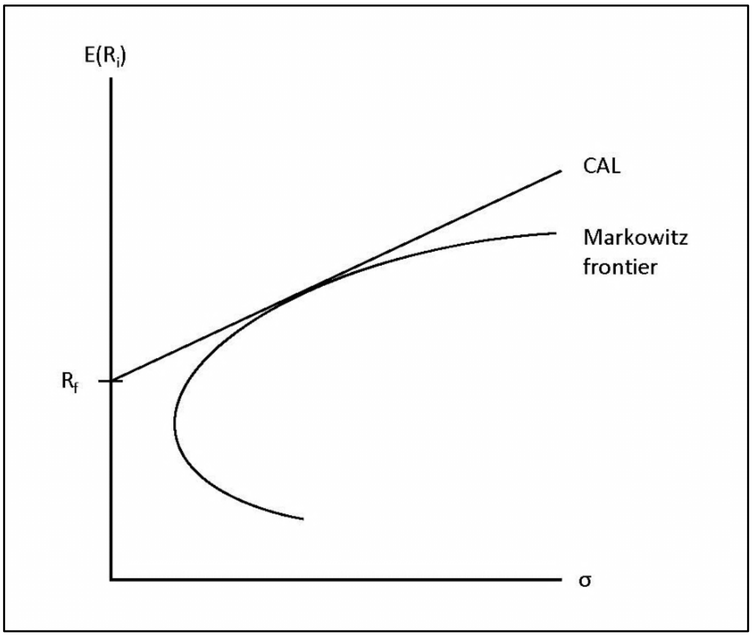
The second key aspect of rational finance theory that is relevant to this study is modern portfolio theory (MPT), developed by Markowitz in 1952. Miller (1999, p.96) describes this study as the "big bang" of modern finance that formed the basis for much of the subsequent modelling of finance. MPT provides a mathematical tool for developing asset allocations based on a risk and return trade-off and emphasises the benefits of diversifying assets amongst various instruments. It allows an investment portfolio to be selected which has a lower collective risk than any individual asset.

Markowitz makes a number of explicit and implicit assumptions in his theory, including rational investors, efficient markets and normally distributed returns. These assumptions allow Markowitz to develop the theory that the relevant unit of investment analysis for an individual is his or her whole investment portfolio, not an individual share. Miller (1999) notes that that this is because the risk of individual shares can only be defined relative to the whole portfolio.

MPT maintains that the exposure of an investment portfolio to risk can be reduced by holding combinations of assets which are not perfectly positively correlated. "Covariance—and not mere numbers of securities held—determines the risk-reducing benefits of diversification. The absence of correlation lowers the volatility in expected returns and thereby lowers risk" (Beukes 2010, p.30). This diversification of assets in a portfolio allows an investor the same expected return at a reduced level of risk, or alternatively a greater expected return at the same level of risk.

Markowitz employs a mean-variance analysis which identifies the return on an investment with the expected value of its possible outcomes and its risk with the variance of those outcomes around the mean. This “makes the powerful algebra of mathematical statistics available for the study of portfolio selection” (Miller M.H. 1999:96). The mean-variance analysis constructs an efficient frontier (also known as the Markowitz frontier), shown in Figure 4.1, which represents the portfolios which generate the highest expected return for each level of risk. Investors can “choose ‘mean-variance-efficient’ portfolios, in the sense that the portfolios 1) minimize the variance of portfolio return, given expected return, and 2) maximize expected return, given variance” (Fama and French 2004, p.26). Rational utility maximising investors positioned on this line cannot achieve higher returns at the same or lower levels of risk. This concept is fundamental to the rational explanation of the apparent value premium and size effect.

Figure 4.1 Markowitz frontier and capital allocation line



When a risk-free asset is introduced as a possible component of a portfolio, the capital allocation line (CAL) can be constructed as shown in Figure 4.1. The CAL indicates the most efficient combinations of risk-free assets and risky assets and in effect becomes the new efficient frontier. The effect of the CAL is that the range of risk-return combinations increases as the CAL gives a higher expected return at every level of risk except at the tangency. This is the known as the mutual fund theorem developed by Tobin (1958).

MPT has been challenged on a number of fronts, including its use of historical data to make statements about the future, the suitability of standard deviation as a measure of risk, the assumption of fixed correlations and normally distributed returns and the fact that it does not account for its own effect on systematic risk. Proponents of behavioural finance argue that investors are not rational and markets are not efficient as the MPT assumes. They point out that MPT does not take into account factors in investment other than the risk-return trade-off and argue that its model of financial markets does not match the real world in many ways. These matters are further discussed in the next chapter.

Apart from the theoretical challenges, a practical problem faced by MPT is the onerous volume of calculation it necessitates. A complete mean-variance analysis requires the calculation of the covariance of every security to every other security in a common market. For example, market of 1 000 securities would require estimates of 499 500 covariances and 1 000 expected returns and variances (Bodie, Kane and Marcus 2003).

This problem is addressed in CAPM which, as Beukes (2010) explains, can achieve the same result by calculating a single covariance between the security and the whole market.

4.4 The capital asset pricing model

CAPM is an influential theoretical model that “offers powerful and intuitively pleasing predictions about how to measure risk and the relation between expected return and risk” (Fama and French 2004, p.25). However, it is also criticised in the literature, most significantly by Fama and French (1992) who find that it does not explain apparently excess returns on the shares of companies with high book to market value of equity (BM) ratios or small size.

The model, built on the earlier work of Markowitz (1952), was developed independently by Sharpe (1964) and Lintner (1965) and further refined in later years, most notably by Black (1972). For this reason the CAPM is also often referred to as the Sharpe-Lintner-Black (SLB) model. "[D]ecades later, the CAPM is still widely used in applications, such as estimating the cost of capital for firms and evaluating the performance of managed portfolios" (Fama and French 2004, p.25).

Markowitz's MPT model and CAPM are based on based on the same key assumptions in terms of which investors choose mean-variance efficient portfolios. However the CAPM adds two further assumptions to the Markowitz model: complete agreement amongst investors on the distribution of returns, and unlimited borrowing and lending at the risk-free rate of return. The CAPM theorises that, under these assumptions, the input for portfolio selection is the same for every investor and therefore each will hold the same portfolio of assets. Miller (1999) observes that as all assets in the market must be held by somebody, the implication is that each investor holds a proportional share of the market portfolio. "The CAPM assumptions imply that the market portfolio … must be on the minimum variance frontier if the asset market is to clear. This means that the algebraic relation that holds for any minimum variance portfolio must hold for the market portfolio" (Fama and French 2004, p.28).

The CAPM is used to determine the required rate of return of a particular risky security for an investor that holds the market portfolio. According to the model, the required rate of return to an investor is determined by the compensation required for two separate considerations. Firstly, compensation for deferral of consumption, the time value of money. The CAPM assumes that the risk-free rate of return is adequate compensation. Secondly, compensation for risk. A well-diversified portfolio reduces unsystematic risk, the company specific risk, to an arbitrarily low level. So the holder of a market portfolio is not concerned about unsystematic risk and does not require compensation for bearing it (and indeed will not be compensated for it). However, systematic risk, attributed to macroeconomic factors affecting all securities in a market, cannot be diversified away. It persists even after broad diversification. Investors require compensation for bearing systematic risk.

The sensitivity of a particular security's returns to macroeconomic market factors, its systematic risk, is termed beta. It is measured by the covariance of the returns of a security and the market relative to the variance of the market return. The market has a beta of one. As each security responds differently to macroeconomic factors, each will have a different beta. A beta of greater than one indicates that the security has a greater systematic risk than the market. The converse is true for betas of less than one. The CAPM maintains that beta is a full measure of an individual security's risk and is alone a sufficient variable to explain the cross-section of security returns.

The CAPM expresses a positive liner relationship between a security's expected returns and its systematic risk, beta.

Equation 4.1   Capital asset pricing model

$$\boldsymbol{E(r_i) = r_f + \beta_i[E(r_m) - r_f]}$$

where

$E(r_i)$ is the expected return on security $_i$

r_f is the risk-free rate of interest

β_i is the beta of security $_i$

$E(r_m)$ is the expected return of the market

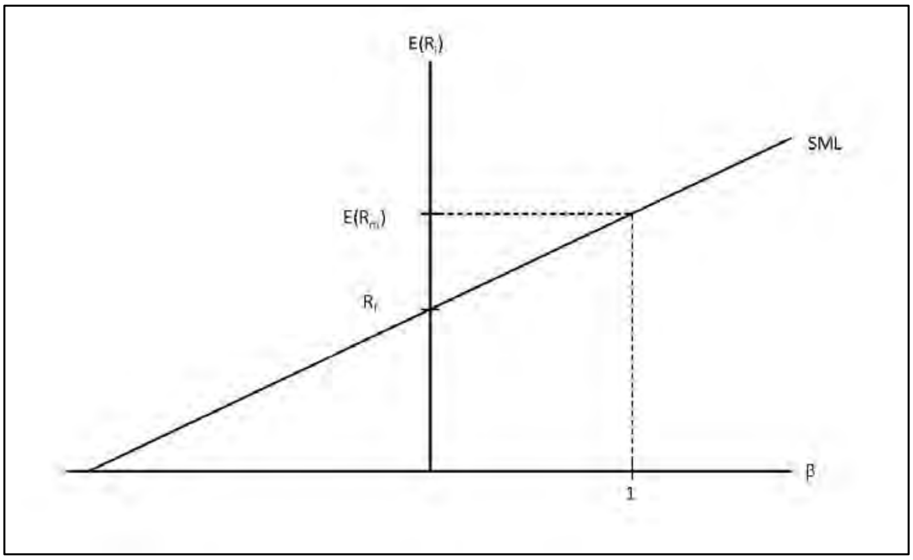
$[E(r_m) – r_f]$ is the market risk premium

$\beta_i[E(r_m) – r_f]$ is the risk premium of security $_i$

This CAPM function postulates that the expected return on security i is a function of the risk-free rate and the risk premium of security i, which is in turn the product of the market risk premium and beta. The function can be presented graphically by the security market line (SML), shown in Figure 4.2, which plots the expected return for a range of betas.

The SML serves as benchmark for investors analysing the returns of securities relative to their systematic risk, beta. A security plotted above the SML offers a higher return than can be expected based on that security's beta. This theoretically indicates a security that is undervalued by the market (such as a value share, or a share underpriced because of the size effect). Similarly, a security plotted below the SML is, in theory, overvalued (such as a growth share).

Figure 4.2 Security market line



Beta can be used to calculate the risk premium of a portfolio, as the contribution of a single security to the risk of a portfolio of securities depends upon the betas of the individual securities. The beta of a portfolio of securities is the weighted average of the betas of the individual component securities, where the weighting is in proportion to the portfolio (Bodie et al. 2003).

An early empirical study of the CAPM by Black, Jensen and Scholes (1972) found evidence supporting the predictions of the CAPM. Other tests by Fama and MacBeth (1973), Gibbons (1982) and Stambaugh (1982) also produced results supporting the CAPM. These early studies "coupled with the model's simplicity and intuitive appeal, pushed the CAPM to the forefront of finance" (Fama and French 2004, p.35).

However, the CAPM has subsequently been the subject of significant scrutiny in numerous academic studies during the four decades since its inception and has been rigorously challenged, both theoretically and empirically.

Theoretical problems with the CAPM arise mostly from its many simplifying assumptions. Foremost is the problem that the CAPM requires the risk of a security to be measured relative to the market portfolio. Unfortunately, the term "market portfolio" is not defined. In the extreme, a market portfolio may comprise all possible investment opportunities in every asset in every market. Fama and French (2004) argue that, even in a narrower sense, where it includes only financial assets, the market portfolio is empirically unobservable and tests of the CAPM are forced to use a benchmark, such as a market index, as proxy. However, this substitution is not always as innocuous as it might seem, and may lead to false conclusions on the validity of the CAPM.

Roll (1977, p.129) argues that "any valid test presupposes complete knowledge of the true market portfolio's composition." As tests of CAPM have to use proxies, his view is that the CAPM cannot be empirically tested. Rather, it is the proxy that is subject to the test. Fama and French (2004) take the more pragmatic view that a reasonable proxy that describes the minimum variance frontier can be used in tests of the CAPM. (However, as discussed later, they strenuously challenge the CAPM on other grounds.)

Merton (1973) points out that the CAPM's assumption that investors are mean-variance optimisers, implies that the CAPM is subject to all the theoretical criticisms of Markowitz's MPT model. Assumptions that have been challenged include the normal distribution of returns, the use of the variance of returns as a measure of risk and the absence of taxes or transaction costs. As noted in Chapter Five below, however, one of the biggest challenges comes from proponents of behavioural finance such as Shiller, Schleifer and Thaler. These researchers argue that the very core of the CAPM, the EMH, is flawed and cannot explain the behaviour of markets.

Beukes (2010) notes that these theoretical challenges do not substantially shake confidence in the CAPM. Rather, the main criticism is based on a significant body of evidence that the CAPM does not stand up to empirical scrutiny. Fama and French (2004, p.25) argue that "the empirical record of the model is poor—poor enough to invalidate the way it is used in applications". They continue that ultimately, "whether the model's problems reflect weaknesses in the theory or in its empirical implementation, the failure of the CAPM in empirical tests implies that most applications of the model are invalid" (Fama and French 2004, p.26).

The seminal paper that challenges the CAPM is the Fama and French (1992) study. This focused on the 1963 to 1990 period and aimed to "evaluate the joint roles of market β, size, E/P, leverage and book-to-market equity in the cross-section of average returns on NYSE, AMEX, and NASDAQ stocks" (Fama and French 1992, p.428). Fama and French (1992) find that the positive relationship between beta and average returns, central to the CAPM, did not exist during the period reviewed. They also find that company size and BM are related to returns. In other words, CAPM failed to account for an apparent value premium and size effect. The "…results delivered a stunning blow to the explanatory power of the capital asset pricing model and sparked debates about the 'death of beta'" (Chan and Lakonishok 2004, p.71).

Fama (1970) points out a joint hypothesis problem, in which he argues that a test of market efficiency is also a test of the model used to measure returns in equilibrium. He contests that it is not possible to reject market efficiency without also rejecting the model that measures normal returns as one cannot be certain whether a problem is caused by an imperfection in the model or an inefficiency in the markets. “Thus, whenever someone concludes that a finding seems to indicate market inefficiency, it may also be evidence that the underlying asset-pricing model is inadequate” (Schwert 2003, p.940). As noted by Bodie et al. (2003) and Beukes (2010), the joint hypothesis problem equally implies that market efficiency is indirectly tested in an empirical test of rational model of equilibrium. Therefore it is appropriate jointly to review empirical challenges of CAPM and EMH. These challenges are described in Chapters Five and Six below.

4.5 Multifactor asset pricing models

The empirical studies which have found evidence for violations of the CAPM “have spawned research into possible explanations” (Lo and MacKinlay 2002, p.189). Miller’s (1999) view of the consensus amongst researchers and theoreticians is that the CAPM’s single risk factor (beta) is not sufficient to explain a cross-section of expected returns. Research has produced more complex multifactor pricing models, as alternatives to the single-factor CAPM, that attempt to explain CAPM anomalies, such as the value premium and size effect, by introducing additional risk factors into each model. These models generalise the single-factor CAPM to accommodate more than one source of systematic risk, and imply a multifactor efficiency.

Three of the most significant models are Merton’s (1973) intertemporal capital asset pricing model (ICAPM[1]), Ross’s (1976) model based on arbitrage pricing theory (APT) and Fama and French’s (1993; 1996) three-factor model.

[1] The acronym ”ICAPM” is also sometimes used for the international CAPM of Stulz (1981).

The ICAPM of Merton (1973) is an extension of the SLB CAPM. While the CAPM assumes that investors are concerned only with maximising their utility, the ICAPM assumes that they “act so as to maximize the expected utility of lifetime consumption” (Merton 1973, p.867). These investors are concerned with the consumption and investment of their wealth. So when choosing a portfolio they consider how their wealth might vary with future state variables, including labour income, the prices of consumption goods and investment opportunities (Fama and French 2004). The ICAPM recognises that these variables are relevant to investors, and therefore it incorporates additional risk factors into the asset pricing model.

The APT was introduced by Ross (1976). The theory has less restrictive assumptions than the CAPM. While the CAPM assumes that all investors hold market portfolios and are mean-variance optimizers, the APT only requires that investors hold well-diversified portfolios.

The APT maintains that a security’s expected return is a linear function of a number of macro-economic variables. The sensitivity of each security’s expected return to changes in these factors is represented in the model by a factor-specific beta. The expected return derived by the APT model can be used to price the security by discounting future cash flows. The APT theorises that when the price of a security drifts away from its intrinsic value, arbitrage activity by well-informed investors drives prices back to their intrinsic value determined by APT’s model.

The Fama and French (1993; 1996) three-factor asset pricing model followed their 1992 study in which they find that company size and the BM ratio of companies are negatively and strongly positively related, respectively, to average returns. They also find that beta, central to CAPM, does not explain the cross-section of share returns during the period reviewed and conclude that missing risk factors are the source of the deviations from CAPM. Fama and French (1992) go on to advocate the use of a multifactor model.

Their three-factor model is not derived theoretically. In a purely empirical decision, which was based on their 1992 findings, Fama and French add company size and BM as the additional relevant risk factors to their asset pricing model. They contend that "the [three-factor] model captures much of the variation in average return for portfolios formed on size, book-to-market equity and other price ratios that cause problems for the CAPM" (Fama and French 2004, p.39). This supports a rational explanation of the value premium and size effect. Basiewicz and Auret (2010) test whether the Fama and French three-factor model could be used on the JSE to explain the size and value effects. They find that that the "three-factor model could be used in expected return estimation for firms listed on the JSE" (Basiewicz and Auret 2010, p.13).

There is debate whether multifactor modifications are adequate enough for the defence of the traditional view on efficient markets, particularly in light of the significant empirical evidence to the contrary. Lo and MacKinlay (2002, p.191) argue that "[w]ithout a specific theory identifying the risk factors, one will always be able to explain the cross-section of expected returns with a multifactor asset pricing model, even if the real explanation lies in one of the nonrisk-based categories."

4.6 The current state of the efficient markets hypothesis

The EMH, central to the rational explanation of the value and size effect, was developed more than 40 years ago and has been the subject of hundreds of studies, providing empirical and theoretical evidence both for and against the hypothesis. Lo (2008) points out that during this time there have been many advances in statistical analysis, databases and theoretical models. However, no consensus on this hypothesis has been reached. The main result of the studies has been to "harden the resolve of the proponents of each side of the debate" (Lo 2008, p.12).

Many critics of the EMH target only the most extreme version of the hypothesis. However, even the most ardent proponents of the EMH have moderated their views. In a debate with the behaviouralist, Thaler, (Wharton School 2002), Malkiel concedes that the market is not perfectly efficient as investors make mistakes, some act irrationally and psychological factors play a role in their behaviour. He believes that, for this reason, pricing irregularities and predictable patterns will appear and persist for short periods. Despite these concessions, the EMH proponents insist that their rational model of the markets has not failed. Scholes argues that "[t]o say something has failed you have to have something to replace it, and so far we don't have a new paradigm to replace efficient markets" (The Economist 2009). Malkiel (2003, p.34) concludes that the market is "remarkably efficient in its utilization of information … and will not provide investors with a method to obtain extraordinary returns."

Behaviouralists have also recognised that "in some ways the events of the past couple of years have strengthened the EMH" (The Economist 2009). They concede that the market has underlined how difficult it is to earn market-beating returns. However they contest that the main idea behind the EMH, that market price reflects intrinsic value, has been undermined by speculative bubbles. Bubbles and crashes are described in Chapter Six.

A practical compromise to the debate has been suggested by Ilmanen (2011)—although markets are not perfectly efficient, they are difficult to beat and most investors would be wise to act as if they were efficient. In the 2002 debate with Malkiel, Thaler commented that "[s]ecurities prices are highly correlated with intrinsic value, but sometimes diverge to a significant degree … [i]t's possible to predict stock prices, but not with great precision—and don't try this at home" (Wharton School 2002).

Ilmanen (2011, p.83) concludes that "[a]lthough the EMH paradigm has faces a vigorous challenge from behavioural finance, there is no doubt that the EMH has been a powerful organizing principle for theoretical and empirical work in finance that has improved our understanding of asset returns". The EMH has also been fertile ground for studies of alternative financial theories to explain the actions of markets and investors such as behavioural asset pricing, behavioural portfolio theory, adaptive markets, agent-based modelling (Arthur, Holland, LeBaron, Palmer R. and Tayler 1997) and evolutionary game theory (Friedman 1991).

4.7 Conclusion

This chapter examines rational finance theory, which is the foundation for a risk based explanation of the value premium and size effect anomalies put forward by Fama and French (1992). Evidence contradicting the EMH has caused a re-examination of the tenets of rational finance amongst economists and researchers, some of whom have turned their attention to alternative pricing models which incorporate psychology and behavioural patterns (Beukes 2010). The next chapter focuses on the theory of behavioural finance and behavioural explanations of the value premium and size effect.

Chapter Five

Behavioural finance theory

5.1 Introduction

Chapter Four reviews rational finance theory and its relevance to the risk based explanation of the value premium and size effect. This chapter examines the most important theories of behavioural finance and discusses behavioural biases and limits to arbitrage, which offer theories for an alternative explanation for the value premium and size effect.

Rational finance models are built on normative theories of how investors and markets should behave. The application of these prescriptive assumptions allows for parsimony in the development of the theory of rational finance: the rational approach is "compelling because it uses a minimum of tools to build a unified theory intended to answer all the questions of finance" (Statman 1999, p.19). However, empirical observations of actual investor and market behaviour have revealed anomalies, such as the value premium and size effect, which challenge rational models. It has become apparent to many researchers (for example, De Bondt and Thaler 1985; Jegadeesh and Titman 1993; Reinganum 1981a; Shiller 2000) that rational models cannot be relied upon to explain these anomalies. Rational finance has become so weighed down by these anomalies, argues Statman (1999), that finance theory needs to be reconstructed.

Behavioural finance has been explored as an explanation of seemingly irrational behaviour in the financial markets. "The premise of behavioural finance is that conventional financial theory ignores people, and that people make a difference"

(Bodie et al. 2003, p.652). This field integrates insights in both neo-classical economics and psychology in an attempt to explain the observed economic actions of investors and how these affect the markets, returns and the allocation of resources.

Behavioural finance does not assume that investors are self-interested rational utility maximisers, or that the markets are efficient. Rather, it recognises that human cognitive errors and emotional biases play a role in investors' perceptions and decision making. In fact, proponents of behavioural finance argue that "investors are often—if not always—irrational, exhibiting predictable and financially ruinous behaviour" (Lo 2008, p.9). Statman (1999, p.20) describes the modelling of behavioural finance investors as "normal", rather than "rational" individuals, who behave in a manner and achieve outcomes that may be suboptimal. However, by understanding the principles of behavioural finance and integrating this knowledge with rational financial models, an investor has the potential to "produce an economic outcome closer to the optimal outcome" (Pompian 2012, p.6).

Behavioural finance theory, like rational finance theory, is based on assumptions. Statman (1999, p.19) notes that some behavioural finance assumptions are identical to rational finance but others "are different because they reflect a different model of human behavior". The key difference though, noted by Pompian (2012), is that the behavioural finance assumptions are grounded in observations of actual investor and market behaviour rather than a rational idealised financial behaviour. In other words, while rational finance is prescriptive, behavioural finance is descriptive, providing explanations for how investors actually behave, rather than how they should behave.

The bounded rationality and prospect theories are central to behavioural finance, and describe how irrational investors make decisions. Such theories provide a basis for an alternative explanation of anomalies such as the value premium or size effect being examined in this study.

5.2 Bounded rationality

The search for a perfectly rational and optimum solution to any problem, including all possible alternatives, is a complicated and time consuming task for any individual. Observations of investors confirm that they often lack the time, resources and cognitive ability to exhaust all alternatives when making decisions. In such cases, they will not arrive at an optimal solution and will not maximise utility, as assumed by rational finance theory.

The theory of bounded rationality (Simon 1957) is an alternative, but complimentary, basis to rationality for modelling human decision making. Bounded rationality relaxes the assumption that all individuals behave perfectly rationally when making decisions. It recognises that individuals do not make decisions in a rational manner as they are limited by time, the information and processing tools available to them and their own cognitive abilities.

Bounded rationality describes the phenomenon where individuals with limited decision making resources apply rational decision-making only after first using heuristics in gathering information and simplifying the alternatives. Such an individual would thus arrive at a satisfactory rather than optimal solution. The term satisfice ("to do or spend as little as possible in the achievement of a specified objective" (Penguin 2001, p.1238)) has been generally used in finance since Simon (1957) to describe the acceptance of a solution which is satisfactory rather than optimal. By satisficing, investors limit the time and cost required by the decision making process. The parameters an individual sets for satisficing indicate what will satisfy their needs and what they will aspire for (Pompian 2012).

Bounded rationality is inconsistent with the efficient markets hypothesis (EMH). The tendency of individuals to satisfice rather than optimise implies that inefficiencies may exist in the market. These in turn may result in the systematic mispricing of securities and create anomalies (such as the value premium or size effect) which allow investors to earn excess returns.

One of the most significant criticisms of Simon's (1957) study is that it does not determine the "point at which an individual stops optimizing and reaches a satisfactory solution" (Lo 2004, p.22). This criticism is key in Lo's (2004) paper on the adaptive markets hypothesis, discussed later in this chapter.

5.3 Prospect theory

The theory of decision making under conditions of risk was dominated by the expected utility theory discussed in Chapter Four, until Kahneman and Tversky (1979) proposed prospect theory as an alternative. Their study finds that individuals do not make decisions in accordance with the axioms of expected utility theory. They argue that "utility theory, as it is commonly interpreted and applied, is not an adequate descriptive model" and propose "an alternative account of choice under risk" (Kahneman and Tversky 1979:263).

Prospect theory describes how individuals make decisions between alternatives that have uncertain outcomes, where the probabilities of these outcomes are known. It attempts to model observations of real-world decision making rather than prescribe optimal solutions as rational finance does. The theory proposes two stages in the decision process, editing and then evaluation.

During the editing stage, potential outcomes or prospects of a decision are analysed according to some heuristic to result in a simpler, more manageable, set of possible outcomes. Outcomes are further analysed relative to an economically neutral reference point established by the individual which serves as a zero point on the value scale. The logical consequence of establishing such a reference point is that the value of a sum of money is not its face value. The value depends on the context. "[T]he location of the reference point … can be affected by the formulation of the offered prospects, and by the expectations of the decision maker" (Kahneman and Tversky 1979:274). Outcomes below the reference point are considered losses while outcomes above it are considered to be gains. This differs from utility theory, which assigns value only to final outcomes, independent of the initial frame of reference.

In the evaluation phase, individuals evaluate the prospects edited in the first stage and choose the outcome which yields the greatest utility. This evaluation is based on the value of potential outcomes and a decision weight. Decision weights are not the same as probabilities. "[T]hey do not obey the probability axioms and they should not be interpreted as measures of degree or belief … Decision weights measure the impact of events on the desirability of prospects, and not merely the perceived likelihood of these events" (Kahneman and Tversky 1979:280). Decision weights are the product of the probability of an outcome and a probability weighting function which "expresses the fact that people tend to overreact to small probability events but underreact to mid-sized and large probabilities" (Pompian 2012, p.27).

Figure 5.1 Prospect theory value function

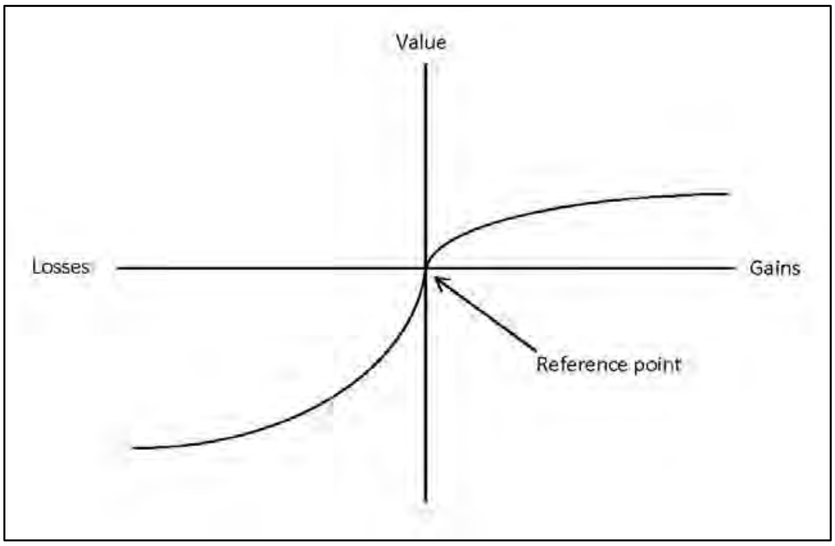


Figure 5.1 shows that while the expected utility curve of rational finance is uniformly concave, reflecting diminishing marginal utility of returns, the value function is generally concave for gains and, to the left of the reference point, convex with a

steeper curve for losses. The curve illustrates Kahneman and Tversky's (1979) finding that individuals place a relatively high value on small gains and small losses. This is reflected in the asymmetry of the curve which has a steeper slope in the proximity of the reference point. The relatively larger impact of losses on an individual's measure of value implies that individuals are loss-averse rather than risk-averse.

Kahneman and Tversky's (1979, p.263) other major finding is that "[d]ecision weights are generally lower than the corresponding probabilities, except in the range of low probabilities". The implication is that individuals overweight low-probability outcomes. Ilmanen (2011, p.95) notes that "this feature explains the simultaneous demand for both lotteries and insurance".

Prospect theory is inconsistent with axioms of rational finance theory as it contends that investors act according to a value function and not as rational utility maximisers. The implication is that the market is not efficient and that systematic mispricing of securities may occur which allow for excess returns, such as the value premium or size effect.

5.4 Adaptive markets hypothesis

Lo's (2004) adaptive markets hypothesis (AMH) study recognises that markets are less stable than a set of laws, either rational or behavioural. In the abstract to his paper, Lo (2004, p.15) describes the AMH as a new synthesis that "reconciles market efficiency with behavioral alternatives by applying the principles of evolution—competition, adaptation, and natural selection—to financial interactions". He argues that by viewing economic behaviour as an evolutionary process, the contradictions between the EMH and actual market observations will be better understood. The AMH may thus provide possible further alternative explanations for the value premium and size effect anomalies.

The AMH is influenced by evolutionary psychology which applies "the principles of competition, reproduction, and natural selection to social interactions, yielding surprisingly compelling explanations for certain kinds of human behaviour" (Lo 2004:21). In contrast to rational finance theory which views individuals as risk averse, rational utility maximisers, Lo views individuals as organisms which evolve with the purpose of survival. "Success is defined as survival rather than as having maximized expected utility" (Pompian 2012, p.43). The competition for scarce resources between individuals and their ability to adapt to the competitive environment has an influence on the market.

The AMH adds an "evolutionary perspective" (Pompian 2012, p.43) to Simon's (1957) theory of bounded rationality in which people satisfice rather than optimise. Lo (2004) argues that Simon's theory of bounded rationality falls short, in that it does not explain where individuals stop optimising and begin to satisfice. He proposes that "[s]uch points are determined not analytically, but through trial and error and, of course, natural selection" (Lo 2004, p.22). Over time, by experimentation and positive or negative reinforcement, individuals will eventually develop heuristics which will provide them with approximately optimal solutions. When the environment is altered, those heuristics are no longer valid and investor behaviour appears irrational and anomalies appear more frequently. So, the observed behavioural biases may be consistent with the AMH. Lo (2004, p.22) suggests that "maladaptive" is a better description of such behaviour, as human evolution has not yet had the time to develop heuristics that are optimal for the modern financial environment.

In contrast to the EMH, where prices are determined rationally, under the AMH "[a]sset prices reflect the number and nature of investor groups in the market ecology" (Ilmanen 2011, p.82). Lo (2004, p.23) refers to the various investor groups as "species" (such as, for example, pension fund managers, hedge fund traders or day traders). Markets which have numerous profit opportunities attract a great number of species and the competition amongst these species forces the market to a more efficient state. However, this efficiency leads to fewer profit opportunities and fierce competition thins out the number of species. This creates the opportunity for another cycle of profitability. This is in contrast to the inexorable development toward higher levels of market efficiency predicted by the EMH. Lo (2004, p.23) argues that "[a]s opportunities shift, so too will the affected populations."

Lo (2004) argues five main implications of the AMH. These all have a bearing on the rational explanation of the value premium and size effect anomalies. The first is that the relationship between risk and return varies over time as it is determined not only by the market ecology, but external factors such as regulations and the competitive environment. The second implication is that arbitrage opportunities must arise for investors to exploit so that the ecology of the market can change and evolve. It follows that active management can add value. The third implication is that "investment strategies will … wax and wane, performing well in certain environments and performing poorly in other environments" (Lo 2004, p.24). While the strategies may be ineffective at times, they may become more profitable when the market conditions change. The fourth implication of the AMH is that innovation is a key to the survival of investors. Lo explains that under the EMH, sufficient returns can be earned just by bearing sufficient risk. However, under the AMH, the risk-return relationship is not stable and innovation is required to adapt to the market conditions and maintain a stable level returns. The final implication is that the survival of market participants is the most important objective. "While profit maximization, utility maximization, and general equilibrium are certainly relevant aspects of market ecology, the organizing principle in determining the evolution of markets and financial technology is simply survival" (Lo 2004, p.25).

The AMH is still a relatively new idea and will require additional research, if it is to strengthen its ideas and become more meaningful. However, Lo (2004, p.24) argues that "[e]ven at this early stage … it seems clear that an evolutionary framework is able to reconcile many of the apparent contradictions between efficient markets and behavioral exceptions".

5.5 The pillars of behavioural finance

In the opinion of Barberis and Thaler (2003) and Ilmanen (2011), behavioural finance is built on two pillars: behavioural biases and the theory of limits to arbitrage. Lakonishok et al. (1994) base their behavioural explanation of the value premium on these pillars. Van Dijk (2011) suggests that this explanation may also apply to the size effect.

5.5.1 Behavioural biases

Rational finance theory assumes that individuals are free of biases and behave in a rational manner. However, observations of individuals indicate “a number of departures from this paradigm, in the form of specific behavioural biases that are ubiquitous to human decision making under uncertainty” (Lo 2008, p.9). The naturally biased judgements and preferences of individuals “influence their demand for assets and can move market prices, causing mispricings” (Ilmanen 2011, p.87). Behavioural biases, the first pillar of behavioural finance, can be categorised as either cognitive errors or emotional biases. Cognitive errors are the result of faulty cognitive reasoning while emotional biases arise when emotion influences reasoning.

5.5.1.1 Cognitive errors

Cognitive errors are “basic statistical, information-processing, or memory errors that cause the decision to deviate from the rational decisions of traditional finance” (Pompian 2012, p.53). While not easily corrected, these errors can be moderated when an individual remains vigilant and employs an objective system to gather and process information and make decisions.

A distinction can be made between cognitive error biases relating to belief preservation and biases caused by information-processing errors. Belief preservation biases manifest themselves in patterns of irrational adherence to previously held beliefs. Information-processing errors can result in, amongst other errors, an expectational bias and the extrapolation of a company's results too far into the future.

Lakonishok et al. (1994) argue that the expectational bias, at least in part, explains the value premium. They argue that naïve investors believe that growth shares will continue to do well and the consequent demand for the shares causes them to become overpriced. In contrast, value shares become underpriced and this creates an opportunity for investors to earn excess returns.

5.5.1.2 Emotional biases

An individual's emotions, feelings, perceptions or beliefs, can significantly influence his or her decision making. Emotions are not necessarily under the control of an individual, even when undesirable. Emotional biases are distortions in cognitive function due to emotional factors which may result in suboptimal decision making. These biases arise spontaneously and are therefore harder to correct than cognitive biases. Pompian (2012) concedes that it may only be possible to adapt to these biases rather than correct for them. In any case, this issue is usually regarded as one relevant to personal portfolio management, rather than asset pricing, and is not further considered in this thesis.

5.5.2 Limits to arbitrage

It is central to rational finance theory that when irrational noise traders cause securities prices to deviate from their intrinsic value, rational arbitrageurs immediately exploit the mispricing and their collective action to derive risk-free returns drives prices back to intrinsic value. The effect of the noise traders is thus neutralised. Shleifer and Vishny (1997, p.35) emphasise that this "[a]rbitrage plays a critical role in the analysis of securities markets, because its effect is to bring prices to fundamental values and to keep markets efficient". Only in an efficient market can the rational explanation of alleged anomalies hold true. The effectiveness of arbitrage therefore has a bearing on the explanation for the value premium and size effect examined in this study.

Although, theoretically, arbitrage requires no capital and is risk-free, the reality is different. Shleifer and Vishny (1997, p.35) argue that “the textbook description does not describe realistic arbitrage trades”. In reality arbitrage positions are risky, involve significant transaction costs, and usually have finite time limits. Arbitrage can only be risk-free “in the extreme case of perfect substitutability and frictionless markets” (Ilmanen 2011, p.88). In reality, arbitrageurs seldom have access to perfect substitutes. This leaves them exposed, to the extent that correlation is lacking, to adverse news affecting the pricing of securities. This theory of limits to arbitrage is the second pillar of behavioural finance.

Arbitrageurs also face the risk that noise trader sentiment will drive prices further from intrinsic value than anticipated. If they are constrained by short time horizons, they may not be able to hold their position long enough for such mispricings to correct, and could be forced, by clients or liquidity constraints, to close a suboptimal position. This risk is exacerbated when the arbitrageur acts as an agent and the principal restricts the agent to a short time horizon. A “widening mispricing normally implies deteriorating performance for the arbitrageur” (Ilmanen 2011, p.88). Principals may withdraw capital from an agent they perceive as underperforming, and in doing so restrict the agent’s ability to arbitrage.

Shleifer and Vishny (1997, p.37) refer to this responsiveness of funds (under an agent’s management) to past returns as “performance based arbitrage” and argue that this limits the effectiveness of arbitrage in achieving market efficiency. Their study finds that “performance-based arbitrage is particularly ineffective in extreme circumstances, where prices are significantly out of line and arbitrageurs are fully invested” (Shleifer and Vishny 1997, p.37).

Ilmanen (2011) highlights two other features of the markets that discourage arbitrage activity. The first is risk management systems or regulatory capital requirements, which may require widespread liquidations at times. This destabilises the markets, in turn requiring further reductions. The second is crowded trade risk, a situation where many arbitrageurs have similar positions and rush to liquidate their position ahead of the others.

The consequence of limiting arbitrage is that its capacity to maintain market efficiency is restricted. If arbitrage is limited, argue Shleifer and Vishny (1997), the mispricing caused by the actions of many irrational noise traders cannot not be entirely corrected by arbitrageurs and prices may wander from their intrinsic values for extended periods of time. This irrational mispricing may seed systematic anomalies.

5.6 Behavioural asset pricing models

Empirical shortcomings in rational finance, and by extension the capital asset pricing model (CAPM), have led to the development of alternative asset pricing models. Proponents of rational finance extended the CAPM to multifactor models such as the Intertemporal CAPM, APT and Fama and French's three-factor model. Behaviouralists have also examined models of asset pricing which incorporate behavioural theory and may offer an alternative explanation for the value and size anomalies. A few of the important behavioural asset pricing models are discussed in this section.

A prominent rational finance proponent, Merton, concedes that "financial models based on frictionless markets and complete information are often inadequate to capture the complexity of rationality in action" (Merton 1987, p.484). However, he continues to defend the EMH by introducing an alternative static asset pricing model with incomplete information. His model assumes that individuals will only include a security in their optimal portfolio if they have perfect information on that security. The deviation of such a portfolio from an efficient portfolio due to the incomplete diffusion of information has an impact on equilibrium expected returns. Merton theorises that efficient market equilibrium will be established again in the long term.

Blume L. and Easley (1992, p.9) examine the "long run behavior of asset prices and the common belief that the market selected for rational investors". Their model includes market participants who do not act entirely rationally. The main finding of this study is that "investors whose investment and savings rules give rise to the highest conditional expected growth rates come to dominate the market" (Blume L. and Easley 1992:32). They find that the link between rationality and dominance of the market is weak.

Shefrin and Statman (1994) developed a behavioural theory of capital asset pricing which extends "the standard pricing models to the case of price inefficiency" (Shefrin and Statman 1994, p.324). Their behavioural asset pricing model features a market in which rational traders and noise traders interact. Shefrin and Statman (1994) explain that noise traders distort the mean-variance efficient frontier, which creates abnormal returns. Contrary to Blume and Easley (1992), they assume that not all noise traders commit the same error. This result is that, viewed as a group, noise traders´ wealth does not vanish in the long run and they may remain market participants. This model allows for mispricing in the market and the long term persistence of some anomalies.

Odean (1998) analyses the effect of overconfidence on financial markets. He modifies three existing "market models in which investors are rational in all respects except how they value information" (Odean 1998, p.1888). He finds that price-taking individuals are overconfident in the signals they receive, and so the market as a whole overreacts to signals and anomalies appear. When the prices correct, the market re-establishes equilibrium. Odean's (1998) model allows for a value premium and size effect, at least in the short term.

Daniel, Hirshleifer and Subrahmanyam (1998, p.1842) propose a theory of securities markets in which investors are quasi-rational, "in that they are Bayesian optimizers except for their overassessment of valid private information, and their biased updating of this precision". The authors develop the idea that investors will overreact to private information signals but underreact to any public information signals. They argue that overconfident investors cause share prices to overreact on private signals but underreact to the noisy public information that follows. The deviation of the price from its fundamental value is only partially corrected in the short term. However, as further public information becomes available, the price moves closer to its fundamental value. This overreaction-correction pattern is consistent with the anomaly of short-run momentum and long-term reversal in returns.

Daniel et al. (2001, p.922) offer a "theory of asset pricing in which the cross-section of expected security returns is determined by risk and investor misevaluation". In their pricing model, risk-averse investors do not use the information available to them correctly in forming their portfolios and as a result, in equilibrium, securities are mispriced. They also argue that "proxies for mispricing are informative about the future returns of different securities"(Daniel et al. 2001, p.922). This mispricing creates an opportunity for investors to earn excess returns.

5.7 Conclusion

This chapter discusses behavioural finance theory and how its proponents use this theory as a foundation to explain anomalies, including the value premium and size effect. The next chapter presents the presents an overview of the debate between the proponents of the rational and behavioural explanations of the value premium and size effect and concludes with statements of the research questions.

Chapter Six

The rational-behavioural debate

6.1 Introduction

The previous chapter sets out the most important theories of behavioural finance and discusses behavioural biases and limits to arbitrage. This chapter reviews the debate between proponents of rational and behavioural finance regarding the explanation for the value premium and size effect and equity market bubbles and crashes. The chapter culminates with statements of the research questions for this thesis.

6.2 The debate in international research

The defence of the efficient markets hypothesis (EMH), in the context of the existence of the value premium and size effect, by advocates of rational finance is centred on two arguments. Firstly, it is argued that the value anomalies are the result of research (not investor) biases arising during the selection and formation of value portfolios. The biases include survivorship (Kothari et al. 1995), look-ahead (Banz and Breen 1986) and data-snooping (Lo and MacKinlay 1990). Beukes (2010) also points out that the often used COMPUSTAT database is limited to the period after 1963. However, the studies of Davis (1994), Cohen and Polk (1995), and Chan, Jegadeesh and Lakonishok (1995) contest that these biases do not have a significant, if any, influence on the value premium.

The second argument is that the value premium and size effect are not due to market inefficiency but rather a dimension of risk omitted from the asset pricing model. The risk may "reflect either assets' changing riskiness or investors' changing risk aversion over time—or both" (Ilmanen 2011, p.111). Fama and French (1992) do not find the positive relationship between beta and average stock returns predicted by the capital asset pricing model (CAPM). They believe that this is due to omitted risk factors which they capture using the book to market value of equity (BM) ratio and size of a company. According to them, a security's risk is multidimensional rather than being captured by beta alone. They suggest that a multifactor pricing model would capture the missing dimensions of risk.

Fama and French's (1993, p.5) study using their three-factor asset pricing model "seem[s] to do a good job explaining the cross-section of average stock returns." The study provides evidence that, using the three-factor model, no abnormal returns are earned. "Fama and French interpret this as evidence that size and book-to-market proxy for sensitivity to common risk factors in stock returns" (van Dijk 2011, p.3267). The implication is that "the higher average returns obtained from value portfolios represent the reward from investing in riskier stocks" (Chin et al. 2002, p.422).

The rational link between the value premium and size effect anomalies and risk, as argued by Fama and French (1992), is dependent upon two relationships. First, a positive relationship must exist between the value variable and returns. Likewise, a negative relationship must exist between the size of companies and returns. Second, the value and size variables must be positively and negatively, respectively, associated with risk. So, both value companies and small companies must be risker. A rational explanation of a value premium and size effect must satisfy both these relationships. This point is critical to the development of the research questions in this thesis.

Lo (2008) suggests that the persistence of value anomalies may, in fact, support the EMH, in that risk or transaction costs may prevent these mispricings from being exploited to any significant degree. It is submitted that the same could be said of the other anomaly studied, the size effect.

As far as behavioural arguments for the value premium are concerned, Lakonishok et al. (1994), La Porta (1996) and La Porta, Lakonishok, Shleifer and Vishny (1997) find evidence that, in their opinion, is inconsistent with the risk based explanation of the value premium and argue that value shares are not fundamentally riskier than growth shares. They argue that the value premium is due to mispricing arising from the sub-optimal behaviour of naïve (or noise) investors, along with limited opportunities for arbitrage. Lakonishok et al. (1994) suggest that naïve strategies include extrapolating historical results too far into the future, assuming a trend in prices and earnings, and overreacting to company announcements. Investors may also be taken in by the halo effect, a form of representativeness bias, where the favourable characteristics of a company are extended to its other characteristics. Further behavioural explanations for the value premium offered by Ilmanen (2011) include overconfidence, herding and conformity biases, agency issues and personal considerations.

According to Lakonishok et al. (1994), variables used to measure and classify value shares are a proxy for the mispricing of value and growth shares. The resultant demand for growth shares causes them to become overpriced, while value shares become relatively underpriced. Fama and French (1996) study the anomalies identified by Lakonishok et al. (1994) using their three-factor asset pricing model. They argue that their multifactor model can explain these apparent anomalies.

Behavioural explanations for the size effect "are relatively unexplored. Yet, the overreaction interpretation of the value effect might hold water for the size effect" (van Dijk 2011, p.3268). Van Dijk (2011) also briefly highlights other irrational-investor explanations for the size effect. Firstly, investors have an inherent preference for large companies rather than small ones. This notion is supported by Daniel and Titman's (1997) finding that size and BM do not proxy for risk but are rather characteristics relevant to the determination of returns. Secondly, often incomplete information from small companies results in a market which is not perfectly informationally efficient and creates opportunities for abnormal returns. Finally, overconfident noise investors may lead to the mispricing of small companies. This creates further opportunities to be exploited by rational investors.

The literature also includes other explanations for the size effect, such as seasonality, delisting bias and extreme returns. The effect of extreme returns is sometimes termed the turtle egg effect, where "small stocks [generally] do not perform well, but this is compensated by a few extremely successful firms" (van Dijk 2011, p.3269). Finally, Lo (2008, p.8) notes that while "some anomalies are currently inexplicable, this may be due to a lack of imagination on the part of academics, not necessarily a violation of the EMH."

While there is persistent evidence of a value premium and size effect, the competing rational and behavioural explanations for these anomalies remain controversial. Brav, Heaton and Rosenberg (2004, p.404) describe this rational-behavioural debate as the "most important philosophical concern facing financial economists today." While they believe that the debate has had successes and failures on both sides, they also believe that it may hide hitherto unexplored links between the two sides.

6.3 The debate in South African research

South African studies include most of the prominent anomalies identified internationally. However, they have, with few exceptions, not attempted to explain the underlying causes but have, instead, merely provided uncritical descriptions of the rational-behavioural debate.

Beukes (2010) attempts to explain the value premium anomaly in South Africa using extrapolation, an essentially behaviouralist explanation. She studies the returns of all companies, including those subsequently delisted, which were listed on the JSE between 1972 and 2001. Beukes's (2010, p.169) conclusion is that "extrapolation serves as a convincing explanation for the persistence of the value premium in South Africa".

Basiewicz and Auret (2010) test whether the Fama and French (1993) three factor model can explain the value premium and size effect on the JSE between 1992 and

2005. Their conclusion, that the model is successful in explaining the anomalies, provides evidence for the rational explanation. Furthermore, they argue that the cause of the size effect is not the irrational behaviour of investors but rather “market microstructure effects” which can be explained rationally (Basiewicz and Auret 2010, p.23).

6.4 Equity market bubbles and crashes

This thesis studies two anomalies immediately before, during and after one of the most significant equity market crashes in history. While behaviouralists argue that such a crisis provides dramatic evidence of an inefficient market, the proponents of rational finance maintain their defence of the EMH. It is relevant to consider the value premium and size effect in light of such opposing arguments.

Equity market crashes are characterised by a sudden and rapid decline in securities prices across a broad section of the market which typically follow speculative bubbles. They are characterised by periods of frantic selling and falling prices, such as the market crashes of 1929, or 1987 where the Dow Jones Industrial Average fell by over 20% in a single day (The Wall Street Journal 2011). The most recent equity market collapse, which began in September 2008, saw the biggest single day fall in the Dow Jones Index points in history (The Wall Street Journal 2011). Such crises raise questions as to whether securities were, in each instance, rationally priced before prices fell.

Komáromi (2006, p.3) explains that “[e]conometric models assuming rational behavior on the part of market actors divide bubbles into two sets.” These are termed “rational” and “speculative” bubbles (Komáromi 2006, p.3). Rational finance theory postulates that securities prices fluctuate around their intrinsic value. In this context, asset price bubbles are referred to as rational bubbles—actual securities prices are anchored by intrinsic value and the extent of the bubble is governed by rational expectations.

Speculative bubbles are generally described as periods during which the aggregate market is significantly overvalued. In this case there is a significant gap between the intrinsic value and price of a security. Speculative bubbles can persist for lengthy periods during which “asset prices become decoupled from economic fundamentals” (Pompian 2012, p.146). These bubbles are characterised by abnormal positive returns on securities, the major part of which relates to increases in prices. Komáromi (2006, p.80) points out that “[a] stock market boom can [only] be described as a bubble if there is high probability of a large scale fall in share prices”, known as a crash. The most significant bubbles of the last 100 years are Wall Street (late-1920s), Japanese property (mid-1980s), global technology shares (late-1990s) and the recent US property and liquidity bubble (described in Chapter One).

The term irrational exuberance was first used by Greenspan (1996) when describing the behaviour of investors in global securities markets. This became the title of Shiller’s (2000) book in which he analyses the bubble in US securities markets that existed at the turn of the millennium. Shiller (2000) argues that bubbles have four elements:

1. Precipitating events that are factors outside the securities markets, such as technology, politics and demography which contribute to the onset of a bubble.
2. Amplifying mechanisms which “cause these precipitating factors to have such an outsized effect on the market” (Shiller 2000, p.xvi).
3. Cultural factors which reinforce bubbles, such as theories of a new era which are amplified by the news media.
4. Psychological factors that play a central role in supporting bubbles.

Kindleberger (1991) argues that the formation of a speculative bubble starts with a clear and continuous rise of share prices which is caused by an exogenous shock to the economy. This initial upward trend positively influences the outlook and generates expectations of a further rise. This attracts new investors and an increase in trading volume. Positive feedback coupled with the lack of relevant information amplifies noise trading.

Speculative bubbles seem to offer overwhelming evidence that markets do not price assets rationally and that behavioural considerations must play a major role in this process. Ilmanen (2011) describes bubbles as a major challenge to the EMH. However, advocates of the EMH continue to argue that markets are efficient. They acknowledge that at times prices are not completely rational but argue that these bubbles are rare statistical events or a fat tail in an otherwise normal distribution. Malkiel (2003, p.29) concludes that they are the "exception rather than the rule and acceptance of such occasional mistakes is the necessary price of a flexible market system that usually does a very effective job of allocating capital to its most productive uses".

Malkiel's (2003) view is that crashes sometimes result from fairly rapid changes in economic prospects and that such changes are not necessarily from a single indicator. He believes that the October 1987 crash resulted from the cumulative effect of a number of unfavourable events, none of which were critical on their own. Miller (1991) agrees that this crash followed weeks of relatively minor external events which cumulatively signalled a possible change to a very favourable climate for equities.

Behaviouralists reason that speculative bubbles and crashes can be explained by the two pillars of behavioural finance described in Chapter Five—the limitation of arbitrage opportunities and behavioural biases. Pompian (2012, p.147) argues that "[f]or periods of time, there may not be effective arbitrage because of the cost of selling short, unwillingness of investors to bear extended losses, or simply unavailability of suitable instruments". This limits the effectiveness of the collective action of rational arbitrageurs in driving prices back to intrinsic value and speculative mispricing persists.

Ironically, rational investors may contribute to speculative bubbles if they are unable to overwhelm noise traders. In that case, Shleifer (2000) points out, it may be more profitable for these investors to ride the trend until the momentum shifts rather than fight it. However, timing this momentum shift is difficult to predict. Keynes is famously, but unverifiably, attributed with the comment: the markets can remain irrational far longer than you or I can remain solvent.

When the behaviour of individuals during speculative bubbles and crashes is analysed, a number of cognitive and emotional biases are found to be prevalent during those periods. The most important of these biases may be overconfidence—an individual's excessive confidence in his or her own abilities. Pompian (2012) suggests that overconfidence is prevalent in a rising market as sales of shares generally yield a profit. This gives the individual an illusion of knowledge and can lead to self-attribution bias. One of the consequences of overconfidence, according to Shefrin (2000), is that it causes the individual to trade excessively. This in turn raises volatility in a bubble market. Shiller (2000) also identifies representativeness, anchoring and herd behaviour as some of the other important psychological factors in this phenomenon.

Finally, Komáromi (1996, p.80) argues that the crash "is not triggered by fundamental news or by a certain level of share overvaluation. Instead, it happens because of a drastic change in the behavior of market players." Behavioural biases are also present when speculative bubbles unwind or crash. Initially investors, biased by anchoring, may refuse to update their beliefs and attempt to rationalise their decisions and market behaviour. Their aversion to losses may cause them to ride losers too long in an attempt to postpone the onset of regret (Shefrin and Statman 1985). This aversion may initially cause an underreaction to bad news in the market but also an acceleration in its decline once the market finally succumbs to the news. The initial losses may make investors highly, even irrationally, risk-averse which exaggerates the price falls when a bubble bursts.

6.5 Research questions

The review of the literature indicates a persistent value premium and size effect, both longitudinally and cross-sectionally. The dominant and competing explanations for these apparent anomalies are based on rational and behavioural finance theory, and the debate between the proponents of each continues.

Accordingly, two research questions are addressed by this research:

1. Is there evidence to support the effectiveness of value and size related investment strategies in the South African equity market between 2006 and 2012?
2. If value and size related equity investment strategies are found to be effective in this specific market for this specific period, is there evidence in this context to support a rational theoretical explanation for this phenomenon?

6.6 Conclusion

This chapter reviewed the debate between the proponents of rational finance and behavioural finance surrounding the value premium and size effect and equity market bubbles and crashes. The chapter culminated in the statements of research questions. The next chapter describes the empirical methods and data used in this study to find evidence for, firstly, the existence or otherwise of the value premium and size effect in South Africa between 2006 to 2012 and, secondly, evidence for the conformity of these observations with a rational risk based explanation.

Chapter Seven

Methodology and data

7.1 Introduction

The previous chapters discuss the value premium and size effect and the rational and behavioural finance theories that seek to explain these effects. This chapter describes the empirical methods and data used in this study to find evidence for, firstly, the existence or otherwise of the value premium and size effect in South Africa between 2006 and 2012. This chapter also explains the methods and data used to find evidence for the conformity of these anomalies with a rational risk based explanation.

Section 7.2 describes how returns are analysed, cross-sectionally, on portfolios of shares sorted by value and company size to determine whether a value premium and size effect can be observed during the period between 2006 and 2012.

Attention is then turned, in section 7.3, to the methodologies used to find evidence supporting the rational explanation of returns. Rational finance theory argues that the excess returns of value shares and small company shares expose investors to higher levels of systematic risk. This relationship has two implications for this study. First, it must be established whether positive, statistically significant, relationships exist between the value and size variables and returns. Second, it must be established whether the value and size variables are associated with risk.

Section 7.3.1 describes the procedures used to examine the relationships between the value and size of a company and its equity returns using a series of correlations and regressions of returns. This will indicate whether there are statistically significant relationships between the value and size variables and returns, as argued in the rational risk based explanation.

Section 7.3.2 describes the procedures used to analyse the riskiness of value and size related strategies relative to two traditional measures of risk and relative to the market and economy. This will indicate whether, in conformity with the risk based explanation, value and size are associated with risk.

7.2 Methodology: Evidence for the existence of the value premium and size effect

Fama and French (1992) construct a series of portfolios to show that the book to market value of equity (BM) ratio and the market value of equity (ME) are both factors in the variation of share returns. BM is an extensively used indicator of "orientation toward either growth or value" (Chan and Lakonishok 2004, p.71). Although there are many other candidates, such as earnings/price, dividend/price, cash flow/price and sales/price, they all capture some measure of the company's intrinsic value (Ilmanen 2011). Ilmanen (2011) argues that even a composite value strategy, which employs multiple value indicators, performs much like BM alone. However, Lakonishok et al. (1994, p.1541) counter that BM includes a significant amount of noise and is "not a 'clean' variable uniquely associated with economically interpretable characteristics of firms". Banz (1981) regards ME as the appropriate measure of a company's size, as do Fama and French (1992; 1993) and other studies such as Reinganum (1981b), Chan et al. (1991) and Loughran (1997).

In their (1993) study, Fama and French construct six portfolios of shares formed on a number of categorisations, based on sorts of ME and BM. The portfolios are designed to "mimic the underlying risk factors in returns related to size and book-to-market equity" (Fama and French 1993, p.8). The Fama and French (1993) methodology is designed to investigate, cross-sectionally, the extent to which the returns on portfolios of value shares exceed returns on portfolios of growth shares, and thereby provide evidence relevant to the existence of a value premium. Their research design also indicates the extent to which returns on portfolios of small company shares exceed returns on portfolios of big company shares, and therefore provides additional evidence relating to the size effect. The rigour of the Fama and French (1993) methodology has resulted in its application in a number of subsequent studies, including Loughran (1997) and Fama and French (1998)(2006), Ernstberger, Heinze and Vogler (2008) and Basiewicz and Auret (2010), and this thesis generally follows in this well-established research tradition.

The following five methodological matters are dealt with below:

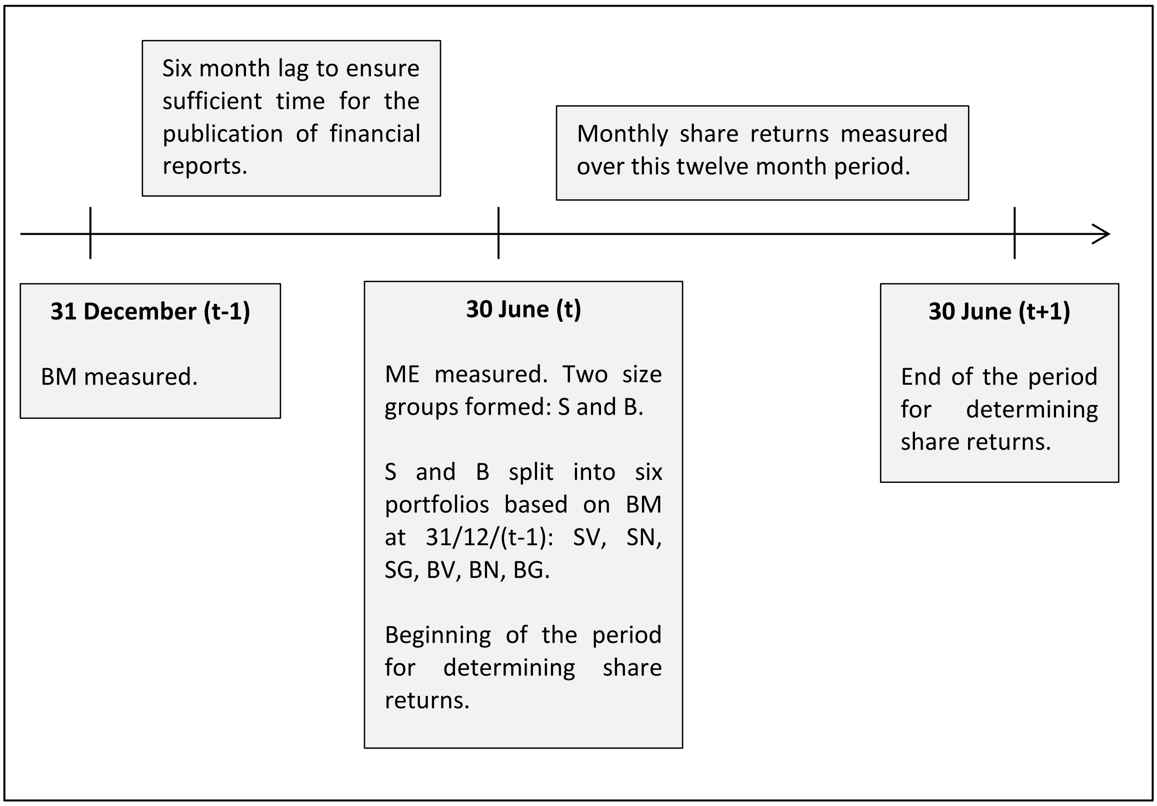
1. The collection of data and filtering of companies.
2. The ranking and division of companies into two size groups based on ME, in order to isolate the size effect.
3. The division of each size group into three sub-groups based on BM in order to isolate the value premium.
4. The measurement of company and portfolio returns.
5. The calculation of the value premium and size effect.

7.2.1 The collection of data and filtering of companies

This study is based on the returns of all companies listed on the JSE's Main Board and AltX which qualify for inclusion in portfolios as described in the paragraphs below. All historical market price, dividend and financial statement data is obtained from the records of an online service, McGregor BFA (MBFA). MBFA has captured standardised financial statements from 1971 to present for JSE listed and now delisted companies while their price data records begin in 1990. MBFA does not retrospectively add accounting or price data for companies prior to the date of their listing on the JSE, so there is no backfill bias. The service also retains data for companies after they have delisted which avoids the problem of survivorship bias.

Monthly returns are examined during the six year period from 1 July 2006 to 30 June 2012. The portfolio formation and return measurement process is shown in Figure 7.1, where "t" denotes the calendar year in which the measurement of returns commences.

Figure 7.1 Portfolio formation and return measurement process



The first day of July is selected as the date on which the measurement of returns commences so that there is at least a six month lag between company financial year ends, grouped into calendar years, and the measurement of returns. The importance of this timing lag is expanded upon in section 7.2.3.

To measure monthly returns, the following data is required for each company:

1. Book value of equity (BE) at the most recent financial year end on or before 31 December (t-1).

2. ME at 31 December (t-1).
3. ME at 30 June (t).
4. Monthly closing share price from 30 June (t) to 30 June (t+1).
5. Dividends paid during the twelve month period from 1 July (t) to 30 June (t+1).

Several important considerations arose in collecting the data, which are described in the next three sub-sections.

7.2.1.1 The book value of equity

There are a number of definitions of BE in the literature. Fama and French (1993, p.8) define BE as the "book value of stockholders' equity plus balance-sheet deferred taxes and investment tax credit (if available), minus the book value of preferred stock". A number of studies of South African markets, such as Basiewicz and Auret (2009; 2010) and Beukes (2010), which extract data from MBFA, use the standardised line item number 01010006, ordinary shareholders interest, (OSI) for BE. MBFA (2008, p.7) defines ordinary shareholders interest as:

> [O]rdinary share capital paid, plus the distributable and non-distributable reserves, less the cost of control of subsidiaries and intangible assets. It represents the equity of the ordinary shareholders of the Company in the total assets of the Group, with the exclusion of the cost of control and the intangible assets.

It is relevant to note the similarities and differences in the two calculations of BE because Fama and French's (1993) definition of BE is significantly broader. Stockholders' equity, included in BE by Fama and French (1993) is more generically referred to as owners' equity or shareholders' equity, comprising paid-up share capital and reserves (Robinson, van Greuning, Henry and Broihahn 2008). This includes preference share capital which is subsequently explicitly deducted from stockholders' equity in their definition of BE. The residual stockholders' equity is then equal to ordinary share capital plus reserves. Both the Fama and French (1993) and MBFA definitions specifically exclude preference share capital from BE, leaving only the interests of ordinary shareholders. The definitions are thus comparable before considering deferred taxes, investment tax credits, cost of control and intangible assets.

Fama and French (1993) include the deferred tax balance in BE. It may be argued that deferred tax liabilities should be treated as a form of equity when they are unlikely to reverse and result in cash outflows (Robinson et al. 2008). This would be the case where reversing deferred liabilities are continually replacing originating deferred liabilities, as is the case with a company in a strong growth phase. However, should the company cease to expand, as companies ultimately do, a portion of the liability would be realised and it would be inappropriate to treat it as equity. Robinson et al. (2008, p.496) suggest that the "deferred tax liability should be excluded from both debt and equity when both the amounts and timing of tax payments resulting from reversals of temporary differences are uncertain". This is the view taken by MBFA in the calculation of OSI. Accordingly, this study accepts MBFA's unadjusted OSI number.

Investment tax credits in the US are tax incentives that allow companies to deduct a percentage of the cost of certain specified investment from their tax liability in addition to the normal allowances for depreciation or wear and tear. Fama and French (1993) include unused investment tax credits in their calculation of BE, presumably because, similarly to a deferred tax liability, they view the balance as being permanent in nature. South African tax legislation does not provide for such tax credits, and it is therefore not necessary to account for such items in the financial statements of South African companies.

MBFA's (2008, p.6) description of the cost of control is "[t]he excess of the aggregate amounts of the cost of the shares of the subsidiaries in the group over the net asset value of such shares at the date of acquisition". However, the term cost of control is now outdated and "no longer [has] a place in financial reporting" (Bunting 2011, p.29–

7). MBFA's description of cost of control appears to be similar to Robinson et al's (2008) description of goodwill as the difference between the acquisition cost of a company and its net identifiable assets at acquisition. The International Accounting Standards Board defines goodwill in International Financial Reporting Standard 3 (2010, p.A152) as an "asset representing the future economic benefits arising from other assets acquired in a business combination that are not individually identified and separately recognised".

MBFA (2008) is of the opinion that cost of control should be deducted from reserves in the analysis of OSI. The online service argues that "[a]lthough the merits of this decision may be debatable, it conforms to the practice followed by analysts in Europe and the United States of America" (McGregor BFA 2008, p.6). MBFA also deducts other intangible assets from reserves in the calculation of OSI. The service reasons that the intrinsic value of intangible assets seldom approximate book values and that it is common practice for analysts to omit these assets completely from analysis (McGregor BFA 2008).

Fama and French (1993) differ on the matter of cost of control and intangible assets, which they do not deduct from stockholders' equity in their calculation of BE. Robinson et al. (2008) argue that, by including cost of control in BE, the BM ratio is overstated in companies which have grown by acquisition relative to companies which have grown organically but otherwise have identical economic value.

In light of the arguments of MBFA and Robinson et al. (2008) in the preceding paragraphs, this study uses MBFA's OSI as a measure of BE. Basiewicz and Auret (2009; 2010) and Beukes (2010) use the same measure.

7.2.1.2 The market value of equity

Fama and French (1993) use both ME in the calculation of BM, and as a measure of company size. They calculate ME as "stock price times number of shares" (Fama and

French 1993, p.3). This study uses the MBFA service to collect data on the ME of companies. MBFA calculates ME on a given date by multiplying the number of ordinary shares in issue by the closing share price on that date. The number of shares in issue includes any treasury shares held by a company. The implication of such a situation is that the ME of the company, as measured by MBFA, will be higher than its capitalisation in the open market. However, in line with the methodology of Beukes (2010), the difference is not material and is therefore not adjusted for.

ME recorded by MBFA is the product of the number of shares in issue and a market price measured in cents. OSI, which is used as the measure of BE, is derived from a company's financial statements. The majority of companies' financial statements captured by MBFA are expressed in South African rands. However, this study finds 57 companies whose financial statements are reported only in foreign currency at least once during the six years of this study. The reporting currency is predominantly the US dollar, British pound or euro. Other currencies include the Australian, Canadian, Namibian and Zimbabwean dollar and Botswana's pula. In such cases it is necessary to convert the OSI to Rands so that the numerator and denominator in the calculation of BM are expressed in a common currency. A weakness of MBFA is that it does not provide a means of isolating foreign currency financial statements, and every set of financial statements must be checked for this complication. The OSI of these financials is converted into Rands at the ruling exchange rate at balance sheet date, as reported by the South African Reserve Bank.

7.2.1.3 Filtering and exclusions

MBFA classifies voting ordinary shares, non- or low-voting ordinary shares (n-shares), preference shares, listed options, linked units and real estate investment trusts as equity securities. The total number of these securities in each year is shown in Table 7.1. Following Fama and French (1993), only companies with listed ordinary equity are included in the tests. Preference shares, listed options, linked units and real estate investment trusts have economic characteristics that are fundamentally different from ordinary equity securities and are excluded. The n-shares are also excluded. Table 7.1 shows the number of each type of equity security excluded in each year.

Table 7.1 The number of equity securities and exclusions

	2007	2008	2009	2010	2011	2012
Total number of MBFA equity securities	**430**	**459**	**450**	**434**	**441**	**421**
N-shares	10	9	8	8	11	7
Preference shares	6	7	7	6	6	5
Options	1	1	1	1	1	1
Linked units	27	23	20	17	16	17
Real estate investment trusts	7	7	7	7	9	7
Unspecified classification	4	4	4	4	4	1
Subtotal	**375**	**408**	**403**	**391**	**394**	**383**
Unbundling transactions	1	6	11	7	11	9
Share split/consolidation/capitalisation issues	6	7	3	1	5	6
New listing	37	58	13	8	10	5
De-listing	25	19	20	16	11	19
Negative BE value	27	31	28	40	40	27
Incomplete data	36	46	53	16	24	27
Outliers	12	7	3	7	6	11
Number of securities qualifying for inclusion in portfolios	**231**	**234**	**272**	**296**	**287**	**279**

Mining and financial companies are not specifically excluded, as they are in a number of other studies of anomalies on JSE-listed companies (such as Plaistowe and Knight (1986), Fraser and Page (2000), Graham and Uliana (2001) and Mutooni and Muller (2007)). Robins et al.(1999, p.56) argue that the pricing of mining companies is "determined by exogenous factors and [inclusion] would be detrimental to the assumption of homogeneity". Financial companies are also sometimes excluded from tests of the value premium or size effect as the "high leverage that is normal for these firms probably does not have the same meaning as for nonfinancial firms, where high leverage more likely indicates distress" (Fama and French 1992, p.429). This may result in value financial companies being misclassified as growth companies because they have relatively low BM values. However, exclusion arguments based on exogeneity, leverage or similar considerations appear unconvincing in light of the underlying theory and hypotheses, which are specifically based on equity market valuation factors, independent of the nature of each specific company's business or its internal capital financing decisions. In support of this approach, in subsequent Fama and

French studies of the value premium (1993; 1998; 2006) financial companies are not excluded.

MBFA reports 41 suspensions and thirteen suspensions lifted on the JSE during the period of this study. Only 26 of the suspensions related to ordinary shares. Many shares continued to trade again after their suspension, where no lifting of the suspension is recorded by MBFA. Therefore, it is reasonable to assume that the MBFA data on suspensions is incomplete. However, the effects of this matter on the study are not considered to be material, because the majority of the companies suspended either continued to trade, or were excluded from selection for portfolios on the grounds of incomplete data or negative BE. Thus, only a very small number of effectively suspended companies are included in the portfolios, and cannot have a significant impact on the results of this study.

To calculate a complete set of twelve monthly returns as described in the next section methodology, the company's BM at 31 December (t-1), ME at 30 June (t) and closing share price each month during the year that follows is required. In some instances, BE, ME or price data is missing from the MBFA data set. In such cases, where a company's complete set of data for the relevant twelve month period is not available, the company is excluded for that full period, but not subsequent periods. The number of companies that are excluded on the basis of incomplete data is shown in Table 7.1. New listings are included in portfolios only once they have a complete set of data. This is at least six months after listing as these companies must have both a BM at 31 December (t-1) and ME at 30 June (t) to be considered for inclusion. MBFA's data indicates that 134 companies were delisted during the period 1 January 2005 to 30 June 2012. This includes the period from the beginning of the calendar year prior to the measurement of returns (1 January (t-1)), during which BE is measured, to the last day of the period during which returns are measured. These delisted companies do not have a complete data set in the final twelve months of their listing and are accordingly excluded from that period. However, the company's data is not removed from the MBFA service so survivorship bias is avoided.

MBFA also records 95 name changes during the period 1 January 2005 to 30 June 2012. MBFA applies the new name to historical data, so no data continuity problems are encountered.

In this thesis, the effects of unbundling are specifically identified and dealt with carefully. The unbundling company effectively ceases to be the same entity and embodies only the core or components of the previous conglomerate. The company's BE, ME and returns are affected by the process. MBFA reports 34 unbundling transactions during the period 1 January 2005 to 30 June 2012. In terms of the methodology used in this study, unbundling transactions can fall into one of three periods, as follows:

1. If the unbundling is after the financial year end of a company but before 31 December (t-1), when ME is measured, the BE and ME do not reflect the same group of companies and BM will be meaningless. It follows that the allocation of such a company to a portfolio may be invalid. Accordingly, companies unbundling during this period are excluded from portfolios for the period 1 July (t) to 30 June (t+1).
2. An unbundling after 31 December (t-1) but before 30 June year (t), results in BM having been measured before unbundling while the ME is post-unbundling. The two variables do not reflect the same entity. Accordingly, companies unbundling during this six month period are excluded from portfolios for the period 1 July (t) to 30 June (t+1).
3. An unbundling between 1 July in year (t) and 30 June year (t+1) will result in a series of returns from, effectively, different entities. This study excludes the company unbundling during this period from portfolios during the period 1 July (t) to 30 June (t+1).

Based on the approach taken in this study and depending upon the timing of the unbundling, one unbundling can potentially exclude that company from portfolios for three years. For example, a company unbundling in March 2007 is excluded for the twelve months' returns ending 30 June 2007 (refer point 3 above), 2008 (refer point 2), 2009 (refer point 1). The unbundled company is not excluded from portfolios as long as it has all required data fields for portfolio formation and return calculation.

N-shares are excluded from the securities qualifying for the various portfolios, as explained at the beginning of this section. However, OSI, as calculated by MBFA, and which is used for BE as described in section 7.2.1.1, is attributable to both ordinary and n-shareholders while MBFA's ME does not include the value of n-shares. Without adjustment, this results in a situation where BE is logically inconsistent with ME as they represent different share capital. To correct for this, in the case of a company with both listed n-shares and ordinary shares, the ME of listed n-shares are added to the ME of the ordinary shares each time ME is measured. No adjustment can be made where n-shares are not listed.

New issues of shares, rights issues and claw backs[2] increase the total BE and ME of companies. Share buy-backs have the opposite effect. When these transactions are at a discount or premium to the existing market price of shares, the value of shares already in issue will change and the market price will adjust to reflect this. MBFA reports 79 rights issues and claw backs and 203 general or specific buy-backs during the period 1 January 2005 to 30 June 2012. The complications that arise could possibly extend into three periods, as described in the paragraph on unbundling matters above. Scrip dividends, where the shares are issued in lieu of dividends at the prevailing market value, do not, theoretically, affect the total ME of the issuing company. BE is

[2] The JSE Listing Requirements (2011) describe a claw back as "a pre-placed rights offer where placees, acting in lieu of an underwriter, are issued securities, or the rights thereto, for cash by an applicant, which securities or rights are then offered to the applicant's shareholders, in proportion to their existing holdings, in the form of a right to enable such shareholders to "claw back" their right to subscribe for such securities."

also not affected as no funds leave the company and the market price of shares does not require adjustment. Such equity transactions will therefore not affect the methodologies or results of this study.

Share splits, consolidations and capitalisation issues do not directly alter a company's BE or ME. However, the share price will be affected, and in turn this will cause a corresponding adjustment in returns. MBFA reports thirteen share splits, sixteen consolidations and fourteen capitalisation issues during the period of this study. To ensure that returns are not influenced by such fluctuations, companies with share splits, consolidations and capitalisation issues are excluded from the portfolios in the year of that adjustment.

Despite the controls put in place for the inclusion of companies in portfolios, a small number of outliers are still found in the various portfolios. Basiewicz and Auret (2009) are exclude outliers whose returns are greater than 200% and less than -63.3%. In this study, companies whose annual returns are greater than 200% or less than -200% are excluded along with those who have a BM ratio of greater than five.

The World Federation of Exchanges (2011) ranks the JSE as the largest equity exchange in Africa and the nineteenth largest in the world in terms of domestic market capitalisation. However, the JSE ranks only twenty-sixth in the volume of trades and thirty-second in turnover velocity (World Federation of Exchanges 2011), and the exchange is generally regarded as being illiquid. Bailey and Gilbert (2007, p.26) find that the lack of liquidity plays a role in the persistence of abnormal returns on the JSE and that in the absence of illiquid shares, abnormal returns are "effectively eliminated". They also suggest a positive correlation between company size and liquidity. However, Basiewicz and Auret (2009) find that the correlation between size and liquidity is low, and they argue that this may be due to a non-linear relationship between size and liquidity. In the same study, Basiewicz and Auret (2009, p.23) argue that the problem of illiquidity may partially explain the "excessively high value premium documented in previous studies".

Because this study is carried out, and its results are interpreted, specifically in the context of the JSE, it is neither appropriate nor feasible to make adjustments for market illiquidity, such as a liquidity filter. (A liquidity filter would, in any case, result in significant data loss.) However, the results are interpreted in light of the findings of Bailey and Gilbert (2007) and Basiewicz and Auret (2009). The application of a liquidity filter also represents an opportunity for further research.

7.2.2 The ranking and division of companies into two size groups based on ME

As at 30 June (or the last preceding business day) from 2006 to 2011, the qualifying JSE securities are ranked based on the company's ME at that date. The median ME is used as a break-point to divide the companies into two groups. Companies with MEs above the median value are categorised as big companies (B). Those companies with MEs equal to or below the median value are allocated to the small companies (S) group.

7.2.3 The division of each size group into three sub-groups based on BM

The two size groups are then each further divided into three sub-groups based on the company BM, where the book value of equity is measured at the end of the last financial year ended on or before 31 December (t-1) and ME is measured at 31 December (t-1) or the immediately preceding business day. The breakpoints used for this division are the bottom 30%, middle 40% and top 30% of BM value in each group (growth (G), neutral (N) and value (V) respectively). This follows Fama and French's decision to sort companies into two size but three BM groups, on the basis of their findings that "book-to-market equity has a stronger role in average stock returns than size" (Fama and French 1993, p.9). They concede that the break-points are merely arbitrary, but argue that there is no reason why returns should be sensitive to these choices.

Although BE is measured at the end of each company's specific financial year, ME is measured at 31 December that year. Clearly, the measurement of BE and ME is not aligned in companies that do not have a 31 December financial year end. Fama and

French (1992) recognise this problem. However, they also point out that "[u]sing ME at fiscal year ends is also problematic; then part of the cross-sectional variation of a ratio for a given year is due to market-wide variation in the ratio during the year" (Fama and French 1992, p.430). They further argue that this misalignment makes little difference to results. Further complications arise where share capital has changed as a result of a new share issue, rights issue, buy-back or an unbundling between the financial year end and 31 December. In this thesis, these matters are dealt with in the manner discussed in more detail in section 7.2.1.3 above.

A lag between the publication of financial results and the measurement of returns is necessary "to ensure that the accounting variables are known before the returns they are used to explain" (Fama and French 1992, p.429). A failure to allow for sufficient lag may result in a look-ahead bias, where returns are mistakenly linked to information not available at the time (Banz and Breen 1986). There is a cost-benefit trade-off between look-ahead bias and lag. If there is not adequate lag between the end of the financial year and the release of the results, a look-ahead bias may exist. However, too much lag may mistakenly link obsolete information to returns.

The JSE requires that audited annual financial statements be distributed to shareholders within six months of the company's financial year end and, if not distributed within three months of year end, a provisional report must be distributed (JSE Limited 2011). In a manner that is consistent with the Fama and French (1993) methodology, therefore, a minimum lag of six months is set in this thesis. This minimum lag, which applies to companies with a 31 December financial year end, is measured from 1 January (t), to 30 June (t). The maximum lag, of seventeen months, applies to companies with a 31 January financial year end. The lag is measured from 1 February (t-1) to 30 June (t). This approach minimises the risk of look-ahead bias. Fama and French (1992), following a similar methodology, report that in tests with December only year ends, the results are similar to tests without this constraint. They are satisfied that the potentially long lag is of little consequence.

The intersection of the two size groups and three BM groups forms a matrix of six portfolios:

1. SV - Small companies with a high BM ratio (small value companies)
2. SN - Small companies with a neutral BM ratio (small neutral companies)
3. SG - Small companies with a low BM ratio (small growth companies)
4. BV - Big companies with a high BM ratio (large value companies)
5. BN - Big companies with a neutral BM ratio (large neutral companies)
6. BG - Big companies with a low BM ratio (large growth companies)

These portfolios produce a series of six returns. These portfolios form the "components of the monthly size and value-growth returns of the Fama-French three-factor model" (Fama and French 2006, p.2165). Table 7.2 shows the portfolio matrix. The SV portfolio, for example, contains all shares that have a ME equal to or below median and a BM value in the top 30%. Likewise, the BG portfolio contains all shares that have a ME greater than median and a BM value in the bottom 30%.

Table 7.2 The portfolio matrix

	High BM	Neutral BM	Low BM
Small companies	SV	SN	SG
Big companies	BV	BN	BG

SV Small companies with a high BM (small value companies)
SN Small companies with a neutral BM (small neutral companies)
SG Small companies with a low BM (small growth companies)
BV Big companies with a high BM (large value companies)
BN Big companies with a neutral BM (big neutral companies)
BG Big companies with a low BM (large growth companies)

Each year, from 2006 to 2011, portfolios are formed at 30 June (t) and monthly returns measured from 1 July (t) to 30 June (t+1) in the same manner. This results in a series of 72 monthly returns.

This thesis uses an open data set, where all JSE companies listed at 30 June (t) are considered for inclusion in the portfolios each year from 2006 to 2011. As a consequence, both the number and composition of companies in the data set changes from year to year. A number of companies move between portfolios as their ME or BM changes relative to other companies in the set changes. For example, a company may fall into the SV portfolio in one year and the BV the next year. Some companies are excluded entirely while other companies are introduced into the portfolios in terms of the criteria set out in section 7.2.1.3.

The approach taken in some studies is to rebalance portfolios each year from a closed data set that includes only those companies which have complete data for the entire reference period. This methodology is not applied in this thesis because it introduces a survivorship bias: companies which do not have complete data in every year would then be excluded from the entire study. Such an approach also excludes new companies that enter the market during the period studied.

7.2.4 The measurement of company and portfolio returns

Fama and French (1993) use monthly returns in tests of their three-factor asset pricing model. In a subsequent defence of their (1993) study, they argue that monthly returns are more appropriate because annual returns produce “hopelessly imprecise” results for the purpose of testing asset pricing models (Fama and French 1998, p.1977). In order to avoid the data imprecision problems referred to by Fama and French (1998), monthly returns are used in this thesis. The period of this study, 1 July 2006 to 30 June 2012, comprises 72 months.

The calculation of monthly returns for each company is shown in equation 7.1.

Equation 7.1 Monthly return

$$r_1 = \frac{(P_1 - P_0) + D_1}{P_0}$$

where

r_1 is the return for month 1

P_1 is the closing share price for month 1

P_0 is the opening share price for month 1

D_1 is the dividend for month 1

Using the monthly company returns, both value- and equal-weighted returns are calculated for each portfolio for the period 1 July (t) to 30 June (t+1).

Fama and French (1993) use value-weighted returns rather than equal-weighted returns for two reasons. Firstly, they assume a negative relationship between company size and variance of returns, and argue that "[u]sing value-weighted components is in the spirit of minimizing variance" (Fama and French 1993, p.10). Secondly, value-weighted returns "capture the different return behaviours of small and big stocks, or high- and low-BE/ME stocks, in a way that corresponds to realistic investment opportunities" (Fama and French 1993, p.10). Basiewicz and Auret (2009) add that value-weighting returns decreases the effect of transaction costs. However, they continue that "equal-weighted results may be preferable as firm specific events are less likely to influence the results" (Basiewicz and Auret 2009, p.26). Equal-weighted returns may also be preferable in a relatively small market where wealth is concentrated in only a small number of dominant companies or industries. In such a market, the value-weighted returns would be significantly influenced by these factors.

This study presents the results of both value- and equal-weighted returns because the pros and cons of each approach are so finely balanced. Such an approach will also provide an indication of how robust the value premium and size effect are to the method of weighting.

The measurement of monthly returns necessitates spreading the periodic dividends across the full calendar year. According to Fama and French (1998, p.1977) "[t]his approach maintains the integrity of average returns. But it assumes that the capital gain component of monthly returns, which is measured accurately, reproduces the volatility and covariance structure of total monthly returns".

7.2.5 The calculation of the value premium and size effect

Differences in the returns of the six portfolios are determined in order to isolate the value premium and size effect. The first of these is the value-minus-growth (VMG) return (r_{VMG}), which isolates the value premium. This return is calculated as the difference between the unweighted mean of the value portfolio (SV and BV) returns and the growth portfolio (SG and BG) returns. Assuming statistical significance (discussed separately below), a positive r_{VMG} provides evidence that returns of value shares, on average, exceed returns of growth shares. Such evidence supports the existence of a value premium.

To eliminate the size effect in this return calculation, company size must be approximately evenly distributed between value and growth companies. In such a case the mean size of the two value portfolios will approximate the two growth portfolios and the r_{VMG} "should be largely free of the size factor… focusing instead on the different return behaviours of high- and low-BE/ME [BM] firms" (Fama and French 1993, p.9).

Equation 7.2 Value premium

$$r_{VMG} = \frac{r_{SV} + r_{BV}}{2} - \frac{r_{SG} + r_{BG}}{2}$$

where

r_{VMG} *is the value premium*

r_{SV}, r_{BV}, r_{SG} *and* r_{BG} *are the returns from the relevant original portfolios*

The small-minus-big (SMB) return (r_{SMB}) calculation is used to isolate the size effect. This return is calculated as the difference between the unweighted mean of the three small company portfolios (SV, SN, SG) returns and the three big company (BV, BN, BG) portfolios. Once again, assuming statistical significance, a positive r_{SMB} provides evidence that returns from smaller companies are on average higher than returns from larger companies. This evidence would support the existence of a size effect.

The SMB return calculation is designed to control for the effect of value. It is to be expected that BM is independent of company size, and therefore the average BM of the three small company portfolios should approximate the three big companies and the SMB returns should be unaffected by the effects of BM.

Equation 7.3 Size effect

$$r_{SMB} = \frac{r_{SV} + r_{SN} + r_{SG}}{3} - \frac{r_{BV} + r_{BN} + r_{BG}}{3}$$

where

r_{SMB} *is the size effect*

r_{SV}, r_{SN}, r_{SG}, r_{BV}, r_{BN} *and* r_{BG} *are returns from the relevant original portfolios*

Three other return differences are calculated. The VMGS and VMGB returns (r_{VMGS} and r_{VMGB}) provide an indication of the value premium amongst small and big companies respectively. These returns are calculated as the difference between SV and SG portfolios and the BV and BG portfolios respectively. A positive return in either case provides evidence in support of the existence of a value premium in that particular size grouping. Finally, the VMGS-B return ($r_{VMGS\text{-}B}$) calculation indicates the difference between the VMGS and VMGB returns. A positive return supports the presence of a higher value premium in smaller companies.

Equation 7.4 Value premium - small companies

$$r_{VMGS} = r_{SV} - r_{SG}$$

Equation 7.5 Value premium – big companies

$$r_{VMGB} = r_{BV} - r_{BG}$$

Equation 7.6 Value premium – small companies minus big companies

$$r_{VMGS-B} = r_{VMGS} - r_{VMGB}$$

where

r_{VMGS} *is the value premium for small companies*

r_{VMGB} *is the value premium for big companies*

r_{VMGS-B} *is the difference between the value premium for small and big companies*

r_{SV}, r_{SG}, r_{BV} *and* r_{BG} *are the returns from the relevant original portfolios*

The various returns are tested for significance using one-tailed Student's t-tests. These tests indicate whether the arithmetic mean of the series of 72 monthly portfolio returns is significantly different from zero. A t-test is a valid measure of the significance of returns because normality is not assumed, the sample size is large (it exceeds 50) and the variance of population is not known.

7.3 Methodology: Evidence for the conformity of the value premium and size effect to rational finance theory

Having established whether a value premium and size effect exist during the period 1 July 2006 to 30 June 2012 in South Africa, attention is turned to evidence for the conformity of the value premium and size effect to rational finance theory.

The rational link between the value premium and size effect anomalies and risk is dependent upon the two sets of relationships. First, a positive relationship must exist between the value variable and returns and a negative relationship must exist between the size of companies and returns. Second, the value and size variables must be positively and negatively, respectively, related to risk. The implication is that both value and size related strategies are riskier.

A rational explanation of the value premium and size effect must satisfy both sets of relationships. The relationships between the value and size variables and returns are analysed in section 7.3.1, using correlation and regression analyses. In section 7.3.2, the riskiness of value and size related strategies are analysed relative to two traditional measures of risk and relative to the market and economy.

7.3.1 Evidence for the relationships between the value and size variables and returns

As before, BM and ME are used as the relevant indicators of value and company size. Each company's returns, BM and ME are also measured as described in section 7.2. In order to avoid misspecification arising from the non-negative constraint on asset prices, this study analyses the lognormal distribution of ME (ln(ME)) in regression models and correlation studies.

While returns are measured monthly, BM is measured only once a year, at 31 December (t-1, from the previous discussion). Accordingly, monthly returns are correlated or regressed against the relevant preceding annual BM. Similarly, ME is measured at 30 June each year (t, from the previous discussion), and the following series of twelve monthly returns are regressed or correlated against this value. Auret and Sinclair (2006) follow a similar approach.

The study uses the Pearson product-moment coefficient (correlation coefficient, r) to measure the strength and direction of the relationship between two variables, but without assuming a cause-and-effect relationship between those variables. Three pairwise correlations are calculated—BM and returns, ln(ME) and returns, and BM and ME. A statistically significant positive correlation between BM and returns, where value companies—those with a high BM—show higher returns, would provide evidence supporting a value premium. A statistically significant negative correlation between ln(ME) and returns, where smaller companies show higher returns, would provide evidence supporting a size effect. The third correlation is between BM and ME. Fama and French (1992, p.446) explain the relationship between BM and size as follows:

> [F]irms with low market equity are more likely to have poor prospects, resulting in low stock prices and high book-to-market equity. Conversely, large stocks are more likely to be firms with stronger prospects, higher stock prices, lower book-to market equity, and lower average stock returns.

It follows that a negative correlation between these two variables is to be expected. However, the correlation of BM and ln(ME) also provides an indication of their joint value in the context of a multivariate asset pricing model. Where the explanatory variables are highly correlated, whether positively or negatively, they have low explanatory power in multivariate models as they overlap. One variable will, to some extent, absorb the effect of the other. This is known as multicollinearity and "is a serious practical concern because approximate linear relationships among financial variables is common" (DeFusco, McLeavey, Pinto and Runkle 2007:356). In an effective asset pricing model, the explanatory (i.e. independent) variables are not highly correlated. Two-tailed Student's t-tests are used to determine the significance of results. Significance is also presented by p-value calculations.

This study also uses ordinary least squares (OLS) regression analysis to study the relationship between value, size and returns. Both correlations and OLS regressions are based on the assumption of the existence of a linear relationship. However, unlike a correlation, in an OLS regression the dependent and independent variable(s) are specified and the regression allows an analyst to predict the value of the dependent variable (in this case, return) using the independent variable(s) (in this case, BM and/or ln(ME)). The coefficient of determination, or R^2, value calculated from such a regression indicates the extent to which independent variable(s) can explain the variation in the dependent variable. In the context of this study, it indicates the extent to which the variation in returns can be explained by BM and/or size.

Returns are regressed on BM and ln(ME) in univariate OLS regressions. The functions of these regressions take the following form:

Equation 7.7 Univariate regression model – BM

$$\boldsymbol{r_{i,t} = b_0 + b_1 x_{1,i,t} + \varepsilon_i}$$

where

t is an integer from 1 to 72 corresponding to the months from July 2006 and June 2012

$r_{i,t}$ *is the return on share i for the period t*

b_0 *is the intercept co-efficient*

b_1 *is the slope co-efficient*

$x_{1,i,t}$ *is the independent variable, BM, for share i six months prior to the 30 June preceding t*

ε_i *is an error term*

Equation 7.8 Univariate regression model – ln(ME)

$$r_{i,t} = b_0 + b_2 x_{2,i,t} + \varepsilon_i$$

where the additional term

b_2 is the slope coefficient

$x_{2,i,t}$ is the independent variable, ln(ME), at the preceding 30 June

A multivariate OLS regression is employed to analyse the joint explanatory ability of BM and ln(ME) variables in determining returns and takes the following form:

Equation 7.9 Multivariate regression model – BM and ln(ME)

$$r_{i,t} = b_0 + b_1 x_{1,i,t} + b_2 x_{2,i,t} + \varepsilon_i$$

The significance of each of the estimated slope coefficients in all three regressions is individually tested using a Student's two-tailed t-test. This tests whether each slope coefficient, being the relevant BM or ln(ME) factor, is significantly different from zero. A t-test is a valid measure of the significance of the relationship for the reasons noted in section 7.2.5. The significance of portfolio returns is also presented by p-value. The multivariate regression is also subjected to an F-test, which assesses how effectively this particular set of independent variables (BM and ln(ME)), as a group, explains the observed variation in the dependent variable (return).

Homoskedasticity, where the variance of the error term is constant across the population, is assumed in OLS regression models. This assumption fails when variance is found to vary in different sections of the population. Such a population is termed heteroskedastic. "Although heteroskedasticity does not affect the consistency of the regression parameter estimators, it can lead to mistakes in inference" (DeFusco et al. 2007:345). The existence of heteroskedasticity will most likely result in underestimates of least square standard errors, and render invalid any tests based on those standard errors. In turn, the t-tests for the individual regression coefficients will be unreliable. DeFusco et al. (2007) warn that heteroskedasticity may also cause unreliability in an F-statistic.

Breusch and Pagan (1979) test for heteroskedasticity by regressing the square of the residuals in the estimated regression model on the independent variables in the regression (DeFusco et al. 2007). The results indicate whether the distribution of data violates the OLS regression assumption that the variance of the error is constant across the population.

The effects of heteroskedasticity can be corrected by calculating robust standard errors. Robust standard errors relax the OLS assumption that standard errors are both independent and identically distributed. Using robust standard errors, the coefficient estimates of the regression remain unchanged, but the robust standard errors are more accurate than the uncorrected standard errors and the t-statistics are more reliable. These are referred to as heteroskedasticity-constant t-statistics.

7.3.2 Evidence for the relative riskiness of value and size investment strategies

Fama and French (1992) reason that, if BM and ME are proxies for risk, and assets are priced rationally, the excess returns of value shares and small company shares expose investors to higher levels of systematic risk. The cause of this risk is, they conjecture, a financial distress factor (Fama and French 1992). Behaviouralists argue that risk does not explain the difference in returns and that these, and other contrarian strategies are not, on average, riskier. The empirical work of Lakonishok et al. (1994, p.1564) is based on their theory that:

> [v]alue stocks would [only] be fundamentally riskier than glamour stocks if, first, they underperform glamour stocks in some states of the world, and second, those are on average "bad" states, in which the marginal utility of wealth is high, making value stocks unattractive to risk-averse investors.

The behaviouralist argument is that, if value shares are riskier than growth shares, as argued by proponents of rational finance theory, during periods of financial crisis value shares will be less attractive than growth shares. Thus, they theorise that the value premium would decline or become negative during such times.

Lakonishok et al. (1994) measure the returns of equal-weighted growth and value portfolios relative to two traditional measures of risk, beta and standard deviation, in the US during the 1968 to 1990 period. They also contrast growth and value returns in good and bad states of the economy during this period. The state of the economy is indicated, first, by overall market returns and, second, by quarterly gross national product growth rates.

This thesis adapts the Lakonishok et al. (1994) methodology for JSE data. The analysis of the riskiness of the value premium requires the calculation of monthly returns from value portfolios (r_V) and growth portfolios (r_G) and the monthly value premium (r_{VMG}). The formation of equal-weighted value, growth, small and big portfolios is described in detail in section 7.2 above. The calculation of r_V and r_G from these portfolios is as follows:

Equation 7.10 Return on value portfolios

$$r_V = \frac{r_{SV} + r_{BV}}{2}$$

Equation 7.11 Return on growth portfolios

$$r_G = \frac{r_{SG} + r_{BG}}{2}$$

The calculation of r_{VMG}, the difference between r_V and growth portfolios r_G, is shown in equation 7.2.

The analysis of the riskiness of the size effect requires the calculation of monthly returns from small company portfolios (r_S), big company portfolios (r_B) and the monthly size effect (r_{SMB}). The calculation of r_S and r_B are as follows:

Equation 7.12 Return on portfolios of small companies

$$r_S = \frac{r_{SV} + r_{SN} + r_{SG}}{3}$$

Equation 7.13 Return on portfolios of big companies

$$r_B = \frac{r_{BV} + r_{BN} + r_{BG}}{3}$$

The calculation of the monthly size effect, r_{SMB}, is shown in equation 7.3.

The analysis also requires the calculation of monthly market returns. These are the unweighted means of monthly returns of all companies qualifying for inclusion in portfolios.

To examine the relative riskiness of returns on value and growth portfolios during the period 1 July 2006 to 30 June 2012, the returns are first contrasted in total and then by two traditional measures of risk—beta and standard deviation. The beta of returns on each portfolio is calculated:

Equation 7.14 Beta

$$\boldsymbol{\beta_p = \frac{Cov_{pm}}{\sigma^2{}_m}}$$

where

β_p *is the Beta of portfolio p*

Cov_{pm} *is the covariance of portfolio p's monthly return with the market return*

$\sigma^2{}_m$ *is the variance of the monthly market return*

Chan and Lakonishok (2004, p.76) note the possibility that "beta and volatility are crude proxies that do not capture all the relevant risks". Indeed, Fama and French (1992) find that beta does not explain a cross-section of returns and that risk is multidimensional. Thus, the performance of the value and growth portfolios is also compared during good and bad states of the economy.

The first indicator of the state of the economy is the monthly market return during the period 1 July 2006 to 30 June 2012, which is sorted into three periods—the best eighteen months of returns, the worst eighteen months of returns and the intermediate 36 months. The average r_V, r_G and r_{VMG} are calculated and contrasted in each of these periods to provide evidence of the relative riskiness of a value investment strategy. Lakonishok et al. (1994) argues that, if value shares are more risky, then the premium will be negative during the worst eighteen months. Similarly, the average r_S, r_B and r_{SMB} are calculated and contrasted for evidence of the relative riskiness of a size related strategy.

The second indicator of the state of the economy is the quarterly gross domestic product growth rate. The series of 24 quarters during the period 1 July 2006 to 30 June 2012 is collected from the MBFA online database. The 24 months are sorted into three periods—the best six quarters, the worst six quarters, and the twelve intermediate quarters. The average r_V, r_G and r_{VMG} are calculated and contrasted in each of these periods to provide evidence of the relative riskiness of a size related investment strategy. Similarly, the average r_S, r_B and r_{SMB} are calculated and contrasted for evidence of the relative riskiness of a size related strategy.

7.4 Conclusion

This chapter sets out the methodology and data used to find evidence for the existence or otherwise of the value premium and size effect in South Africa between 2006 and 2012. It also deals with methods and data used to find evidence for the conformity of these anomalies with the rational explanations. The next chapter presents the findings of these procedures.

Chapter Eight

Results, analysis and discussion

8.1 Introduction

The previous chapter describes the empirical methods and data used in this study to find evidence for, firstly, the existence of the value premium and size effect in South Africa between 2006 and 2012, and, secondly, evidence for the conformity of these anomalies with rational explanations. This chapter presents the empirical findings of the tests described in Chapter Seven and an analysis and discussion of these results.

Section 8.2 relates to the first research question. It presents the evidence for the existence of the value premium and size effect. This is compared with and contrasted to other relevant studies. The results of procedures relating to the second research question are set out in sections 8.3 and 8.4. Section 8.3 presents the findings of tests for the significance of relationships between the value and size variables and returns. Finally, section 8.4 analyses the results of various tests for the relative riskiness of value and size related investment strategies.

8.2 Evidence for the existence of the value premium and size effect

This section begins with a review of the companies selected for portfolios in each year. Table 8.1 shows the number of companies which meet all the inclusion criteria and are assigned to the various portfolios. The year in each column refers to the twelve month period ending 30 June. The methodology by which companies are selected and assigned to portfolios is fully described in Chapter Seven. The total number of companies in each of the six-twelve month periods varies between 231 (2007) and 296 (2010), with a mean of 267 companies. As returns are measured monthly, this study is based on a cross-section of 19 188 data points, each one being an individual observation of the return for a particular company's share for a particular month.

Table 8.1 The number of companies selected and allocated to each portfolio

Portfolio	2007	2008	2009	2010	2011	2012
SV	35	35	40	44	43	42
SN	46	47	56	60	57	56
SG	35	35	40	44	43	42
Total number of small companies	**116**	**117**	**136**	**148**	**143**	**140**
BV	35	35	40	44	43	42
BN	45	47	56	60	58	55
BG	35	35	40	44	43	42
Total number of big companies	**115**	**117**	**136**	**148**	**144**	**139**
Total number of companies selected	**231**	**234**	**272**	**296**	**287**	**279**

SV Small companies with a high BM (small value companies)
SN Small companies with a neutral BM (small neutral companies)
SG Small companies with a low BM (small growth companies)
BV Big companies with a high BM (large value companies)
BN Big companies with a neutral BM (big neutral companies)
BG Big companies with a low BM (large growth companies)

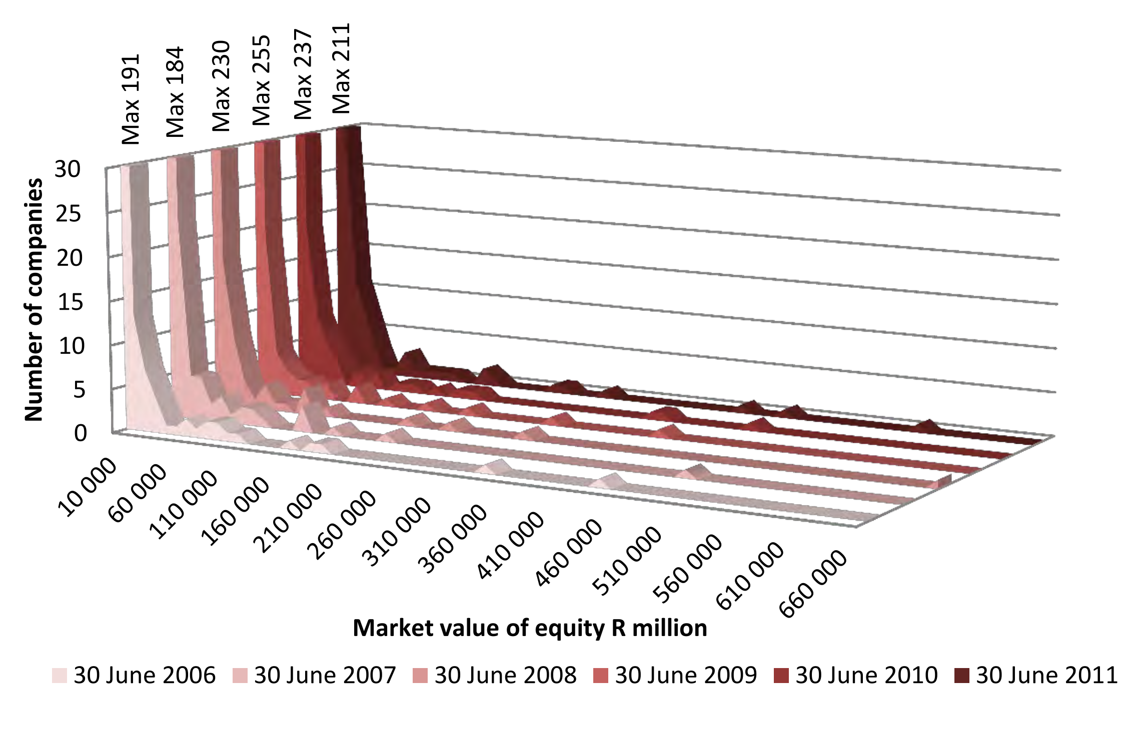
Table 8.2 shows the descriptive statistics for the market value of equity (ME) which includes the metrics used to arrange companies into big and small groups each year. The mean ME for all companies declines each year between 2006 and 2009 from R13 269m to R9 190m before rising again in 2010 and then 2011 to R17 377. The sharpest fall is between 2008 and 2009, where the mean ME decreases by 18%. This coincides with the worst period of the most recent global financial crisis. Both small and big groups of companies follow a similar trend.

Table 8.2 Descriptive statistics for the market value of equity of companies

	30/06/2006	30/06/2007	30/06/2008	30/06/2009	30/06/2010	30/06/2011
All companies						
Mean (R'million)	13 269	12 614	11 237	9 190	12 728	17 377
Median (R'million)	1 314	1 527	832	534	727	1 192
Excess kurtosis	48.37	74.50	112.49	60.97	46.47	42.44
Skew	6.55	7.74	9.79	7.39	6.56	6.25
Small companies						
Mean (R'million)	332	405	247	165	189	312
Median (R'million)	176	250	189	115	134	165
Excess kurtosis	-2.95	-2.92	-3.22	-3.18	-2.24	-2.79
Skew	1.06	1.07	0.92	0.91	1.23	1.16
Proportion of total ME (%)	1.26	1.61	1.10	0.90	0.76	0.90
Big companies						
Mean (R'million)	26 318	24 823	22 226	18 215	25 180	34 566
Median (R'million)	6 915	7 412	4 512	4 041	5 684	9 890
Kurtosis	22.50	38.05	55.92	28.67	21.14	19.08
Skew	4.65	5.67	7.02	5.24	4.63	4.41
Proportion of total ME (%)	98.74	98.39	98.90	99.10	99.24	99.10

The values in Table 8.2 reflect the general cross-section of the ME of companies listed on the JSE—a large proportion of relatively small companies, and a small proportion of relatively large companies. There are few mid-sized companies between these two extremes. The mean ME of companies is significantly higher than the median value in all five years, indicating a distribution of the ME across all companies that is highly positively skewed, as shown in Figure 8.1. The figure's histogram very dramatically illustrates the extent of the kurtosis and skew of the ME amongst the selected companies and which applies to the JSE in general. The high proportion of relatively small companies results in a significant peak in the histogram at low ME values and a long right tail.

Figure 8.1 Distribution of the market values of equity of JSE companies



When companies are separated into the small and large groups, the kurtosis and skew values of these groups are significantly different. The results in Table 8.2 indicate that while the group of small companies exhibits relatively little skew and kurtosis, the effects are far more pronounced in the group of large companies. The same table shows that the ME of the big companies varies between 98.39% and 99.24% of the total selected companies ME. The five largest companies in the group of big companies comprise between 37.97% and 48.96% of the total group's ME each year.

Although Fama and French's (1993) methodology is designed to control for the effect of company size, as described in Chapter Seven, in an extreme market profile such as the JSE, problems arise. The results of value weighted portfolio returns are disproportionately influenced by a small number of large companies. Together, the five largest companies in the group of big companies account for up to almost 49.0% of returns. Where large value companies report high returns, the VMGB returns are also high. The reverse is true for large growth companies reporting high returns. When portfolios are equally weighted, the large companies have as much influence on portfolio returns as small companies. This suggests that it may be more appropriate to use an equally weighted basis of measuring returns in this study, while remaining mindful of the practical implications of the limited liquidity of small company shares. This matter of weighting portfolios is more fully discussed in the Chapter Seven. Loughran (1997), following similar methodology to Fama and French (1993), also chose to report both equal- and value-weighted portfolio returns.

Table 8.3 below shows the book to market value of equity (BM) ratio which corresponds to each years' returns, for all companies and the big and small company groupings. The mean BM for small companies is higher than for big companies in every year of this study. This indicates that small companies generally exhibit greater value, measured by BM, than big companies. There is also a significant increase in the ratio for the 2008 year, which corresponds with the falling share prices at the deepening of the financial crisis and economic downturn in 2008. The increase in mean BM is evident in both big and small company groups and persists in small companies until the end of the period under study. Big companies, however, show a decline in BM in the final two years from a peak of 0.56 to 0.42.

Table 8.3 The book to market ratio by year

	31/12/2005	31/12/2006	31/12/2007	31/12/2008	31/12/2009	31/12/2010
All companies						
Mean	0.49	0.42	0.43	0.76	0.79	0.73
Median	0.34	0.31	0.27	0.58	0.51	0.43
Small companies						
Mean	0.63	0.55	0.54	0.95	1.10	1.04
Median	0.43	0.43	0.32	0.80	0.94	0.64
Big companies						
Mean	0.35	0.29	0.32	0.56	0.47	0.42
Median	0.28	0.23	0.25	0.43	0.36	0.32

Table 8.4 sets out the results for the various return calculations, for both value-weighted and equal-weighted portfolios. The results, measured in value-weighted

returns, provide evidence of a value premium of 0.22% per month and 0.77% per month for VMG and VMGS respectively. However, the VMGB mean monthly return is -0.32%. VMGS–B, which gives the difference in value premium between the two size groups, shows a mean monthly return of 1.09%. The mean monthly return of SMB is -0.20%, which indicates that the average return on big companies exceeded the return on small companies. The t-statistic and p-value indicate that the mean returns for VMGS and VMGS-B are statistically significant at the 10% level. The same tests do not show statistical significance in the VMG, VMGB and SMB returns.

Table 8.4 shows that when portfolios are constructed on an equal-weighted basis, the results are materially different. The VMG and VMGS calculations show mean monthly returns which increase to 0.8% and 1.33% respectively. These are both significant at the 5% level. The VMGB mean return increases to a positive return of 0.27% per month although this is not statistically significant. The VMGS-B return changes little at 1.06% per month and is significant at the 5% level. Finally, although the size effect is greater when portfolios are constructed on an equal-weighted basis, it is still not statistically significant.

Table 8.4   Results of return calculations

	VMG	VMGS	VMGB	VMGS-B	SMB
Value-weighted portfolio returns					
Mean monthly return (%)	0.22	0.77	-0.32	1.09	-0.20
Median monthly return (%)	-0.19	-0.13	-0.80	1.01	0.29
Standard deviation (%)	3.12	4.34	4.47	6.23	4.29
t-statistic	0.60	*1.50	-0.61	*1.48	-0.39
p-value	0.27	*0.07	0.73	*0.07	0.65
Equal-weighted portfolio returns					
Mean monthly return (%)	0.80	1.33	0.27	1.06	0.28
Median monthly return (%)	0.21	0.96	0.43	0.70	0.07
Standard deviation (%)	2.88	4.67	2.52	4.83	3.03
t-statistic	**2.35	**2.41	0.91	**1.86	0.78
p-value	**0.01	**<0.01	0.18	**0.03	0.22

*   Significant at a 10% level where the critical t-statistic is 1.29
**   Significant at a 5% level where the critical t-statistic is 1.67

The VMG, VMGS, VMGB calculations all show mean returns measured on an equal-weighted basis that exceed returns measured on a value-weighted basis. A review of the data for each year shows that the majority of the largest companies are growth companies and that they have lower than average monthly returns. For value-weighted portfolios, the returns of these large, low return growth companies significantly outweigh the returns of all other companies and the value premium is low or negative. However, when equal-weighted, the value companies' average returns exceed those of the growth companies, as the significant influence on returns of the few large growth companies is moderated. This indicates that the value premium may be related to the size of the companies.

SMB shows a negative mean monthly return of -0.20% when portfolios returns are value-weighted. However, this negative return may be attributed the influence of large underperforming companies as described in the preceding paragraph. When portfolios returns are equal-weighted, the SMB return increases to a positive value of 0.28%. This positive SMB return may be explained by, at least in part, a size effect, where big companies earn relatively lower returns than small companies.

This study's equal-weighted finding of a statistically significant VMG return is similar to Fama and French's (1993) value-weighted finding[3]. The results for their VMGS and VMGB calculations are unfortunately not reported separately. Similar to the findings in this study, the SMB calculation in Fama and French (1993) also reports positive but lower mean returns than VMG. However, in contrast to this study's findings, Fama French (1993) find that the SMB return is significant.

In a later study, Fama and French (2006) find evidence of a value premium in their VMG and VMGS calculations for the period July 1963 to June 2004. However, returns

[3] Fama and French (1993) refer to VMG as HML in that study.

in their VMGB and SMB calculations, although positive, are not as significant. Fama and French (2006) also find significant returns in VMGS-B. These results are similar to those reported in Table 8.4 for the equal-weighted portfolios.

This studies' findings are also similar to Loughran (1997), who finds that the value effect is strongest in small companies, but virtually non-existent for large companies.

Figure 8.2 shows the distribution of returns for the value-weighted calculations. The solid line represents an estimate of the Gaussian distribution of returns and the serrated line shows the mean return value of the series. Table 8.4 shows that, amongst value-weighted returns, VMG has the lowest standard deviation and is thus the least volatile, measured by standard deviation. This is apparent in the relatively leptokurtic VMG curve in Figure 8.2.

Figure 8.2 Distribution of value-weighted portfolio monthly returns

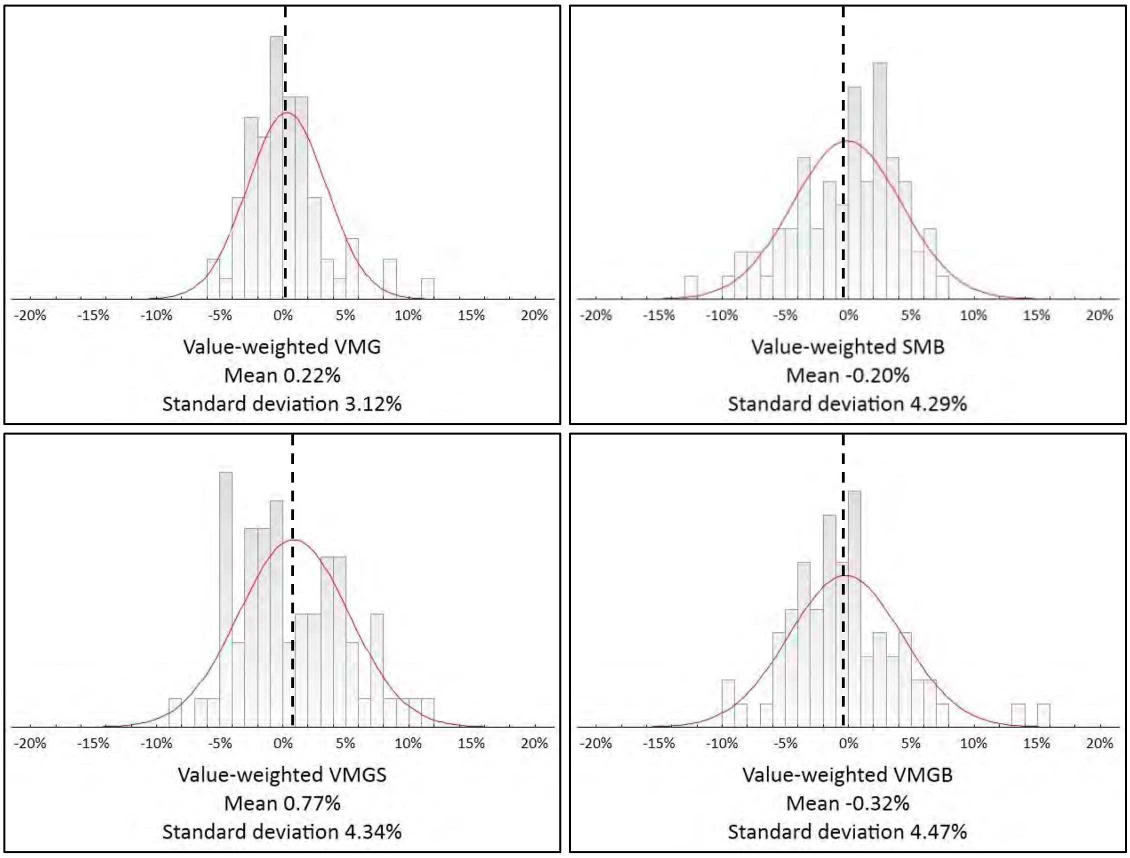


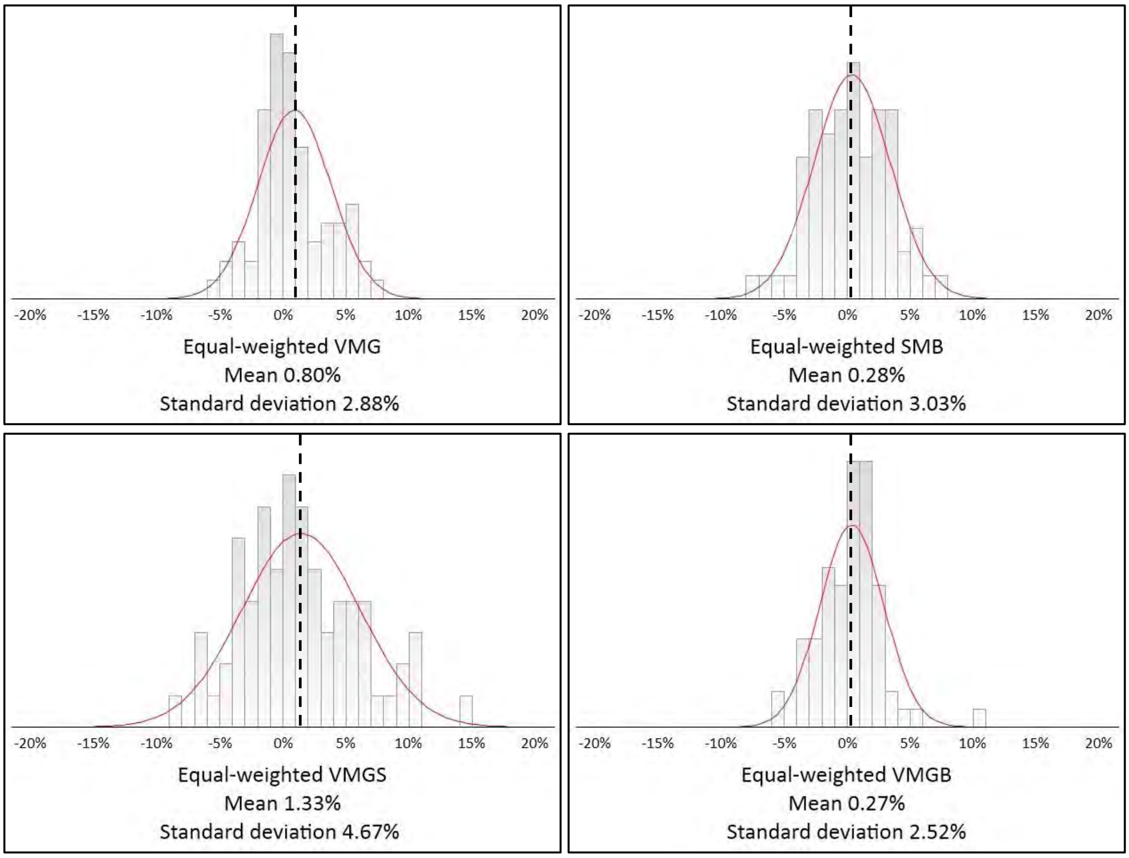
Figure 8.3 shows the distribution of returns for the equal-weighted calculations. The solid curve and serrated line have the same meanings as they did for Figure 8.2. Table 8.4 shows that, amongst equal-weighted returns, VMGS has the highest standard deviation other than VMGS-B. This volatility is apparent in the relatively platykurtic VMGS curve shown in Figure 8.3.

When returns are equal-weighted, rather than value-weighted, the weighting of large companies in the portfolios and therefore in the value premium calculation is reduced. The VMG curve becomes slightly more leptokurtic which reflects the change in standard deviation from 3.12% to 2.88%, and suggests that the value premium on larger companies is relatively more volatile during the period of this study.

The VMGB curve also becomes more leptokurtic when the value premium is measured on an equal-weighted basis, as the standard deviation of these returns decrease from 4.47% to 2.52%. This suggests that the value premium amongst larger companies within in the BV and BG portfolios is more volatile than the small companies during the period of this study. SMB returns experience a similar change in their distribution curve when returns are measured on an equal-weighted basis. This also points towards a higher volatility in the returns of larger companies.

In contrast to the decreases in volatility in VMG, VMGB and SMB, VMGS standard deviation increases from 4.34% to 4.67% with the change from value-weighted to equal-weighted calculation of returns respectively. The change indicates that the value premium amongst the larger companies within the SV and SG portfolios is less volatile than the smaller companies in those portfolios.

Figure 8.3 Distribution of equal-weighted portfolio monthly returns



8.3 Evidence for relationships between the value and size variables and returns

The descriptive statistics for the data used in the univariate and multivariate regressions which may provide evidence for the rational explanation of the value premium and size effect are shown in Table 8.5. As noted earlier, an observation is the return on one company's share for a period of one month. Over the six year period July 2006 to June 2012, there are 19 188 individual observations. The BM data exhibits a positive skew of 2.58, as it includes a relatively small number of observations of high BM—outliers that were not excluded in terms of portfolio criteria. This skewness results in the mean being positioned to the right of the median with a longer right tail. The BM data also exhibits excess kurtosis of 6.08 which indicates a leptokurtic distribution of BM. The skew and kurtosis of the lognormal distribution of ME (ln(ME)) are less pronounced, although the excess kurtosis of -3.55 indicates a platykurtic distribution of this variable.

Table 8.5 Descriptive statistics for each independent variable

Description	BM	ln(ME)
Number of observations (July 2006 – June 2012)	19 188	19 188
Mean	0.61	R20.75m
Median	0.40	R20.67m
Excess kurtosis	6.08	-3.55
Skew	2.58	0.18

Table 8.6 shows the results of three correlations. First, the correlation of BM and return reveals a positive correlation coefficient of 0.0330. Although very low, this is still consistent with a value premium where value companies, those with high BM values, exhibit higher returns. The correlation coefficient of ln(ME) and returns, -0.0261, shows a smaller negative relationship between these variables. Once again, although very small, this is consistent with a size effect where smaller companies exhibit higher returns. Finally, BM and ln(ME) are found to have a correlation coefficient of -0.387. This indicates that larger companies have lower BMs and is similar to the findings of Auret and Sinclair (2006). In their study (Auret and Sinclaire 2006), they establish a statistically significant correlation co-efficient between size and the book-to-market variables of -0.33.

The relationship between explanatory variables is important in an asset pricing model as the variables hold more explanatory power if they are not highly correlated, either negatively or positively. The inclusion of highly correlated independent variables in the model results in the problem of multicollinearity referred to earlier, which weakens the regression model.

Table 8.6 Results of correlations

Correlation variables	BM and return	ln(ME) and return	BM and ln(ME)
Pearson’s correlation coefficient (r)	0.0330	-0.0261	-0.3865
t-statistic	*4.5737	*-3.6182	*-58.0539
p-value	<0.0001	0.0003	<0.0001
*Significant at a 5% level where the critical t-statistic is 1.960.			

Regression data is subjected to the Breusch-Pagan tests for heteroskedasticity. The results are shown in Table 8.7, where the test’s LM scores indicate significant heteroskedasticity in the data. As discussed in Chapter Seven, while heteroskedasticity does not affect the coefficient estimates, it does reduce the reliability of the t-statistic and p-value. Accordingly, robust standard errors are calculated for each regression and heteroskedasticity corrected (HC) t-statistics and p-values are reported in Table 8.8 below.

Table 8.7 Breusch-Pagan tests for heteroskedasticity

	BM and return	ln(ME) and return
Breusch-Pagan LM score	*60.1516	*174.6536
Critical Chi-value at 95%	5.9915	5.9915
*Significant heteroskedasticity at 95%.		

The results of the univariate regressions are shown in Table 8.8. The second column of the table reports on the regression of returns on BM. The average coefficient for BM is 0.0077, which indicates a positive relationship between BM and returns: value companies in this regression (those with a high BM) have higher returns than growth companies. The BM variable’s HC t-statistic of 2.6713 exceeds the critical t-statistic at 5% of 1.960 and is thus significant at this level. The same result is evident in the HC p-value. These results show that the value premium may be explained, at least in part, by BM, and provide support for a value premium in the period tested.

The third column of the table reports on the regression of returns on the ln(ME) independent variable. The average coefficient is -0.0018 which indicates a negative relationship between the size of companies and returns. Smaller companies in this regression earn higher returns than bigger companies. Like the BM variable, the ln(ME) variable's HC t-statistic of -2.8610 exceeds the critical t-statistic and is significant at the 5% level. These results provide evidence that supports a rational explanation of the size effect in the South African equity market during the 2006-2012 period.

The univariate regressions show that BM and company size are at least partially able to explain some of the variations in stock returns. However the HC coefficient of ln(ME) is found to be more significant than the coefficient of BM. Fama and French (1992), Loughran (1997), Auret and Sinclair (2006) and others also find these variables to be significant in their regressions.

Table 8.8 The results of regressions of returns on BM and ln(ME) of all companies

	BM	ln(ME)
R-square	0.0011	0.0007
Coefficient	0.0077	-0.0018
HC t-statistic	*2.6713	*-2.8610
HC p-value	0.0076	0.0042
* Significant at a 5% level where the critical t-statistic is 1.960		

The analysis of portfolio returns in table 8.4 shows that the value premium is higher in the group of smaller companies. Univariate regressions of the BM and ln(ME) variables may produce some insight into the roles that these variables play in the two size groupings.

Table 8.9 shows the descriptive statistics for each size group. Small companies are shown to have a higher mean BM than big companies. The ln(ME) for big companies is, of course, higher than small companies. The excess kurtosis for the BM data of big companies indicates a leptokurtic Gaussian distribution for that variable. The excess kurtosis for the small company BM data is less significant while the ln(ME) data has negative (platykurtic) distributions for both size groups. For both size groups, the mean BM value is to the right of the median, indicating a positive skew. The skew is also positive for ln(ME) amongst big companies but negative for small companies. Possible reasons for skews and kurtosis were discussed in section 8.2.

Table 8.9 Descriptive statistics for small and big company groups

	Small companies	Big companies
BM		
Number of observations (July 2006 – June 2012)	9 600	9 588
Mean	0.82	0.41
Median	0.55	0.31
Excess kurtosis	2.00	17.34
Skew	1.96	3.45
ln(ME)		
Number of observations (July 2006 – June 2012)	9 600	9 588
Mean	18.85	22.63
Median	18.93	22.49
Excess kurtosis	-3.38	-3.00
Skew	-0.37	0.60

Table 8.10 shows the results of the regression of returns on BM in the small and big company groupings. The coefficients for both groupings are positive, small companies (0.0081) showing a slightly steeper slope than big companies (0.0071). While the BM variable is significant for both groups at the 5% level, the HC t-statistic of the smaller companies is lower than it is for big companies. The BM HC t-statistic of all companies, 2.6713, is between these two values (refer Table 8.8).

Table 8.10 Results of regressions of returns on the BM of small and big companies

	BM Small companies	BM Big companies
R-square	0.0011	0.0008
Coefficient	0.0081	0.0071
HC t-statistic	*2.1798	*2.8294
HC p-value	0.0293	0.0047
* Significant at a 5% level where the critical t-statistic is 1.960		

Table 8.11 shows the results of the regression of returns on ln(ME) for the small and big company groupings. The HC t-statistic shows that returns on small companies have a significant relationship with the ln(ME) variable. However, there is no statistically significant relationship between ln(ME) and the returns of big companies.

Table 8.11 Results of regressions of returns on the ln(ME) of small and big companies

	ln(ME) Small companies	ln(ME) Big companies
R-square	0.0049	0.0002
Coefficient	-0.0111	0.0011
HC t-statistic	*-4.9669	1.5308
HC p-value	<0.0001	0.1259
* Significant at a 5% level where the critical t-statistic is 1.960		

Having considered the BM and ln(ME) variables individually in univariate regressions, the variables are combined in a multivariate regression on returns to test their relationship when regressed with a common dependent variable. The results of this regression are shown in Table 8.12. The BM variable is statistically significant at the 5% level while the ln(ME) variable is only significant at the 10% level. Unlike the findings of Auret and Sinclair (2006), size is not rendered completely insignificant by the inclusion of BM in the regression and it still has a role in determining returns.

Table 8.12 shows that the R-square value for this multivariate regression is 0.0013. This indicates that the regression's independent variables together explain only 0.13% of the variation in returns but, as regressions are conducted only at an individual share level, this is to be expected (van Rensburg and Robertson 2003b). The more robust F-statistic for the multivariate regression is also calculated. The F-statistic is 12.4754 with the critical value at the 1% level being 4.6052. This indicates that at least one of the two independent variables, BM or ln(ME), explains a statistically significant portion of the variation in returns and provides evidence to support a rational explanation of the value premium.

Table 8.12 Results of the multivariate regression

Regression statistics		
R		0.0360
R-square		0.0013
ANOVA data		
F-statistic		*12.4754
Significance F		<0.0001
Regression coefficients	**BM**	**(ln)ME**
Coefficients	0.0063	-0.0011
HC t-statistic	**2.0828	***-1.6962
HC p-value	0.0373	0.0899
* Significant at a 1% level where the critical F-statistic is 4.6052		
** Significant at a 5% level where the critical t-statistic is 1.9601		
*** Significant at a 10% level where the critical t-statistic is 1.6449		

Multicollinearity is a statistical phenomenon that may be present in a multivariate regression when independent variables are highly correlated. The phenomenon causes OLS estimates to become “extremely imprecise and unreliable” (DeFusco et al. 2007, p.356) and misleadingly inflates the standard errors of the coefficients. This inflation results in some Type II errors, in the sense that some variables are rendered statistically insignificant while they would otherwise be significant.

Multicollinearity is not always simple to detect. DeFusco et al. (2007, p.356) argue that “multicollinearity is often a matter of degree rather than of absence or presence”. Indicators of the phenomenon include:

- High pairwise correlations between independent variables, and
- A high R-square value with accompanying independent variable coefficients which have insignificant t-statistics,
- A highly significant F-statistic.

The correlation coefficient of the two independent variables, BM and ln(ME), is -0.3865. While this correlation is statistically significant, the variables cannot emphatically be stated to be highly correlated. The multivariate regression has a low R-square value and both independent variables are statistically significant when returns are equal-weighted. Finally, although the F-statistic is found to be significant, it is not associated with a highly correlated and insignificant independent variables or a high R-square value. Therefore, it is concluded that multicollinearity is not a relevant issue in the multivariate regression.

8.4 Evidence for the relative riskiness of value and size investment strategies

This section begins with an examination of the relative volatility of value and growth investment strategies, measured by beta and standard deviation. The performance of these strategies is then compared in good and bad states of the market and economy. Following this, the relative volatility of small and big company returns is examined. Finally, the performance of size related strategies is compared in good and bad states of the market and economy.

The results of the examination of the relative riskiness of value and growth investment strategies during the period 1 July 2006 to 30 June 2012 are shown in Table 8.13. The average monthly value returns over the 72 months exceed growth returns by 0.82% per month. This value premium, however, is found not to be associated with higher levels of volatility. Both measures of volatility, beta and standard deviation, indicate that the value shares are less volatile that growth shares during the period. This supports the view of Lakonishok et al. (1994), that value shares are not riskier than growth shares.

The analysis of returns in good and bad states of the market shows value and growth returns in the worst (18 months), intermediate (36 months) and best (18 months) months of market returns. Lakonishok et al. (1994) argue that if value shares are riskier, they will underperform relative to growth shares during bad states of the economy. However, during the worst eighteen months of market returns, value outperformed growth by 2.99% per month.

There is little difference between returns on value and growth strategies during the intermediate 36 months (0.12%) and best eighteen months (-0.04%). This also provides evidence for the view that value shares are not riskier than growth shares.

Table 8.13 Returns and risk of value and growth portfolios, July 2006 to June 2012

Measure	Value companies	Growth companies	Value minus growth companies
Returns and risk measures			
Average monthly return (72 months) (%)	1.32	0.52	0.82
Beta	0.79	1.14	-
Standard deviation (%)	3.30	4.49	-
Returns in good and bad market states			
Average return - 18 worst market months (%)	-2.47	-5.46	2.99
Average return - 36 intermediate market months (%)	1.39	1.27	0.12
Average return - 18 best market months (%)	4.95	4.99	-0.04
Returns in good and bad economic states			
Average return - 6 worst quarters of GDP growth (%)	-0.42	-5.16	4.74
Average return - 12 intermediate quarters GDP growth (%)	5.55	2.88	2.67
Average return - 6 best quarters of GDP growth (%)	5.54	6.13	-0.59

Figure 8.4 shows the average market return during each of the 72 months, sorted by increasing returns. The market return is overlaid by the corresponding monthly value premium series. During the worst eighteen months of market returns, the value premium is positive in all but three months. The negative linear trend line shows how the value premium declines as average market returns increase. A risk-based explanation of the value premium would be associated with a positive slope. Lakonishok et al. (1994) show similar results.

Figure 8.4 Value premium and increasing market returns, July 2006 to June 2012

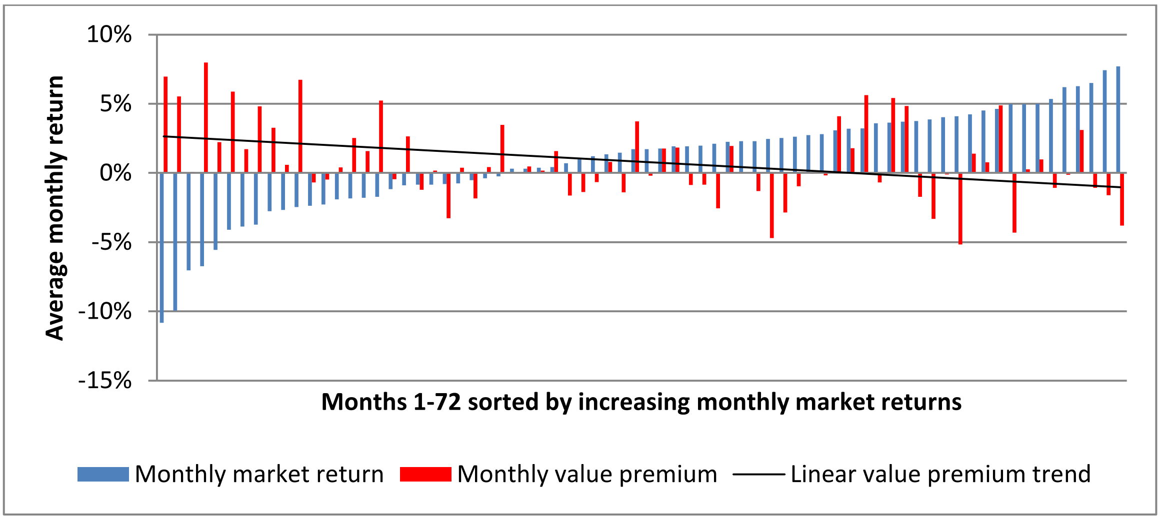


Table 8.13 also shows average returns during good and bad states of the economy, measured by quarterly gross domestic product (GDP) growth. During the worst six quarters of economic growth, the quarterly average return on value shares exceeded growth shares by 4.74%. In the intermediate and best periods of quarterly GDP growth, the value premium is 2.67% and -0.59% respectively.

Figure 8.5 shows the quarterly value premium with increasing quarterly GDP growth rates. The linear trend line for the value premium has a negative slope. Like the analysis of various states of the market, a risk based explanation of the value premium would be associated with a positive slope. Lakonishok et al. (1994) also show a positive value premium during the worst economic states.

Figure 8.5 Value premium and increasing quarters of GDP growth, July 2006 to June 2012

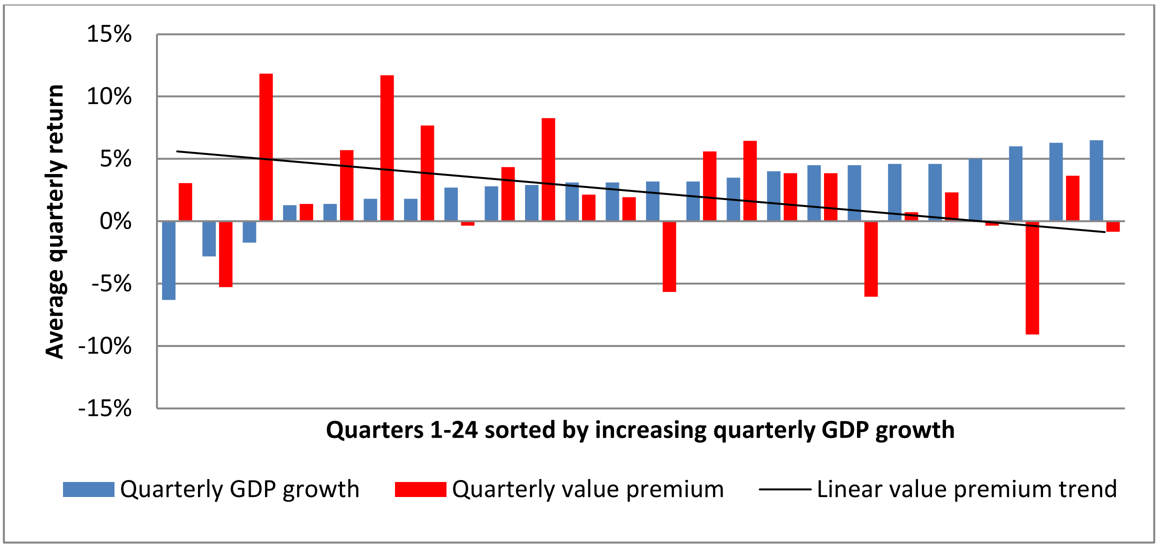


Table 8.14 shows the returns of small and big company portfolios. The average monthly returns of the small companies over the 72 months exceed the big companies' returns by 0.28% per month. This size effect premium, however, is shown not to be associated with higher levels of volatility. Both measures of volatility, beta and standard deviation, indicate that the small company portfolios are less volatile that big company portfolios during the period.

The analysis of good and bad states of the market in Table 8.14 shows that during the worst eighteen months of market returns, small company portfolios outperformed big company portfolios by 1.52% per month. Large companies outperformed small companies by 0.13% and 0.14% during the intermediate 36 months and best eighteen months of market returns respectively. This provides evidence to support the view that small companies are, on average, not riskier than big companies.

Table 8.14 Returns and risk of small and big company portfolios, July 2006 to June 2012

Measure	Small companies	Big companies	Small minus big companies
Returns and risk measures			
Average monthly return (72 months) (%)	1.06	0.78	0.28
Beta	0.89	1.10	-
Standard deviation (%)	3.61	4.33	-
Returns in good and bad market states			
Average return - 18 worst market months (%)	-3.27	-4.79	1.52
Average return - 36 intermediate market months (%)	1.27	1.40	-0.13
Average return - 18 best market months (%)	4.97	5.11	-0.14
Returns in good and bad economic states			
Average return - 6 worst quarters of GDP growth (%)	-2.61	-3.19	0.58
Average return - 12 intermediate quarters GDP growth (%)	4.54	3.48	1.06
Average return - 6 best quarters of GDP growth (%)	6.84	5.86	0.98

Figure 8.6 shows the average monthly market return between 1 July 2006 and 30 June 2012, sorted by increasing returns. The market return is overlaid by the corresponding monthly size effect series. During the two-thirds of the worst eighteen months of market returns, the size effect is positive. The negative linear trend line shows how the size effect declines as average market returns increase. This trend is not consistent with a risk-based explanation of the size effect.

Figure 8.6 Size effect and increasing market returns, July 2006 to June 2012

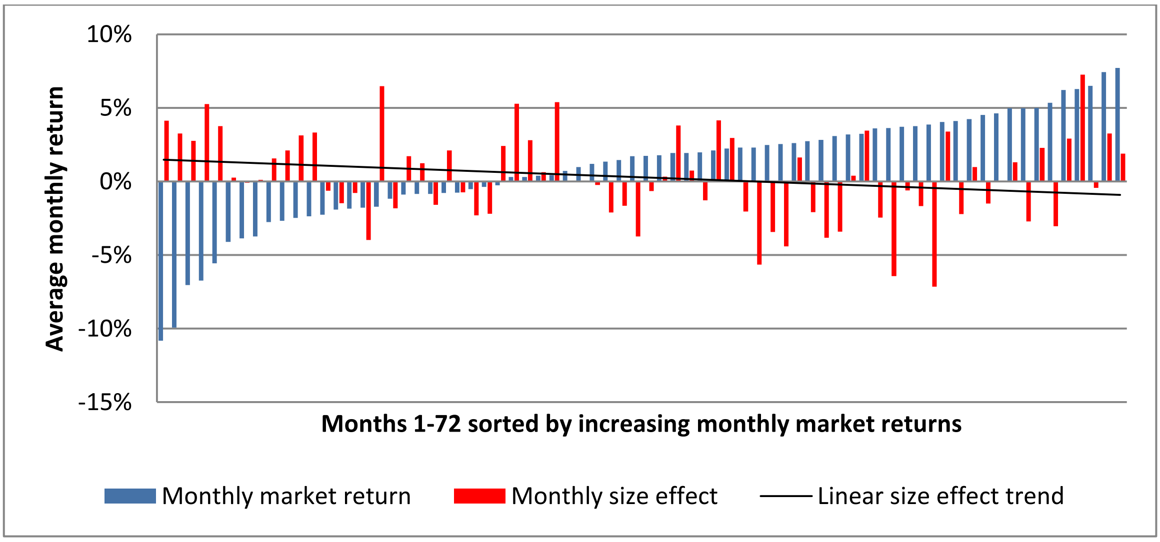
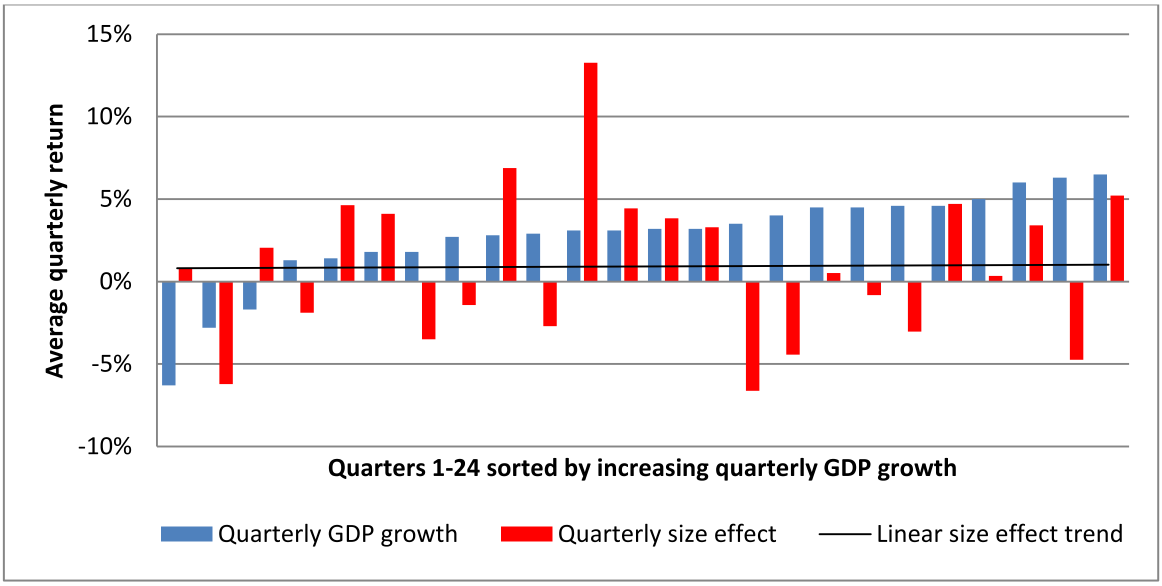


Table 8.14 also shows average monthly returns during good and bad states of the economy, measured by quarterly GDP growth. During the worst six quarters of economic growth, the quarterly return on portfolios of small companies exceeded the return of portfolios of big companies by 0.58%. In the intermediate and best periods of quarterly GDP growth, the size effect was 1.06% and 0.98% respectively.

Figure 8.7 shows the quarterly average size effect with increasing quarterly GDP growth rates. The linear trend line for the size effect is almost horizontal, showing no significant change in the size effect with changes in quarterly GDP growth. Like the analysis of various states of the market, this analysis does not support a risk-based explanation of the size effect.

Figure 8.7 Size effect and increasing quarters of GDP growth, July 2006 to June 2012



8.5 Conclusion

This chapter shows the results of procedures used to provide evidence for the existence of the value premium and size effect. Evidence of a statistically significant value premium is found but the size effect is insignificant. Both the value and size variables are found to be significant in univariate and multivariate regressions with returns. However, neither growth companies nor small companies are found to be associated with higher levels of risk and, on this evidence, the rational explanation fails. The next chapter concludes this thesis.

Chapter Nine

Conclusion

9.1 Introduction

In Chapters Two and Three, this thesis introduces the value premium and size effect and the relative successes of value and size related investment strategies, documented both internationally and in South Africa. Chapters Four and Five focus on the two dominant explanations for the anomalies, rational and behavioural. Chapter Six highlights the rational-behavioural debate. The chapter also states the research questions which are, first, whether there is evidence supporting the effectiveness of value and size related investment strategies during the period of this study and, second, whether rational finance theory can explain the apparent value premium and size effect. Chapter Seven discusses the data and methodology used to answer the research questions and Chapter Eight presents the empirical results. This chapter summarises the results, concludes on the findings and suggests areas for further research.

9.2 Summary of results

This thesis produces only limited evidence of a value premium on the JSE during the period July 2006 to June 2012. The results do provide some evidence of a value premium amongst the shares of smaller companies but not amongst the shares of larger companies. The results do not show evidence to support a significant size effect during the same period.

Univariate regressions of returns on the ratio of book to market value of equity and on company size show that both these variables provide statistically significant explanations of returns. The univariate regressions are also conducted for the small and big groups of companies. These regressions show differences in significance of the book to market ratio and size in the two groups. A multivariate regression of returns on both independent variables shows that the multivariate model as a whole and both component variables (book to market and size) are statistically significant. These results provide initial support for the rationally anticipated relationships between the value and size variables and returns.

However, examination of the final requirement for supporting rational theoretical explanations of value and size effects shows that these strategies are relatively less risky than their antitheses. The tests also show that the average returns on value portfolios are higher than growth portfolios when the market or economy is performing poorly. There are similar findings for strategies which focus on small companies rather than big companies.

In conclusion, a value premium is detectable in small companies, although no size effect is evident. Evidence shows that the relationships between the value and size variables and returns are significant, but this study does not produce evidence that those variables are associated with risk. Accordingly, the evidence does not support a rational risk-based explanation of the anomalies.

9.3 Recommendations for further research

The JSE is a relatively illiquid market, as highlighted in section 3.1. Studies, such as Basiewicz and Auret (2009) and Basiewicz and Auret (2010), apply a liquidity filter to exclude highly illiquid shares from their sample and to assess the impact of illiquid companies on returns. This study does not filter out illiquid shares, and results of procedures may be affected by this limitation.

This study focuses on empirical evidence for the rational explanation of the value premium and size effect during the July 2006 to June 2012 period. The results do not support the rational explanation in this particular period and alternative explanations, such as that offered by behavioural finance theory, should be explored.

Finally, this research encompasses the most recent equity market crisis. Further research could study the performance of value and size related strategies during prior crises on the JSE, such as those experienced in the late 1980s and 1990s, to determine whether there is evidence of a systematic change in performance of the strategies during such periods.

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