Using Capital Intensity and Return on Capital Employed as filters for security selection

by
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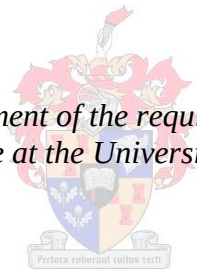

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DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety, or in part, submitted it at any university for a degree.

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Signature **Date**

ABSTRACT

Do firms that have low dependence on physical assets as well as high profitability outperform companies with the opposite characteristics in the market? Despite the lack of empirical research, conventional wisdom would suggest that they should. Conceptually, investors should prefer profitable companies to less profitable companies, and lower capital-intensive to high capital-intensity firms. Using a large sample of global stocks over the period from 1988 to 2010, the effect of using capital intensity and return on capital employed (ROCE) as filters for portfolio inclusion was investigated.

A quantitative research approach was followed in this study. This involved dividing the sample into five subsets, or quintiles, according to the specific metric (for example capital intensity). The total return of an equally weighted portfolio was then measured for each quintile for the subsequent 12 months. The portfolio was rebalanced annually and the subsequent 12-month return recorded. Because enhanced performance on new capital investments may take longer than 12 months to be reflected in share prices, quintile performance was also measured over five-year holding periods.

The empirical findings of this study reveal that there was no discernible pattern of outperformance by low capital-intensive quintiles using annual rebalancing. However, the lowest capital-intensive firms had the highest average returns using five-year holding periods. The highest ROCE firms performed best with annual rebalancing and with five-year holding periods. Combining both capital intensity and ROCE, a portfolio focused on low capital intensity and high profitability produced a compound annual growth rate that is 9.18 percentage points higher than a portfolio focused on the highest capital intensity and the lowest ROCE. Over five-year holding periods there is a distinct outperformance by low capital-intensive firms with high operational profitability.

These results indicate that allocation of investment capital to capital-intensive companies with low operational profitability seems likely to impair long-term returns, and there may be value in a focus on low capital-intensity firms that are able to generate high returns on capital employed.

OPSOMMING

Sal maatskappye met lae afhanklikheid van fisiese bates, asook hoë winsgewendheid, maatskappye met die teenoorgestelde eienskappe uitpresteer in die mark? Ten spyte van ‘n gebrek aan empiriese navorsing, sal konvensionele wysheid voorstel dat dit so moet wees. Beleggers behoort winsgewende maatskappye bo minder winsgewende maatskappye te verkies, en laer kapitaalintensiewe bo hoë kapitaalintensiewe maatskappye. Die gebruik van kapitaalintensiteit en opbrengs op kapitaal aangewend (OOKA) in die beleggingsbesluit word ondersoek deur gebruik te maak van ‘n groot steekproef globale aandele oor die tydperk 1988 tot 2010.

'n Kwantitatiewe navorsingsbenadering was gevolg in die studie. Dit het die verdeling van die steekproef in vyf onderafdelings, of kwintiele, volgens die spesifieke maatstawwe (byvoorbeeld kapitaal-intensiteit) behels. Die totale opbrengs van 'n gelyk-geweegde portefeulje is vervolgens gemeet vir elke kwintiel vir die daaropvolgende 12 maande. Die portefeulje is jaarliks herbalanseer en die daaropvolgende 12 maande se opbrengs is aangeteken. Omdat verbeterde prestasie op nuwe kapitaalbeleggings langer kan neem as 12 maande om in aandeelpryse weerspieël te word, is kwintiel prestasie ook oor vyf jaar hou periodes gemeet.

Die bevindinge van hierdie studie dui daarop dat daar geen beduidende verbetering in prestasie onder laer kapitaalitensiewe kwintiele oor een jaar houperiodes was nie. Die laagste kapitaalintensiewe maatskappye het egter oor ‘n hou periode van vyf jaar die hoogste gemiddelde opbrengs gelewer. Die hoogste OOKA maatskappye het die beste gevaar met jaarlikse herbalansering en met 'n houperiode van vyf jaar. 'n Portefeulje gefokus op lae kapitaalintensiteit en hoë winsgewendheid het 'n saamgestelde jaarlikse groeikoers gelewer wat 9,18 persentasiepunte hoër was as 'n portefeulje gefokus op die hoogste kapitaalintensiteit en die laagste OOKA. Oor houperiodes van vyf jaar was daar duidelike uitprestering deur lae kapitaalintensiewe ondernemings met hoë operasionele winsgewendheid.

Hierdie resultate dui daarop dat die toekenning van beleggingskapitaal aan kapitaalintensiewe maatskappye met lae operasionele winsgewendheid waarskynlik langtermynopbrengste benadeel en dat 'n fokus op lae kapitaalintensiteit maatskappye, wat in staat is om 'n hoë opbrengs op kapitaal te genereer, moontlik meer lonend kan wees.

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

Generating long-term superior returns on invested capital is important to money managers and professional investors (Campbell & Viciera, 2001). Individual investors and institutions entrust their financial capital to professional active portfolio managers with the explicit expectation that the employed agents will apply their relevant skill set to increase investor wealth over time. Investors typically desire long-term, risk-adjusted excess returns. In the effort to maximise investor wealth over time, these allocators of capital have to navigate a vast amount of international financial instruments for potential investment. Equity portfolio managers, in general, consider many financial factors relating to a company before making the investment decision. According to Smith (2010), investing in high quality companies, with good fundamentals increases the probability of generating higher risk-adjusted returns.

The search for high quality companies, and the demand for quality investing as an investment style, increased in popularity after the burst of the stock market bubble in 2001, and after prominent large corporations like Enron and WorldCom failed. A higher demand from investors for quality companies was caused by the increasing occurrence of balance sheet manipulation and various forms of financial fraud. Quality companies are typically characterised by high profitability, low dependency on continued capital investment and enduring intangible assets, like strong brands (Allison, 2009), or competent management (Hall, 1993). Firms that incur relatively little capital expenditure to generate revenue should be able to produce higher free cash flow and increase shareholder wealth over time.

Portfolio managers will benefit from the application of an investment approach that can produce superior returns with less than average risk. Research in the investment management field should be structured to develop measures that are able to deliver performance and increase wealth over time. New methods of evaluation and selection that aid them in the security selection process may be important to portfolio managers.

The objective of this research was to examine the value of using the financial metrics of capital intensity and return on capital employed (ROCE) when choosing investments that produce sustainable long-term portfolio returns.

1.2 BACKGROUND AND THEORETICAL FRAMEWORK

It is common practice in the investment industry to organise the equity world into categories based on characteristics like Growth, Value, Large-Cap, Small-Cap, and Domestic or International. This distinction is made at the fund level and fund definitions typically are made along these lines. Portfolio managers and professionals tend to structure their research in this manner, and build their models for portfolio inclusion according to these specifics.

Equity investment strategies exist that have a strong disposition towards focusing on capital intensity and ROCE in their investment processes. One such investment strategy is what is known as franchise investing. Global franchise funds typically aim to achieve attractive long-term returns by investing in a concentrated portfolio of exceptionally high quality global companies. The specific franchise equity investment strategy focuses on factors such as strong cash flows, modest capital requirements, capable management, and growth potential. The research process typically focuses on identifying companies that can consistently and reliably compound shareholder wealth at superior rates of return over the long term (Madden, 2005). Companies deemed to be of high quality, which are typically associated with global brands or franchises, fall into this category. Three key attributes that companies must possess to be considered for portfolio inclusion in franchise funds are:

- Sustainable and high returns on capital on an un-leveraged basis
- Difficult to replicate intangible assets which protect against mean-reversion of the returns on capital
- A reliable recurring revenue stream, which supports a high free cash flow

Capital intensity is an important consideration for global franchise funds, because capital-intensive firms typically rely more on physical, as opposed to intangible, assets as a source of income. As such, capital-intensive firms are less desirable to invest in. The capital intensity metric can be used to filter out capital-intensive firms and indicate possible companies for consideration.

The amount of capital expended to produce a unit of sales revenue gives an indication of the level of capital intensity of a company. A business that requires a large amount of capital investment in physical assets to generate revenue can be labelled as being more capital-intensive (Parker, Ortega, Neuhart & Kausar, 2011), whereas less capital-intensive companies typically do not rely as much on physical assets in its business model. These companies rather depend on their intangible assets as sources of income. It is likely that the nature of the intangible assets of a business and the extent to which it depends on physical assets for its competitive advantage will affect its ability to produce superior returns on invested capital. A company that relies heavily on physical assets and requires continuous capital expenditure in order to sustain its competitive advantage is unlikely to outperform over the long term (Elmasry, 2004).

On the other hand, companies that have a proclivity to intangible assets, such as patents and licenses, tend to have lower capital intensities. As they require less capital investment to sustain their competitive advantage, and rather enjoy a competitive advantage by virtue of their intangible assets, they are more likely to earn consistent excess returns over the long term (Barney, 1991). In addition, intangible assets are more difficult to replicate than physical assets. A company that relies on its physical assets for its competitive advantage is more exposed to the risk of duplication by competitors, which could lead to excess capacity which, in turn, could lead to erosion of returns (Porter, 1979).

It is intuitive that investors should prefer companies with higher levels of profitability above those yielding lower profitability, and the shares of more profitable companies consequently should experience higher returns. Businesses that can deliver strong operational performance (returns from core operations) relative to the capital used to generate those returns should increase shareholder wealth over time. ROCE is widely used as a performance measure in the profit-seeking sector (Rutherford, 2002) and effectively measures how well management is able to employ a firm's assets to generate returns. ROCE is generally characterised as being a measure of the ability and efficiency of management (White, Sondhi & Fried, 1998:167). High ROCE in firms will therefore be indicative of potential outperforming shares. It can thus be argued that a portfolio consisting of higher ROCE companies should outperform a portfolio comprising lower ROCE firms over the long term.

This study was undertaken to examine the relationship between capital intensity, profitability and stock returns. The expectation was that firms with greater capital intensity and lower profitability would experience diminished returns on capital and depressed long-

term stock returns. Companies that rely more on their intangible assets, and therefore have lower capital intensity, were expected to be able to achieve and maintain superior returns on capital and increase shareholder wealth over time. Similarly, companies with a higher ROCE, therefore being operationally more profitable, should produce excess returns for their shareholders. The effect of compiling a portfolio incorporating both these metrics was also explored. If an annually rebalanced portfolio compiled using ROCE and capital intensity as filters could outperform a total return benchmark index, then a strong argument could be made for the use of the strategy in the money management industry.

1.2.1 Capital intensity

Most companies need to invest capital in their revenue generating process to generate revenue. Capital refers to the plant and equipment used in the production function of a business, as well as its stock of financial assets (Link & Boger, 1999:120). Capital is therefore the term used to refer to the amount invested in plant, property, equipment, inventory and other physical assets (Samuelson & Nordhaus, 2004). Capital expenditure represents the funds used to acquire or upgrade fixed assets other than those associated with acquisitions (Koller, Goedhart & Wessels, 2010:154). It includes but is not restricted to additions to property, plant and equipment, as well as investments in machinery and equipment. It typically represents the necessary expenditure associated with maintaining or increasing the scope of operations.

Capital intensity refers to the amount of capital a business requires to generate one unit of revenue. It therefore gives an indication of the amount of plant, property, equipment, and other tangible assets required to produce a unit of sales. This characteristic can be quantified by using the ratio of a company's annual capital expenditure divided by revenues, as indicated by Equation 1.1. A lower ratio would indicate a lower amount of capital needed per unit of sales produced; consequently a lower ratio would be more favourable.

$$\text{Capital Intensity} = \frac{\text{Capex}}{\text{Revenue}} \tag{1.1}$$

The strength of this metric is its ability to measure a firm's efficiency in the deployment of its assets. However, as firms typically go through capital cycles – periods of increased capital expenditure followed by periods of lower capital expenditure – this metric tends to be unstable over time (Coles, 1997:8). Therefore, as capital expenditure varies from year to year, the static capital-intensity measure tends to fluctuate.

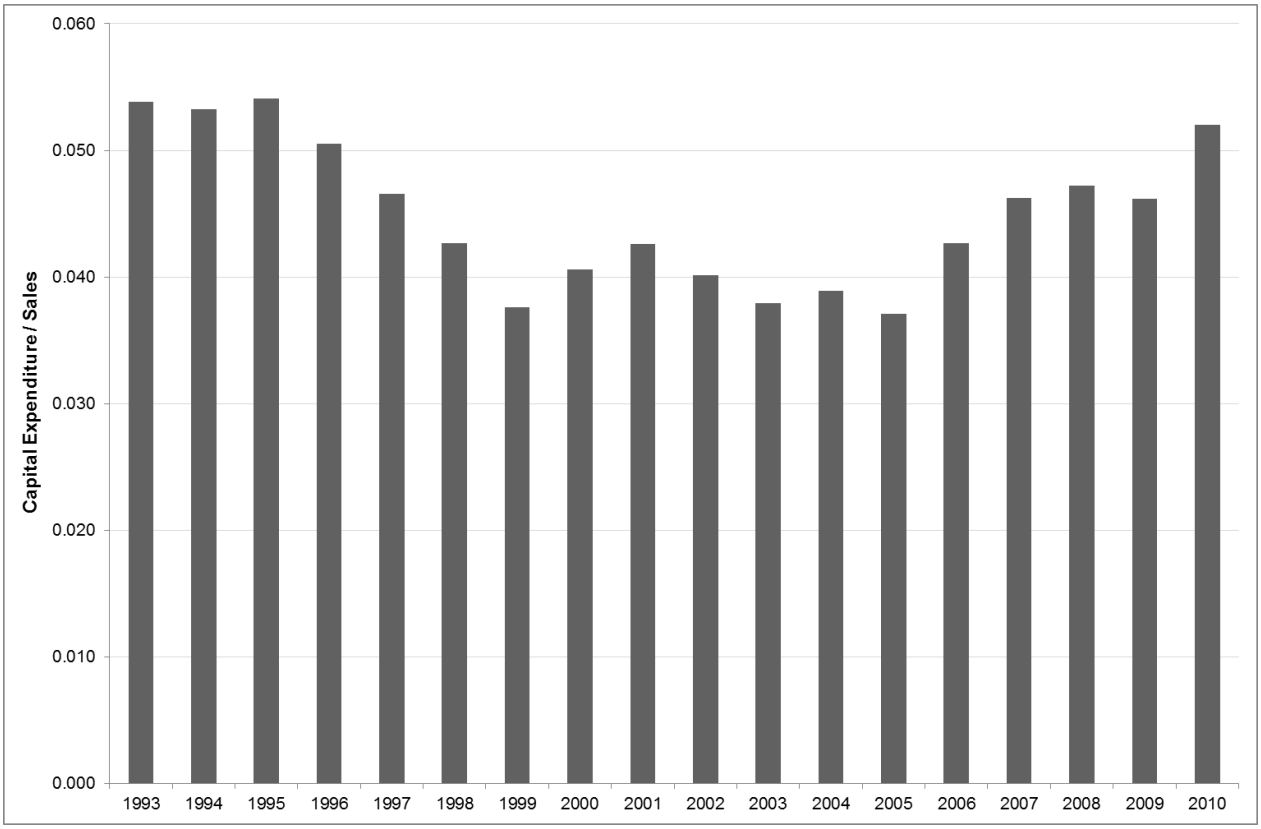

Figure 1.1: Capital intensity for Nestle SA over time

Source: Bloomberg

Figure 1.1 shows the capital intensity over time for Nestle SA. It is evident that capital intensity can change over time and fluctuate with the company's specific capital cycle. The effect of the capital cycle is also evident in the fluctuation of capital intensity over time for Vodafone Group PLC (Figure 1.2). Technical obsolescence can mean the end for a telecom company in a competitive market place. Consequently, it is not unusual for a telephone company to spend a large percentage of its revenues to renew plant, property and equipment. Cellular phone companies are under continuous pressure to migrate from analogue to digital to third generation networks (Elmasry, 2004). This relentless progress and obsolescence of technology manifests itself in hefty capital spending cycles by telephone companies.

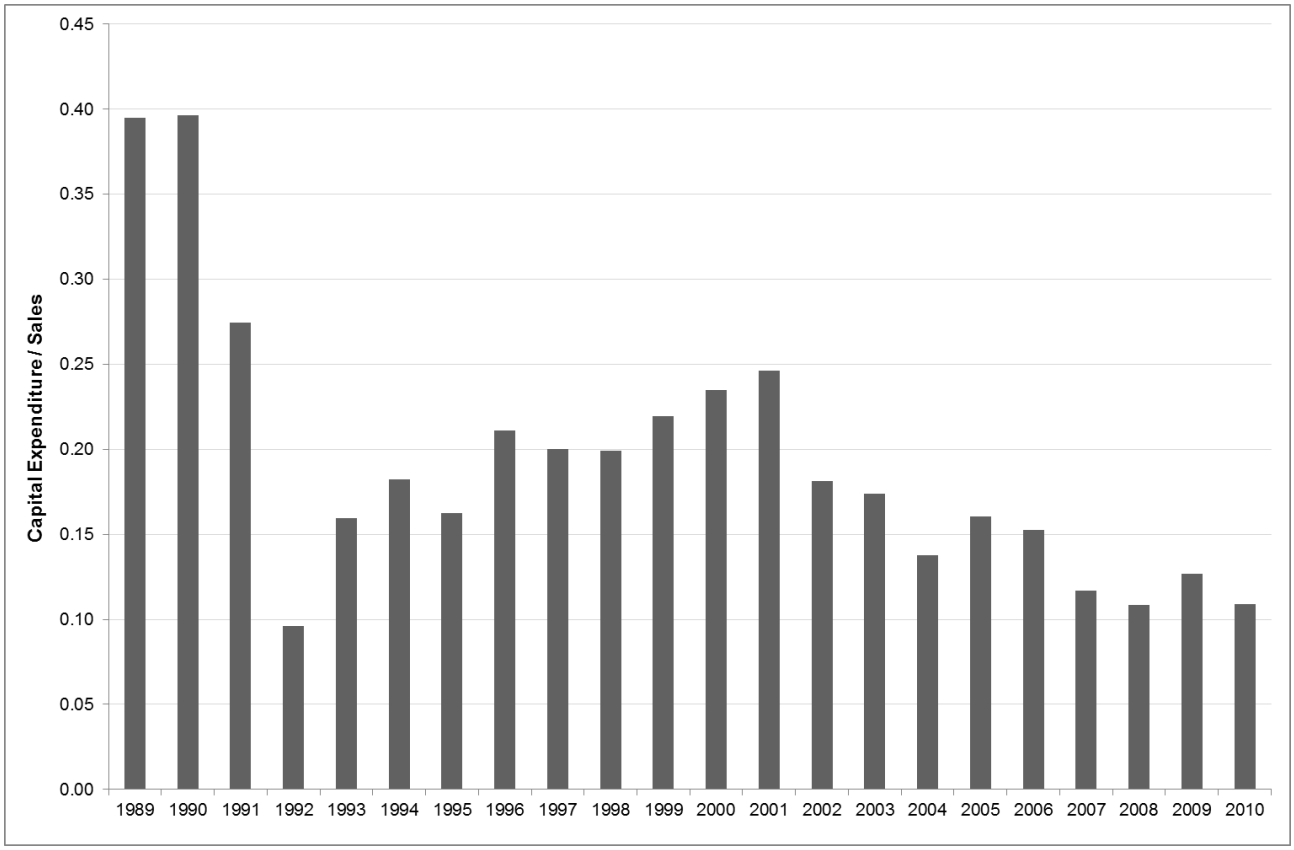

Figure 1.2: Capital intensity for Vodafone Group PLC over time

Source: Bloomberg

A more stable proxy for capital intensity is normalising the capital expenditure over five years and dividing by sales, as indicated by Equation 1.2. This metric will take into account the effect of the capital cycle most companies are subject to.

$$\text{Capital Intensity} = \frac{\text{5 year average Capex}}{\text{Revenue}} \tag{1.2}$$

A low value for capital intensity will mean that the company makes relatively modest use of physical capital to generate revenue through its capital cycle. Firms that can produce a unit of sales revenue with the least amount of capital expenditure through the capital cycle are probably more reliant on intangible assets for their competitive advantage. Intangible assets include customer loyalty, brand names, patents, licences, copyrights and distribution networks (Johnson & Kaplan, 1987). These companies tend to have business models that are not easy to replicate and thus deter new competitive entry into the industry (Porter, 1979).

A high capital-intensity ratio would mean that the company relies heavily on the competitive advantage of its physical capital in order to earn a return. These companies

tend to have business models that are easy to replicate and, as such, invite incursion from rivals (Porter, 1979). New entrants in a market typically absorb excess return as competition in the sector increases. This results in the sharing of the market and competing on price (Madden, 2005; Elmasry, 2004).

Even though the capital cycle varies between companies and between industries, the average capital expense over five years gives a more accurate reflection of a firm's actual capital intensity through the capital cycle.

1.2.2 Return on capital employed (ROCE)

The return on capital employed (ROCE) ratio compares a firm's earnings from its primary operations with the capital invested in the company and can serve as a reliable measure of corporate performance (McClure, 2010). ROCE provides a means of measure to determine how well a company invests funds in its basic business operation (Eilon, 1992). The financial ratio used to express ROCE uses Operating Income in the numerator and Capital Employed in the denominator (Elliott & Elliot, 2001). Essentially, ROCE is the operating profit per unit of capital employed, as expressed by Equation 1.3.

$$\text{ROCE} = \frac{\text{EBIT}}{\text{Capital Employed}} \tag{1.3}$$

Earnings before interest and taxes (EBIT) is a measure of a firm's profitability that excludes interest and income tax expenses (Bodie, Kane & Marcus, 2004). EBIT indicates the level of operating income the firm is generating.

Capital employed is the total amount of share capital and debt that a company has and uses (Scarlett, 2006:289); it refers to the amount of assets that contribute to a company's ability to generate revenue. It represents the financial resources necessary for the company to continue functioning and engage in its primary task of revenue generation (Eilon, 1988). Although capital employed has many definitions, it is commonly defined as Total Assets less Current Liabilities (Robinson, 2011). Therefore the ROCE ratio can be expanded as indicated in Equation 1.4:

$$\text{ROCE} = \frac{\text{EBIT}}{\text{Total Assets - Current Liabilities}} \tag{1.4}$$

ROCE is widely used as a performance measure in the profit-seeking sector (Rutherford, 2002) and is commonly employed in making intra- and inter-organisational comparisons (Drury, 2000; Skinner, 1990). The objective usually is to maximise this ratio.

As the ROCE ratio gives an indication of management's ability to effectively allocate capital (White *et al*., 1998), it should be useful as a screen to indicate profitable companies. The nature of a firm's competitive advantage stems from its basic business function and ROCE measures how well a company invests in its core operation. A high ROCE should typically be indicative of a company that is both well-managed and profitable.

1.3 PROBLEM STATEMENT

The results obtained from academic research have formed the basis of many investment strategies that are applied in financial markets. An example of the rewarding exchange of ideas between academic research and investment practice is the topic of value versus growth investing (Chan & Lakonishok, 2004). Issues encountered by portfolio managers and investment professionals similarly encourage research and ongoing analysis. Academic research often serves to find empirical evidence for a theory or a specific belief, or to provide logical reasoning behind the justification for an investment strategy. Oftentimes an investment strategy or a fund mandate comprises the application of academic research in practice.

Long-term excess returns that lead to increased shareholder wealth is one of the most important goals for investors (Chugh & Meador, 1984; Campbell & Viciera, 2001). Using a strategy of selecting shares for portfolio inclusion based on certain methods that are substantiated by research may prove valuable to portfolio managers, especially those who attempt to generate long-term excess returns. Although past performance is not an indication of future return, an analysis of past relationships can prove to be a valuable source of information in order to forecast the future. A back-test can aid in the understanding of causality factors relating to past performance, and therefore help make inferences about likely future outcomes based on current conditions.

The purpose of this study was to determine whether the use of capital intensity and ROCE as filters for portfolio inclusion, both separate and together, can produce long-term excess returns. Identifying an investment strategy based on these metrics, which result in consistent superior returns, is the central theme of this study.

1.4 OBJECTIVES AND HYPOTHESES

Portfolio managers of global franchise funds look to invest in companies of exceptional quality whose primary operations are dominated by intangible assets and high operational profitability (Madden, 2005). Metrics such as capital intensity and ROCE could be employed in the research process of these funds to aid in identifying investment candidates. Researchers at Morgan Stanley Investment Management have shown that lower capital-intensity companies on average perform better than high capital-intensity stocks over time (Elmasry, 2004; Parker *et al*., 2010).

An investment strategy that produces long-term excess returns proven by a back-test analysis could potentially be employed in the money management industry. It could, for example, be used in a quantitative or fundamental fund as part of a large investment house's product offering.

Against this background, the current study had three primary objectives, namely:

1. Investigating capital intensity and stock returns

The objective was to determine whether there was a causal link between the level of capital intensity of firms and subsequent total returns, in order to establish whether capital intensity can be used as a value-indicating financial metric. This objective also included determining whether an average return of the lowest capital-intensity firms outperforms the average return of the highest capital-intensity firms on a consistent basis. From this objective, the first hypothesis was formulated as:

> H^0: An equally weighted portfolio composed of high capital-intensity stocks will outperform a portfolio composed of low capital-intensity stocks.
>
> H^a: An equally weighted portfolio composed of high capital-intensity stocks will underperform a portfolio composed of low capital-intensity stocks.

2. Investigating ROCE and stock returns

The study was aimed at determining whether a relationship existed between ROCE and total return. This objective included determining whether an average return of the lowest ROCE firms lags the performance of the highest ROCE companies on a consistent basis. The hypotheses follow:

H^0: An equally weighted portfolio composed of low ROCE stocks will outperform a portfolio composed of high ROCE stocks.

H^a: An equally weighted portfolio composed of low ROCE stocks will underperform a portfolio composed of high ROCE stocks.

3. Investigating the resulting stock returns of an investment strategy using a combination of capital intensity and ROCE as filters for portfolio inclusion

   H^0: An equally weighted portfolio composed of stocks with the lowest capital intensity and highest ROCE will underperform a portfolio composed of stocks with the highest capital intensity and lowest ROCE.

   H^a: An equally weighted portfolio composed of stocks with the lowest capital intensity and highest ROCE will outperform a portfolio composed of stocks with the highest capital intensity and lowest ROCE.

In addition, this study investigated the effect of different holding and time periods on the results.

1.5 METHODOLOGY

The proposed methodology included primary as well as secondary research; however, the emphasis in this study was on the empirical results produced by the primary research.

1.5.1 Primary research

Primary research involves the collection and analysis of data collected to specifically address the problem under investigation (McDaniel & Gates, 2001:25). The research process involved defining the population and the sample, the acquisition of the data and, lastly, the data analysis.

1.5.1.1 Population

The universe of securities used included all the constituents of the MSCI World Index for each year over the sample period starting June 1989 to June 2010. The sample period was chosen to provide a sufficient length of time to incorporate the effect of market cycles.

1.5.1.2 Sample

Only companies with a market capitalisation above USD 1 Billion (at 2007 MSCI level) were included in the sample. The 2007 MSCI level was used as the discount factor to filter out small-cap stocks because the constituents are international and, as such, no CPI figure would have been relevant. Firms with small capitalisations were excluded from the universe so that results were not distorted by very small, illiquid firms. Micro- and small-capitalisation shares tend to be more volatile, and small price fluctuations are typically recorded as large percentage return movements, which could significantly skew results when an equally weighted return is calculated (MSCI Barra, 2010).

Firms included in the financial sector were excluded since their financial characteristics and their use of leverage are considerably different from firms in other sectors. The high leverage that is normal for financial firms probably does not have the same meaning as for non-financial firms. Also the capital-intensity metric is less meaningful as financial institutions typically rely less on physical capital investment to generate revenue and more on human and financial capital (both of which are not reflected in the capital-intensity metric).

Companies located in emerging markets were also excluded from the sample. This was done to give the study a developed market focus. Emerging markets constitute a small percentage of the MSCI World Index, and the potential impact of excluding emerging market firms is negligible.

1.5.1.3 Acquisition of Data

Data were taken from *Compustat* via *FactSet*. In order to avoid look-ahead bias, all financial data were lagged by 90 days. Look-ahead bias refers to the use of historical data in the wrong time frame (Daniel, Sornette & Wohrmann, 2008). It is the bias created by the use of information that would not have been known or available during the period being analysed. The best example is the release of a company's financial results only after a certain period after year-end to allow the audit process to be completed. This lag in financial disclosure could lead to an inherent bias if not addressed.

1.5.1.4 Data analysis

The primary research constituted different phases of data analysis in line with the different objectives of the study. The three primary phases investigated the effect on portfolio returns of two separate metrics as well as a combination of both.

The first two phases of the research followed a similar methodology as studies conducted by Fama and French (1992) and Lakonishok *et al.* (1994) into the differences in return between value and growth stocks. This involved dividing the sample into five subsets, or quintiles, according to the specific metric (for example capital intensity). The companies with the most favourable metric were assigned to the first quintile and the least favourable to the fifth quintile. This was done on an annual basis on the same date (30 June). The total return of an equally weighted portfolio was then measured for the subsequent 12 months. The portfolio was rebalanced annually and the subsequent 12-month return recorded. The cumulative performance of this portfolio could then be compared to a portfolio composed of other quintiles and the average return of the sample.

The third phase incorporated both capital intensity and ROCE in the portfolio composition process. This entailed constructing a matrix by dividing the sample into quintiles based on capital intensity and then arranging the constituents of each quintile into subsets based on their profitability (ROCE). Therefore a primary capital-intensity filter essentially was applied, followed by a secondary filter. This means that there were 25 boxes, as reflected in Figure 1.3. The total return for portfolios composed of the different boxes was recorded and the cumulative performance over the period compared to one another.

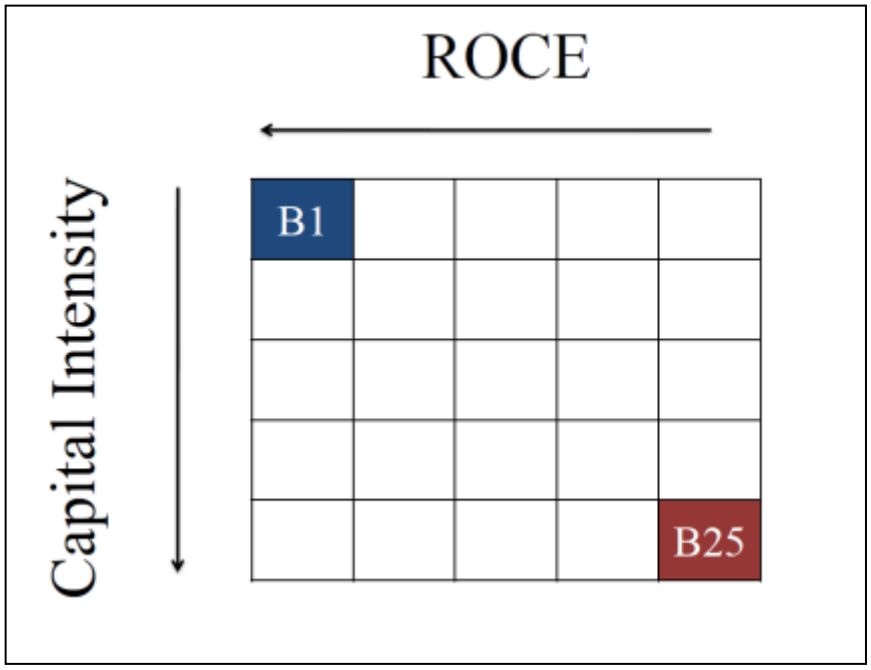

Figure 1.3: The construction of a matrix incorporating both metrics as filters

1.5.2 Secondary research

Secondary research (also known as desk research) involves the summary, comparison and systematic review of existing research rather than primary research, where data is collected from, for example, research subjects or experiments (Crouch & Housden, 2003). The main disadvantage of using secondary research is that it may not precisely meet the user's need or be sufficiently recent to be useful (McDaniel & Gates, 2001).

Secondary research was conducted predominantly to investigate three different themes. Firstly the concept of capital intensity as well as its use in practice as an investment tool was examined. Secondly, the relative merits and theory behind franchises, intangible assets and barriers to entry were looked at. Lastly, profitability and the merits of using ROCE were analysed.

1.6 ORIENTATION OF THE STUDY

This section presents a brief outline and short description of the chapters of the thesis.

Chapter 1 Introduction to the study

In this chapter, a background to the study is provided, the research problem and objectives are formulated, and the research method for the study is discussed.

Chapter 2 Literature review

This chapter will be divided into three different sections, namely capital intensity, ROCE and the theory behind franchises, intangible assets and barriers to entry. Each section covers an in-depth discussion of the relevant theories and research on each topic.

Chapter 3 Research methodology

This chapter is focused on the main methods utilised to conduct the research. A discussion of the research process is included and is followed by a detailed explanation of the data that were used.

Chapter 4 Research results

The findings and the results of the data analysis are presented in this chapter. These findings refer to the results gained from applying each metric in a portfolio construction process over time.

Chapter 5 Summary and recommendations

Based on the results from Chapter 4, a broad summary draws attention to the usability and relevance of each metric investigated. The results are interpreted with reference to the initial objectives of the study. Conclusions drawn from the results are subsequently presented and recommendations are provided. Areas for further research are also mentioned.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

An investment comprises the current commitment of money or resources with the expectation to benefit from the sacrifice in the future (Bodie *et al*., 2010:2). Investment management is the act of planning, implementing and overseeing the funds of an individual or institutional investor (Fabozzi, 2009:1). The investment process followed by portfolio managers and professional investors include the following main activities (Fabozzi, 2009:1):

- Setting investment objectives
- Establishing an investment policy
- Selecting an investment strategy
- Constructing and monitoring the portfolio
- Measuring and evaluating investment performance

Although investment objectives may vary among investors, investment managers typically aim to achieve an acceptable level of return commensurate with the investor's stipulated level of risk. Setting investment objectives usually starts with a thorough analysis of the entity whose funds are being managed (Fabozzi, 2009:2). After the investment objectives are established, the investment policy statement is created. The investment strategy must be consistent with the investment objectives and the policy guidelines of the client. Portfolio strategies can be classified as either active or passive (Focardi & Fabozzi, 2004:6). An active portfolio strategy uses available information and forecasting techniques to seek a better performance than a portfolio that is simply diversified broadly. A passive portfolio strategy involves no effort to search for underpriced securities but instead relies on diversification to match the performance of a specified index (Fabozzi, 2009:9).

Two important actions within the constructing and monitoring step are asset allocation and security selection. Asset allocation refers to the process of deciding what proportion of the portfolio should be invested in various classes of assets (Mayo, 2010:98). In most developed countries, the four main asset classes are common stocks, bonds, cash, and real estate (Fabozzi, 2009:5). The asset allocation decision is regarded by many

investment professionals as the most important part of portfolio construction (Bodie *et al*., 2010:131), and has been shown to account for almost 94 per cent of the differences in total returns achieved by institutionally managed pension funds (Bogle, 1994:235). Within each asset class, specific securities are chosen for investment. This security selection function involves deciding which specific investments to hold within a particular asset class (Riepe, 2002:38). It is a very important activity for investment managers of portfolios focused on a specific asset class, as security selection explains almost 100 per cent of the difference in performance among funds with restricted mandates. An investment manager's revenue is fee driven, and fees primarily are based on a percentage of the average amount of assets under management (Jackson, 2003:147). The ability of portfolio managers to find undervalued securities is often the source of their competitive advantage. As such, successful investment managers will be able to attract new funds with greater ease than less successful managers. New methods of evaluation and selection that enhance their security selection skill may therefore be of importance for portfolio managers.

The security selection process starts with screening the universe of available securities and reducing the number by filtering the securities to eliminate those that have undesirable characteristics (Ferri, 2011). The analyst, or portfolio manager, can choose specific factors to screen for, and can, for example, eliminate securities with certain fundamental qualities, or lack of those qualities. By focusing on a reduced number of suitable securities, the analyst can use thorough financial analysis to determine which companies have the most favourable outlook. The portfolio manager typically tries to understand the fundamental profit drivers of companies, and aims to identify firms with favourable prospects.

The investment style describes the approach of the process of managing portfolios, allocating proportions of the portfolio to different asset classes and selecting individual investments (St. Giles, Alexeeva & Buxton, 2003:74). The most prominent equity investment styles are the 'value' investment style and the 'growth' investment style (Lederman & Klein, 1995:297). The value portfolio manager invests in companies whose current market price appears to be below the company's real worth, and typically uses fundamental measures such as price-to-earnings (P/E) ratio and price-to-book value (P/B) ratio, amongst others, to help identify these companies (Hall, 2010:135). A portfolio manager who uses the 'growth' investing approach selects a potential company based on expectations of strong growth in earnings (Hall, 2010:136). Many other investment styles

exist, such as technical, balanced, core, socially responsible and momentum investing, to name a few.

Similarly, equity investment strategies exist that have a strong disposition towards focusing on capital intensity and return on capital employed (ROCE) in their investment processes. One such investment strategy is what is known as franchise investing. Global franchise funds typically aim to achieve attractive long-term returns by investing in a concentrated portfolio of exceptionally high quality global companies. The specific franchise equity investment strategy focuses on factors such as strong cash flows, modest capital requirements, capable management, and growth potential. The research process typically focuses on identifying companies that can consistently and reliably compound shareholder wealth at superior rates of return over the long term (Allison, 2009). Companies deemed to be of high quality, which are typically associated with global brands or franchises, fall into this category. Three key attributes that companies must possess to be considered for portfolio inclusion in franchise funds are:

- Sustainable and high returns on capital on an un-leveraged basis
- Difficult to replicate intangible assets which protect against mean-reversion of the returns on capital
- A reliable recurring revenue stream, which supports a high free cash flow

Capital intensity is an important consideration for global franchise funds, as its application can filter out capital-intensive firms and indicate possible companies for consideration. The amount of capital expended to produce a unit of sales revenue gives an indication of the level of capital intensity of a company. A business that requires a large amount of capital investment in physical assets to generate revenue can be labelled as being more capital-intensive (Parker *et al.*, 2011), whereas less capital-intensive companies typically do not rely as much on physical assets in the business model. These companies rather depend on intangible assets as sources of income. It is likely that the nature of the intangible assets of a business and the extent to which it depends on physical assets for its competitive advantage will affect its ability to produce superior returns on invested capital. A company that relies heavily on physical assets and requires continuous capital expenditure in order to sustain its competitive advantage is unlikely to outperform over the long term (Elmasry, 2004).

On the other hand, companies that have a proclivity to intangible assets, such as patents and licenses, tend to have lower capital intensities. As they require less capital investment

to sustain their competitive advantage, and rather enjoy a competitive advantage by virtue of their intangible assets, they are more likely to earn consistent excess returns over the long term (Barney, 1991). In addition, intangible assets are more difficult to replicate than physical assets. A company that relies on its physical assets for its competitive advantage is more exposed to the risk of duplication by competitors, which could lead to excess capacity which, in turn, could lead to erosion of returns (Porter, 1979).

It is intuitive that investors should prefer companies with higher levels of profitability to those yielding lower profitability; consequently the shares of more profitable companies should experience higher returns. Businesses that can deliver strong operational performance (returns from core operations) relative to the capital used to generate those returns should increase shareholder wealth over time. ROCE is widely used as a performance measure in the profit-seeking sector (Rutherford, 2002) and, in effect, measures how well management is able to employ a firm's assets to generate returns. ROCE is generally characterised as measuring 'management's ability and efficiency in using the firm's assets to generate…profits' (White *et al.*, 1998:167). Firms with a high ROCE will therefore be indicative of potential outperforming shares. It can therefore be argued that a portfolio consisting of higher ROCE companies should outperform a portfolio comprising lower ROCE firms over the long term.

This chapter presents a review of literature relating to the concepts of capital intensity and ROCE, and their relation to stock market performance. Secondary research was conducted to find evidence to support the expectation that firms with greater capital intensity and lower profitability experience diminished long-term stock returns. In the first part of this chapter, capital intensity-related studies are examined and the second part is focused on ROCE. Lastly, quality investing as an investment style is examined and its similarities to franchise investing are highlighted.

2.2 CAPITAL INTENSITY

Current management literature focuses on classical value levers, such as cost reduction, sales optimisation, and mergers and acquisitions; thereby neglecting a vitally important aspect, namely capital expenditure (Hansen, Huhn, Legrand, Steiners & Vahlenkamp, 2009: 43).

Capital refers to the plant and equipment used in the production function of a business, as well as its stock of financial assets (Link & Boger, 1999:120). Capital expenditure is the amount invested in physical assets and immovable property during the financial year (Koller *et al.*, 2010:154). To generate revenue, most companies need to invest capital in their revenue generating process. A firm needs to make capital investments in order to maintain and grow its operations. Although capital expenditure has received limited attention as a value enhancer, it has a considerable influence on long-term company performance (Hansen *et al*., 2009:3).

The traditional view is that higher capital expenditures are to be interpreted as good news and rewarded in the market by share price appreciation (Zacks, 2011:124). McConnell and Muscarella (1985) found that stock prices tend to respond favourably to announcements of major capital investment. The rationale is that higher investment expenditures are likely to be associated with greater investment opportunities. It may also indicate that capital markets, which provide financing, have greater confidence in the firm and its management. Capital investment also plays a role in optimising the asset structure of a firm and enabling the introduction of new products. However, Abarbanell and Bushee (1998) found evidence of a negative relationship between capital expenditure and future stock returns. They suggest that it is difficult to interpret evidence of event studies that found higher stock returns in years when firms increased capital expenditure because firms tend to publicly announce only those expenditures that are likely to be viewed favourably. In theory, increased investment expenditures can provide both favourable and unfavourable information. Firms that invest more are more likely to be managed by individuals who have a tendency to over-invest. Thus, by increasing capital expenditure, they are sending a negative signal to the market regarding managerial intentions. Chung, Wright and Charoenwong (1998) argue that share price reaction to a firm's capital expenditure decisions depends critically on the market's assessment of the quality of its investment opportunities. Empirical evidence shows that firms that do not have valuable investment

opportunities will experience a decline in share price after announcements of increases in capital spending.

Titman, Wei and Xie (2004) indicate that prior research shows that share prices react favourably to announcements of major capital investment. However, they found evidence that investors tend to under-react to empire building implications of increased investment expenditures. Specifically, they found that firms with the largest increase in investment expenditure tend to underperform their benchmarks over the following five years. This negative relationship cannot be explained by either the risks or the characteristics of the firms. Additionally, they found that firms that increase their capital investments tend to have high past returns and often issue equity. In their empirical analysis, Titman *et al.* (2004) examined firms listed on the New York Stock Exchange (NYSE), American Stock Exchange (AMEX) and NASDAQ during July 1973 to June 1996, that report an annual net sales figure larger than USD 10 million. Additionally, only firms with a positive book value of equity, and more than two years' history on *Compustat* were included. They define an abnormal capital investment (CI) metric as capital expenditure to sales in year *t-1* divided by the average capital expenditure to sales for years *t-4* to *t-2*. The sample firms are then divided into quintiles based on the CI metric. Titman *et al.* (2004) then examine a trading strategy that forms portfolios in July of year t by taking a long position in firms in the lowest quintile of CI and a short position in firms in the highest quintile of CI. They found that the hedged return is about 16.8 per cent per year. The authors further show that the hedged returns are higher for firms with high cash flows and low debt-to-assets ratios. These firms typically have more flexibility in terms of capital expenditures as they are not encumbered with high levels of debt.

Chan, Martin and Kensinger (1990) found that share price responses to 95 announcements of increased research and development (R&D) spending are significantly positive on average, even when the announcement occurs during a period of declining earnings. The effect differed between high-technology and low-technology companies. Announcements regarding increased R&D expenditure by high-technology firms were followed by positive abnormal returns on average, whereas announcements by low-technology firms are associated with negative abnormal returns.

Traditionally, a firm's degree of capital intensity is not considered an important indicator of expected future financial performance. Other measures like the price-to-earnings ratio, earnings-per-share and the dividend yield are more popular. Bloom, Lambrechts and Le Roux (1998) found that the ability to differentiate between capital- and labour-intensive

firms has specific consequences for predicting expected financial performance of the two types of enterprises.

From a managerial perspective it is important to determine the level of capital intensity of a firm. Labour-intensive firms react differently to changes in the economic environment than capital-intensive firms (Bloom *et al*., 1998). If the degree of capital intensity is known, it can be used to predict how a firm will react to economic changes, which could be a valuable source of information for financial decision making. A large number of different capital intensity measures have been developed and used in the literature (Sen, 1957; Burger & Hamman, 1999; Shepard, 2005:257; Stickney & McGee, 2007). These definitions were developed in different fields of study and could all be used to define the concept of capital intensity. In the field of financial management a firm is defined as being capital-intensive if a large percentage of total assets consists of property, plant and equipment (PPE), or a large amount of capital is needed to generate a certain level of revenue (Erasmus, Lambrechts, Le Roux & Gardner, 2000). However, the different definitions focus on different aspects of a firm. In some instances it may therefore be possible that one definition is more applicable to a specific firm than another.

Lim (1976) showed that the different techniques developed in the literature to measure capital intensity leave much to be desired and argues that a modified capital-labour ratio, with capital adjusted for utilisation, is theoretically the most suitable measure of capital intensity. Lim (1976) asserts that the common measure of capital intensity as total capital divided by labour has many weaknesses. One weakness is the failure to define labour as the number of workers on the biggest shift. It also assumes that the stock of capital is utilised at the same rate across firms and industries. Previous studies have shown that the level of capital utilisation varies considerably between industries in less developed countries (Winston, 1971).

Erasmus *et al*. (2000) critically considered various traditional measures of capital intensity and developed a method to determine the appropriate measure of the capital intensity of a firm. After classifying firms listed in the industrial sector of the Johannesburg Stock Exchange (JSE) during the time period from 1989 to 1996, Erasmus *et al*. (2000) used principal component analysis and related biplots to provide a multidimensional graphic representation of the multivariate data. The results of the study indicated that the five traditional measures of capital intensity not based on value-added figures are all suitable for use as measures of capital intensity. Erasmus *et al*. (2000) propose the use of a

composite measure composed of the five traditional measures of capital intensity as the most appropriate definition.

Burger and Hamman (1999) investigated selected listed companies in the industrial sector of the JSE to determine the degree of capital intensity of the selected companies. This was done by calculating various measures of capital intensity and ranking the companies accordingly. It was found that there were no significant differences between the rankings of the ratios. It was also found that some companies displayed a dualism in that they were capital-intensive on some measures and not capital-intensive on others.

Capital-intensive firms use large amounts capital to invest in PPE, which exposes the firm to a number of risks (Lee, Lee & Lee, 2009:301). Changes in the economic cycle could have a negative effect on the financial performance. A change in factors such as interest rates, inflation, the availability of capital and liquidity in capital markets could all have a detrimental impact on the profitability of a capital-intensive firm. An increase in the interest rates in the economy, for example, will lead to an increase in the cost of capital, which will have a negative impact on the profitability of the firm. In an environment of high inflation, the capital-intensive firm needs to ensure that provision is made for the increased replacement value of assets (Erasmus *et al*., 2000). If liquidity in capital markets is low, a capital-intensive firm may find it difficult to obtain sufficient capital to support its operations. Similarly, if there is a shortage of capital in the market, or low availability of capital, the implication would be that the capital-intensive firm may have to pay more to obtain the limited amount of capital that is available, or not be able to obtain capital at all.

Lee *et al*. (2009) emphasise that capital intensity increases total business risk. A firm with a large dependence on capital expenditure to support its operating function tends to have more fixed costs, like depreciation, as a result of the large amount of PPE. Business risk increases as the amount of fixed costs utilised in operations increases (Kapil, 2011:248). The percentage fixed costs in the total cost structure is directly proportional to the operating leverage of the firm. In a firm with a high operating leverage, a small change in sales will result in a large change in operating income. Fixed costs do not decline when demand drops off, so when there is a downturn in the economic cycle, the large operating leverage has an amplified negative effect on profitability (Lee *et al*., 2009:301). Variable costs, on the other hand, are adjustable in meeting changes in revenue. When a decrease in sales occurs, variable costs can be reduced to meet the lower output demand. The extent to which firms can control operating leverage depends on the type of product or service they provide. Companies that require large investments in fixed assets, like steel

mills and automobile manufacturers, have large fixed costs and a resulting high operating leverage (Bhabatosh, 2008:158). If a capital-intensive firm increases its debt or issues securities to finance large capital expenditures, the financial risk of the firm would increase as well. However, the latitude available to management in terms of economic stress tends to be less for capital-intensive companies (Burger & Hamman, 1999). A risk-averse firm may opt for alternatives with smaller investments and lower fixed costs, or use finance arrangements like leases to shift the burden of ownership and thereby reduce the investment requirement.

According to Giovinazzo (2008), high-margin businesses that are not capital-intensive are intuitively preferable to investors compared to low margin, high capital-intensive businesses. The author investigated whether a strategy based on selecting firms with lower capital intensity produced long-term excess returns. Giovinazzo (2008) used asset intensity as a proxy for the net investment a firm needs to make to attain a given growth rate. The study showed that firms with heavy (light) asset intensity have lower (higher) subsequent stock returns. A long-short portfolio based on this effect yielded abnormal returns of around 0.4 per cent per month. He also found that asset-heavy stocks miss consensus analyst earnings forecast 16 per cent more often than asset-light stocks, suggesting that investor forecast error is the main driver of the return difference. Giovinazzo (2008) used a universe of stocks that included all listed stocks on the NYSE, AMEX and NASDAQ for the period 1963 to 2006. He excluded all American Depository Receipts (ADRs), Real Estate Investment Trusts (REITs), Financial firms and Indices.

Elmasry (2004) investigated the relative performance of low versus high capital-intensive companies over different time horizons through to 2002. The universe of stocks included more than 2200 listed firms in North America and Europe, but excluded financial firms. Quintiles were created on the basis of capital intensity where the least capital-intensive stocks were assigned to the first quintile and the most capital-intensive companies to the fifth quintile. The average return for the stocks in each quintile was then measured over the following year and the quintiles rebalanced annually. The results showed that the lower capital-intensive quintiles outperformed the more capital-intensive quintiles over three-, five-, ten- and eighteen-year horizons. This effect is more pronounced over longer periods. However, it was not the least capital-intensive quintile that performed best in any of the time periods, but rather the second quintile. More capital-intensive companies struggle to generate consistently superior growth in shareholder value. This may be because capital-intensive firms typically rely on tangible assets for their competitive advantage which is

easy to reproduce by rivals. This ease of replication promotes ample capacity, tough competition, feeble pricing, margin pressure and lower returns on capital. In contrast, companies that use more intangible assets can benefit from a gentler pricing environment, higher returns on capital and greater compounding of shareholder wealth.

Corporations often choose between increasing capital intensity by installing expensive technology, like using robotics in place of labour, and increasing their labour inputs (Lee *et al*., 2009:301). A recent trend for many growth-oriented firms, whether manufacturers or other members of the business sector, is to increase their efficiency through increased investments in physical capital. Automobile firms, for example, are finding that robots assemble cars of high and consistent quality at a fraction of the cost of assembly line labour. This may result in automobile firms increasing their capital intensity ratio over the short term becoming more efficient and ultimately more profitable over the longer term. Hansen *et al.* (2009) assert that there is value-creating potential in optimising capital investments. By introducing structural cost reductions, amongst others, Hansen *et al.* (2009) specifically found that the potential increase in a firm's return on investment (ROI) is between 15 per cent and 40 per cent. The authors assert that this potential increase arises from the acceleration of production ramp-up and increases in operating cash flow during the productive life of the project. A company that is able to employ optimising strategies effectively may create value for shareholders despite seemingly high capital intensity.

According to Shapiro (1982:399) investments are made to increase the assets of a company, as greater output requires an increase in assets. Companies can, however, increase their output by using existing assets more productively, but there is a limit to which this could occur.

Kostin, Fox, Maasry, Sneider and Timcenko (2009) suggest that there are two primary factors that determine the quantity and timing of capital expenditure:

1. Anticipated end-market demand.
2. Cost of financing.

Using the S&P 500 during 1985 to 2007 as the sample, these researchers found that capital expenditure is highly correlated with sales. The computed correlation increased to 0.85 from 0.62 when sales are lagged for two quarters. This shows that capital expenditure responds to sales after a 1-2 quarter lag. Kostin *et al*. (2009) consider sales growth to be

the best real-time indicator of end-market demand for most companies. The lag between capital expenditure growth and sales growth suggests that firms wait to see validation of sales trends before committing to long-term investment projects. When using a static capital-intensity measure, such as capital expenditure divided by sales of the same year, the capital-intensity measure can fluctuate from one year to the next. This will result in contradictory capital-intensity classifications of the same company, depending on the position of the company in its capital cycle. Secondly, changes in the availability and cost of credit have a significant impact on capital expenditure decisions. Rising interest rates can push the cost of borrowing higher, which will ultimately result in a decline in capital expenditure. Declining interest rates decrease the cost of borrowing and make capital expenditure projects more attractive. From a return-on-invested-capital (ROIC) perspective, higher borrowing costs prohibit less profitable projects from meeting required internal-rate-of-return (IRR) thresholds, forcing firms to postpone capital investments until conditions improve.

Parker *et al*. (2011) found that the stock market is historically weak in periods following accelerating capital spending. Parker *et al*. (2011) also found that historically low capital spenders have subsequently outperformed high capital spenders. A strategy of overweighting the lowest capital spenders and underweighting the highest would have generated 280 basis points of outperformance per year, outperforming in 62 per cent of the months in the period 1979 to 2010 (Parker *et al*., 2011). Figure 2.1 shows that energy and utilities sectors represent the largest capital spenders, comprising nearly half of the overall US market's capital spending dollars (Parker *et al*., 2011). Consumer discretionary, industrials and telecoms are also capital-intensive sectors (Figure 2.1).

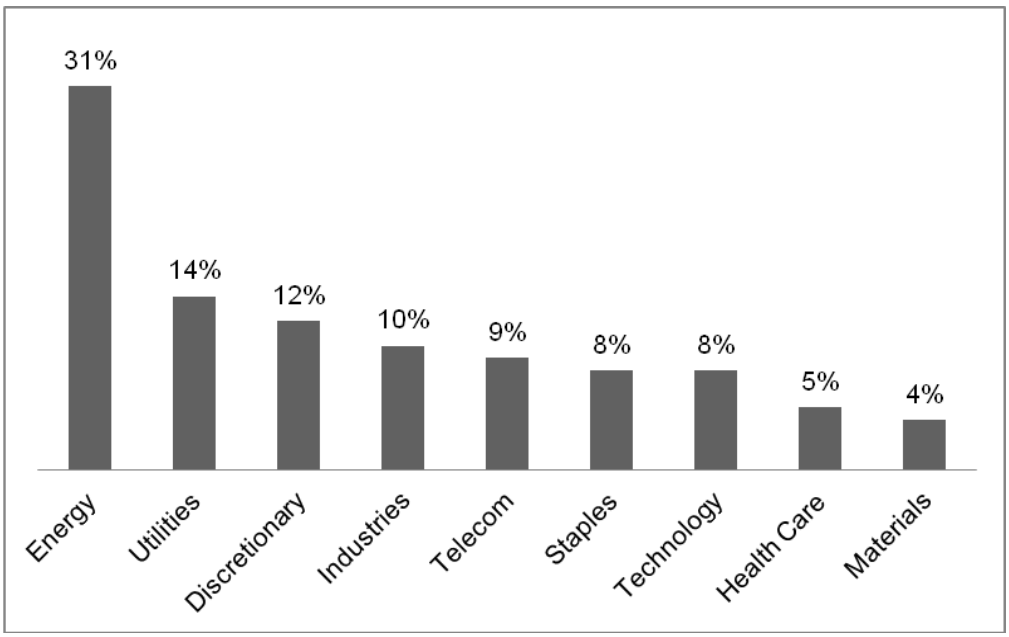

Figure 2.1: Share of capital spending by sector in the USA during the third quarter of 2010

Source: Factset, Morgan Stanley Research

Highlighting the difference in capital intensity between sectors, Elmasry (2004) compared selected industries during the period 1998 - 2002. Elmasry (2004) defined capital intensity as capital expenditure divided by sales revenue for the given year. The results of this study are displayed in Figure 2.2. He found that food manufacturing was among the least capital-intensive industries, with its capital expenditures averaging roughly 3 per cent of revenues. The pharmaceutical industry was in the middle of the capital-intensity range, with an average capital expenditure equal to approximately 9 per cent of annual revenues. Telecoms were among the most capital-intensive, spending in excess of 20 per cent of annual revenues to renew plant, property and equipment. This was largely due to the continuous investment required to replace older technology with the latest systems. The constant progress and obsolescence of technology manifests itself in hefty capital spending by phone companies.

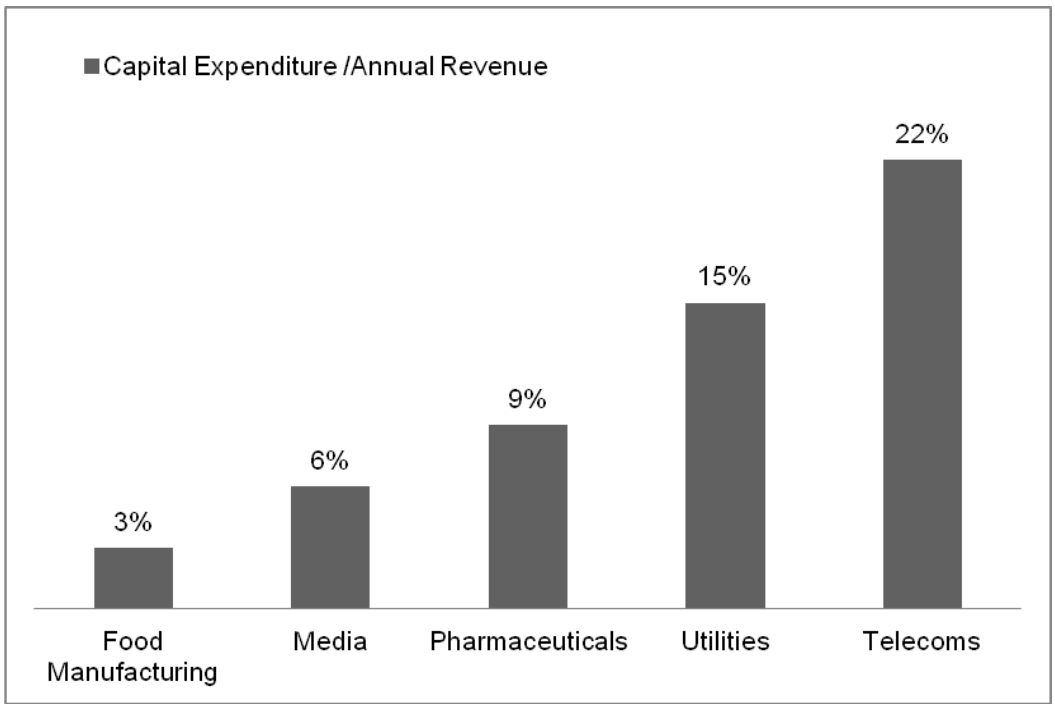

Figure 2.2: Capital intensity by sector as of December 2002

Source: Factset, Worldscope, Morgan Stanley Research (in Elmasry, 2004)

Food processing, on the other hand, requires less substantial capital spending, and processing factories are fairly simple. Volumes, and therefore revenues, can be significant. The capital-intensity ratio benefits from a small numerator (capital expenditure) and a large denominator (sales).

Davis and Kay (1990a) point out that the capital intensity and gearing of firms frequently interfere in the appropriate rankings of firms. Pharmaceutical companies, for example, tend to have lower capital employed figures. Most of the real capital investment of the industry is not included in the balance sheet, but is allocated as expenditure under research and development. This may result in inappropriate conclusions when comparisons are made between industries.

According to Wüstenhagen and Teppo (2004), one way to manage capital intensity is to develop adequate business models that allow for maximum impact with limited capital input. The authors suggest the following strategies to cope with capital intensity:

- Licensing and manufacturing partnerships
- Franchising and distribution partnerships
- Pursuing multiple target markets and the use of a real options framework.

Referring to venture capital markets, Wüstenhagen and Teppo (2004) assert that capital intensity can actually be regarded as an advantage rather than a disadvantage for later-stage investors who are looking for larger financing rounds. This is especially relevant where relatively high management effort is required to apply a relatively small amount of capital.

Researchers at Goldman Sachs found that sales growth leads capital expenditure, which in turn drives returns (Kostin *et al*., 2009). Firms that have high levels of reinvestment, as measured by capital expenditure divided by depreciation, generate faster sales growth than firms with a low reinvestment ratio. According to Kostin *et al*. (2009), firms that reinvest in their business via capital expenditure and R&D are able to differentiate themselves from competitors, produce better top-line results, and should be rewarded by investors accordingly. Firms that continue to invest in their businesses can develop new products, streamline manufacturing processes and gain market share.

2.2.1 Intangible assets and barriers to entry

A high capital-intensity ratio would mean that the company relies heavily on the competitive advantage of its physical capital in order to earn a return. These companies tend to have business models that are easy to replicate and, as such, invite incursion from rivals (Porter, 1979). New entrants in a market typically absorb excess return as competition in the sector increases. This results in the sharing of the market and competing on price (Madden, 2005; Elmasry, 2004). For many years it has been difficult for very capital-intensive sectors of industry to earn high returns, except where there was some element of monopoly (Walsh, 1996:92).

In the long run, the market tends to favour companies that rely less on tangible assets and punish those that are more capital-intensive. The level of capital intensity of a firm plays a significant role in its ability to produce and compound shareholder wealth over the long term (Parker *et al*., 2011). According to Johnson and Kaplan (1987), a company's economic value is not merely the sum of its tangible assets' value, whether measured at historic cost, replacement cost or current market value. Reported earnings cannot show the company's decline in value when it depletes its stock of tangible resources (Johnson & Kaplan, 1987). These authors maintain that investors should value intangible assets such as:

- knowledge of flexible and high quality production processes;
- employee talent;

- customer loyalty;
- reliable suppliers; and
- efficient distribution networks.

A capital un-intensive firm may be more focused on growth as less attention is required to maintain current operations. Caves (1996) proposes that a firm's motive for international expansion and success is largely determined by its intangible assets.

According to Hitt, Ireland and Hoskisson (1998), the intensity and complexity of the modern global economy force firms and challenge corporate executives to compete successfully with anybody, anywhere and at any time. Companies must strive to provide the highest quality goods and services at the lowest possible cost, in a timely and responsible manner. The authors assert that global strategic leadership is needed to implement strategies that enhance the firm's global reputation and produce sustainable competitive advantage for the firm. This will result in an augmentation of the firm's intangible asset base, as a firm's reputation is a key intangible asset. Davids (1995) proposes that successful corporate executives, when applying a global leadership style, enhance the intangible asset of corporate reputation and leverage the firm's global sustainable competitive advantage. Intangible global leadership skills heighten intangible reputational assets at both firm and industry levels. The executive team of Coca Cola, for example, under the late Roberto Goizeta, showed strategic leadership in handling global growth complexities (Finkelstein & Hambrick, 1996). Goizeta and his team enhanced the brand name and the global reputation of Coca Cola, and contributed to its sustainable competitive advantage.

According to Aaker (1989), long-term competitive advantage is the result of exploiting an enduring core of relevant capability differentials cultivated by the responsible management of tangible and intangible internal skills and assets.

Hansen *et al.* (2009) analysed investment intensity across industry sectors, comparing it to the degree of exposure/protection of the firm. A company that is not protected by brands, patents or licensing is labelled as having high exposure. The authors try specifically to answer the question of whether a low-exposure company will be able to realise a higher ROIC, given its relative investment intensity as measured by capital expenditure divided by sales. One would expect companies in protected situations to be able to invest more than less protected companies. A reduced level of exposure should give the firm more security to invest without the fear of recovering the initial investment, as well as the certainty of

achieving a reasonable rate of return. Hansen *et al.* (2009) found a correlation between asset exposure level and capital expenditure per unit of sales in asset heavy industries. The regression of capital intensity against exposure gave an R^2 measure of 90 per cent.

Hall (1993) emphasised the role of intangible assets, which create regulatory and positional capabilities, in the development of sustainable competitive advantage. Intangible resources include the intellectual property (IP) rights of patents, trademarks, and copyrights, as well as trade secrets, licenses and contracts (Hall, 1993). It is difficult for accountants and economists to allocate an orthodox valuation to intangibles as they rarely have exchange value, and do not have an impact on metrics such as capital intensity. When a company has possession of valuable data bases, personal and organisational networks, employee know-how and skills, as well as a good product reputation, it should be reflected in a low capital intensity measure. The consistently low capital intensity metric should reflect the fact that the company does not rely on capital-intensive physical assets to drive revenues, but rather has a sustainable competitive advantage arising from its intangible assets. The sustainability of its competitive advantage will depend on the ability of its capability differential to endure. The intangible resources identified as being important to driving competitive advantage include company reputation and employee know-how (Hall, 1993).

Ambrosini (2003) highlights the importance of tacit knowledge as a source of sustainable competitive advantage and developing a core competence. According to Ambrosini (2003), the concept of imperfect mobility is also important. If an intangible asset is a source of competitive advantage and augments the revenue generation capability of the firm, it should be imperfectly mobile or not easily traded. An imperfectly imitable trait means that others cannot copy it and obtain equivalent exposure from it. If competitors are able to copy the core competence of the firm, the advantage will be nullified and reversion to the mean will occur. Organisations that are difficult to imitate have ‘isolating mechanisms’ that protect resources from imitation and preserve the stream of profits accruing to them (Rumelt, 1984).

There are various reasons why a firm’s resources may be imperfectly imitable. Dierickx and Cool (1989) assert that corporate culture and past investment have the largest impact on the development of resources. It is difficult to discover and repeat the development process that led to the discovery of a significant resource. Some resources that are hard to imitate require a lot of time to develop, a concept known as time compression diseconomies (Dierickx & Cool, 1989). The interconnectedness of asset stocks is another

reason why resources may be difficult to replicate. This refers to the related factors of history, processes, culture, and routines that resulted in a specific stock of assets and competencies. Due to the dynamic conditions of the market, competitive advantage is no longer dependent on investment in machinery (Quinn, 1992), on attributes of products, or on tangible resources, as these can be purchased or replicated (Clark, 1987). Firms that can achieve competitive advantage without large investment in machinery, but have positive attributes that are difficult to replicate, should therefore be better compounders of shareholder wealth. Barney (1991) has emphasised that the intangible asset underlying a knowledge-based competitive advantage can contribute to higher performance, especially when a multi-national firm can exploit intangible assets in a new environment without diminishing asset value.

The possession of hard-to-replicate intangible assets that is the source of competitive advantage, may act like a barrier to entry for competitors. According to Demsetz (1982), the existence of barriers to entry helps to explain the perceived persistence of higher rates of return in some industries. Barriers to entry are the factors that make entry unprofitable while permitting established firms to set prices above marginal cost, and to persistently earn excess returns (Ferguson, 1974:10). Bain (1968:252) described the concept of barriers to entry as: “the extent to which, in the long run, established firms can elevate selling prices above minimal average costs of production and distribution....without inducing potential entrants to enter the industry”. Firms that can successfully create barriers against competitive entry from their possession of intangible resources should be able to charge a long run price that exceeds the long run average cost, and thereby create value for shareholders.

2.3 RETURN ON CAPITAL EMPLOYED

The key objective of making investments in any business is to obtain a reasonable return on capital invested (Banerjee, 2006:860). The return on capital employed ratio is an accounting ratio that is widely used by management and investors as a summary indicator of business success (Eilon, 1988). The ROCE ratio is a measure of the returns a company derives from its capital. It is calculated as profit before interest and taxes divided by tangible capital employed. The resulting ROCE ratio presents how efficient capital is being used to generate operational profit (Kuppapally, 2008:230). ROCE establishes the relationship between profit and the capital employed in the enterprise.

The main items in the ROCE ratio, as illustrated in Equation 1.3, are capital employed and operating profit. Capital employed can be defined in a number of ways (Kuppapally, 2008:230; Scarlett, 2006:289). Two widely accepted definitions include gross capital employed and net capital employed. Gross capital employed refers to total assets, fixed as well as current assets, while net capital employed is the book value of total assets minus current liabilities (Drury, 2004:166). Since there are a number of different definitions for capital employed, it is important that the same basis of measurement be used for comparing the performance of different companies (Bishop, 1969). All assets that are controlled by the firm should be included in the valuation of capital employed.

Capital employed can be valued on a historical cost basis, or an alternative method such as replacement cost might be used (Drury, 2004:166). In an environment of high inflation it is best to use market values as a more accurate indication of the value of capital in use. If historical cost is used, assets might be valued at written-down value. If written-down value is used, an asset that yields a constant profit will show an annual increase in ROCE, because the written-down value will decline over the asset's life. Companies with old assets and low written-down values might therefore incorrectly show higher ROCE calculations. The ROCE figure will be misleading because the capital structure does not adequately reflect the long-term funding requirements, nor does it provide a sufficiently accurate asset base on which to judge management performance (Eilon, 1992). According to Bishop (1969), if the flow of capital replacement is fairly consistent, the problem of re-valuing assets is not so great. However, if the primary ROCE ratio is artificially high, it could change dramatically with the introduction of possibly much needed new equipment. For comparison purposes it is important that the same accounting methods be applied to all firms being compared.

Jarvis and Skidmore (1978) discussed the application of ROCE as an indicator of the profitability of an organisation in Great Britain. The authors specifically outline the use of ROCE as a:

- corporate and divisional objective
- a basis for performance appraisal
- a standard for investment and disinvestment decisions

Jarvis and Skidmore (1978) stress that the ROCE ratio should be calculated using current values, because the effect of inflation will cause the ROCE to be overstated. This is especially important when using the ROCE as a basis for performance appraisal, as the

overstated ROCE will deceive management into believing the firm's performance is better than it actually is. It also presents a danger that objectives will be set that represent a declining return in real terms.

To compute net capital employed, current liabilities are deducted from total assets, as shown by equation 2.1 and 2.2 (Kuppapally, 2008:230):

Net capital employed = Fixed Assets + Investments + Working Capital (2.1)

Working Capital can be seen as the margin for meeting obligations due within the ordinary operating cycle of the business, and is equal to the difference between current assets and current liabilities:

Working Capital = Current Assets – Current Liabilities (2.2)

There are different ways of selecting a point in time to measure the appropriate total capital amount used (Dodge, 1997:341). One method is to use the total capital at the end of the reporting period, which is the common practice when dealing with business assets. Alternatively, the total capital at the start of the reporting period could be used. The average capital over the period is sometimes used, for which the average of the opening capital at the start of the year and closing capital at the end of the year is calculated. Arguments could be made for using either one of the different bases, but when employing ratio analysis, consistency is more important than correctness (Dodge, 1997:341). It is important to be able to justify using the chosen base, and then apply it consistently.

The profit figure used in the calculation of return on capital employed must be related to the actual operational capital in use in the business. Therefore the profit figure used is the operational profit, or earnings-before-interest-and-taxes (EBIT). To arrive at the EBIT, the net profit figure should be adjusted with the tax applicable to the financial year. This is because tax is paid after the profits are earned and has no relation to the earning capacity of the business (Banerjee, 2006:860). Interest on long-term borrowings should be added back to net profit, but not interest on short-term borrowings, as current liabilities are excluded when calculating net capital employed. Interest is excluded because firms can operate with different levels of debt. The interest charges on this debt can skew the comparative earnings of a firm. Interest represents a cost of capital and can be seen as a distribution to capital providers. If it were to be included in the earnings calculation, other cost of capital items like the cost of equity should also be included. However, Enyi (2005) contends that interest is the cost of using borrowed funds, which directly impacts the

scope of operations; as such, interest costs should be considered as part of operating costs. Borrowed funds also form an integral part of a firm's capital employed for the purpose of achieving the financial results of the firm (Enyi, 2005). Net profit should also be adjusted for any abnormal, non-recurring, non-operating gains or losses such as profit from the sales of fixed assets (Thomsett, 2006:223).

The ROCE is a closely-watched business scorecard, especially in capital-intensive industries (Smith & Hickman, 2006). Major capital decisions tangibly shape the future of a company and can have a direct impact on the ROCE of a firm. The ultimate objective of making good capital decisions is to improve the firm's performance and thereby improve the ROCE ratio. Good capital decisions focus the firm's capital investments on projects with the highest potential return and ensure that those projects are cost-effectively executed. Good capital decisions drive excellent ROCE ratios.

Eilon (1988) asserts that, although there are many criteria with which to measure and evaluate corporate performance, most analysts and professional managers prefer the use of ratios. The ROCE ratio specifically is the ultimate measure of corporate performance as it highlights the financial outcome (profit) against total financial resources employed by the firm (Eilon, 1992). An increase in the ROCE ratio implies that the firm managed to achieve a higher level of profit for a given input of total financial resources, or the firm achieved a given profit with a smaller resource input, or some combination of both.

Rutherford (2002) highlights the use of ROCE performance indicators by executive agencies under a trading regime. For public sector bodies that are not subject to the full force of competition, the ROCE ratio will reflect the efficiency of service delivery and the extent to which market imperfections are exploited. The advantage of the ROCE metric is that it can be applied across a range of entities, and it can be compared between divisions (Skinner, 1990). In an imperfect market, the ROCE will reflect the gain from exploiting a firm's monopolistic position.

Enyi (2005) questions the use of ROCE as a performance indicator. Performance indicators can only be meaningful to the user if they bear a true reflection of the relationship intended to be measured. The purpose of the ROCE metric is to reflect the efficiency of the employment of capital resources within the firm (Dodge, 1997:340). One objective of financial reporting is to provide a basis for assessing the internal and external performance of the firm (Enyi, 2005). Internal comparative analysis involves comparing the firm's past and present performance in an effort to guide management towards maximising

shareholders' equity (Van Home & Wachowicz, 2005:133). External performance evaluation entails comparison of the firm's performance against the industry standard or the firm's peers. Investors and third parties perform the comparative analysis to show how management has fared in their efforts to maximise shareholder wealth. Internal performance of the firm determines its external position through the economic forces of supply and demand of the firm's shares in the market.

A few competitor performance measures that can be derived from accounting data have appeared in the literature. The cash recovery ratio which measures cash earnings to gross outlay was investigated by Ijiri (1980) and Salaman (1982). Kwong, Munro and Peasnell (1995) provide an empirical comparison between two versions of new added value accounting ratios and the traditional ROCE ratio. The value added ratios are: added value on inputs employed (AVIE) defined by Davis and Kay (1990a, 1990b), and added value on net output (AVNO) defined by Kay (1993). The empirical evidence shows that the new added value ratios provide signals about firm rankings that differ only to a limited degree from those rendered by the traditional ROCE ratio. Kay (1976) used time-series observations of ROCE weighted in the appropriate manner as an indication of corporate performance.

As an indicator of profitability, ROCE avoids the bias of other ratios like return on equity (ROE) in companies with high leverage (Vernimmen & Quiry, 2009:345). It is possible to leverage the ROE measure higher by skilfully increasing the company's debt level. The ROE measure will look more attractive; however, no real value is created since the increased profitability is cancelled out by higher risk not reflected in the accounting data.

Bishop (1969) outlines several weaknesses of the ROCE. The first is the inability of users of the ratio to agree upon a standard and universal definition of capital employed. This could result in possible confusion when using the same term to describe different attributes. As a result, the technique could be abused in investment appraisal by allowing the decision makers to select a definition of ROCE that best suits their preconception of a project's desirability (Lumby & Jones, 2003:43). According to Bishop (1969), if the total assets of a company are supported by very short-term funds, it will reduce the value of capital employed as a base in the ROCE measure. Bishop argues that the funds that contribute effectively to the profit-making process should be included in the base amount. He proposes that funds need to be employed in the business for a certain minimum period of time if it is to be included in the capital employed amount.

Profits and capital are not always related, and dividing one by the other could result in a number that is both arbitrary and volatile over time. Davis and Kay (1990b) raise the example of professional service businesses, where capital employed is simply not important to the activities of the business.

Another critique against the ROCE measure is that it is based on accounting profit and not on cash flows (Lumby & Jones, 2003:43). Accounting profit is subject to accounting treatments, which could be manipulated by management. Lumby and Jones (2003) mention that another major criticism of ROCE is that it ignores the time value of money, and that there is no way that ROCE can be modified to take the time value of money into account. This could be particularly detrimental in an environment of high interest rates and high inflation. However, despite the weaknesses of the ROCE measure it is still widely applied to investment decisions in industry.

A profitability ratio related to the ROCE that is also often used in ratio analysis, is the return on net assets (RONA). The two ratios differ in both the denominator and nominator that are used. The denominator of RONA is net assets defined as total assets less total liabilities (Dodge, 1997:340). The denominator used in ROCE is capital employed, which is the total assets less current liabilities. The difference lies in the treatment of medium-term and long-term loans. The question is rightly asked whether medium- and long-term loans should be treated as part of capital, or as liabilities to be deducted from net assets. If the loans are classified as liabilities, rather than part of capital, then capital is thought of as owners' capital, which is the same figure as total net assets (total assets less total liabilities) as used in RONA (Dodge, 1997:340). If total capital is classified as being owners' capital plus loans, then the profit before interest should be used as representing the return created by that capital. This is often referred to as 'operating profit'. Neither basis has more merit than the other. ROCE has an internal perspective since it indicates how effective management has been in the use of total capital funds (Kwong *et al*., 1995), while RONA has an external perspective and is used to measure the return on the capital that shareholders have provided. RONA furthermore uses profit after interest in the nominator (Dodge, 1997:340). ROCE is chosen for this study because of its use of operating profitability and its indication of a firm's operating efficiency. As this study also investigates the effect of capital intensity and capital expenditure, using RONA makes less sense because the source of the capital used is not important.

The ROCE ratio is an important tool used to identify companies that offer good value and have the potential to grow. If a company's returns on capital are low and its outlook is

uncertain, investors may lose confidence in the company, which may cause a decrease in the share price of the company. Sustained high returns on capital will equate to high returns to investors over long periods as those returns compound and the company grows its book value. The patient investor will be rewarded with returns comprising dividends and capital appreciation. The challenge for investors is to assess the strength of the underlying business model. Here the ROCE ratio can aid the investor in identifying firms with strong earning potential. However, a company with high returns on capital will attract competition, and if the barriers to entry are not significant enough, new entrants will enter the industry. The extra supply in the market will cause reversion to the mean and a decrease in the returns of the company. It is therefore important for a company to have a sustainable competitive advantage, as well as the ability to earn high returns on invested capital to be able to compound shareholder wealth at superior rates over the long term.

2.4 QUALITY INVESTING

Quality investing is an investment strategy focused on identifying assets or shares with above-average quality characteristics (Smith, 2010). In the bond and real estate industries, quality is determined by rating agencies which classify investment instruments according to quality characteristics. Quality ratings reflect the amount of risk the specific security poses for the investor. Equity investments are subject to fundamental analysis to determine their value. In the portfolio management process, various filters are utilised to identify shares of high quality. A variety of business variables and financial coefficients can be used as filters. Quality investing increased in popularity after the stock market bubble of 2001 burst, and after large, prominent corporations like ENRON, Worldcom and Parmalat failed. The higher demand for quality companies from investors was also partly caused by the occurrence of an increased number of cases of balance sheet manipulation and various forms of financial fraud.

Quality investors typically use a defined schedule of criteria that generally focus on factors that clearly influence a firm’s business success. These factors may include:

1. Financial basis: this includes the use of various financial statement ratios and comparisons with sector and market averages. The focus generally is on earnings and free cash flow from various income streams. The larger the income a company can generate from its core business operations, the better quality firm and better quality investment it tends to be.

2. Price potential: an attractive valuation in the market is important because it is a vital determinant of medium to long-term returns (Bodie *et al*., 2010:110). The price-to-earnings (P/E) and price-to-book value (P/B) ratios are often used to compare a company's valuation with market averages.
3. Business model: this involves analysing the strategy the firm follows to serve its market. The nature and strength of its competitive advantage are evaluated, with a focus on determining whether the firm has a core expertise while being sufficiently diversified. Another important issue is whether the current business model has earning potential.
4. Market environment: the potential size of the market, as well as the company's position in the market, are important factors influencing the quality of a firm. Important aspects include future market trends and the degree of competition in the specific sector. Is a high level of profitability achievable given the capacity and saturation level in the market? What is the expected level of capital intensity that the firm will need to operate at to be a viable competitor in the market?
5. Management: plays an important role in steering the company operationally and strategically. Quality management can have a sizable impact on the success of a firm. Indicators of good management include low staff turnover rates, clear and logical cost structures and a high constant ROCE ratio (Kwong *et al*., 1995).

Firms with low capital intensity ratios and high ROCE ratios should be better quality investments than firms with high capital intensity and low profitability, as these firms should comply with more success-generating factors.

Quality investing is an independent investment style that falls somewhere between the value and growth investment styles. Value investing uses stock valuation and ratio analysis, especially P/E and P/B ratios, to indicate good investments. Undervalued securities, where the fundamental value exceeds the market price, are deemed excellent investments. A growth style, on the other hand, has a focus on making profit and earnings per share forecasts based on strong growth and expansion expectations. The price of the security is of secondary importance, as long as the expected expansion in share earnings is high enough. A quality portfolio may include growth and value shares. A quality company should typically have steady and consistent earnings growth, and a fundamental basis that justifies the price. It should also possess an enduring competitive advantage with low reliance on physical assets and a high sustainable return on invested capital (Elmasry, 2004). Other characteristics of quality companies include modest debt-equity

ratios, seasoned management teams and strong competitive positions in the market (Smith, 2010). Low-quality companies typically have erratic or highly cyclical earnings, heavy debt burdens, poor returns on capital, and less experienced management teams (Smith, 2010).

Hall (1993) points out that a firm with superior leadership skills, which is able to implement sustainable development strategies, is in a better position to enhance its reputation with multiple stakeholders and position itself for competitive advantage. Reputation has been established as a critical competitive component of global firms. Many top management teams have failed to capitalise on intangible resources of the firm; this is mainly due to a preoccupation with managing tangible assets and unfamiliarity with how to competitively exploit the untapped value of a good reputation (Hall, 1993).

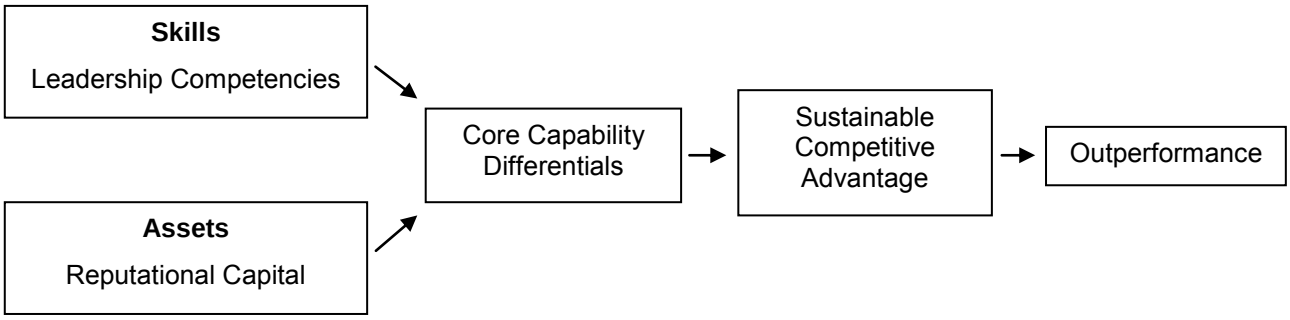

Figure 2.3: Core capability differentials based on skills and assets

Source: Adapted from Petrick, Scherer, Brodzinski, Quinn and Ainina (1999)

Figure 2.3 indicates that core capability differentials are based on skills and assets. Core capability differentials are the basis for developing sustainable competitive advantage which, in turn, leads to long-term outperformance. Skills refer to the functional differential that is due to cumulative know-how and experience. Traditional strategic managers emphasise the value of tangible assets such as plant, equipment and land, and leverage them to maximise shareholder wealth (Petrick *et al*., 1999). Intangible assets are assuming increasingly competitive significance in rapidly changing domestic and global markets (Azmi, 2006). As the speed of comparable tangible asset acquisition accelerates and the pace of imitation quickens, corporations that want to sustain distinctive global competitive advantages need to protect, exploit and enhance their unique intangible assets (Kogut & Zander, 1992).

In their book on retail change in the UK market, Bromley and Thomas (1993) noted that low capital intensity but high ROCE became the key to success in the discount sector of the retail market. This, however, implied low barriers to entry for new competition. This is in contrast to the raising of entry barriers by large increased investment and differential access to capital adopted at the upper end of the market.

Capan, Farley and Hoenig (1996) have shown that capital investment intensity shows a positive relationship to financial performance at the industry level. At the firm level, higher investment is related to lower performance. Wakerly (1984) found that high investment intensity generally reduces profitability, but that its effect is less in high market share businesses than in firms with low market share. Wakerly (1984) defined investment intensity as net book value of fixed capital plus working capital, divided by value added (sales less purchases). Firms with high investment intensity have more difficulty in returning a high profit than those with low investment intensity; this, however, does not mean that high investment intensive businesses cannot be profitable.

Smith (2010) found that low quality stocks tend to dominate the performance of high-quality firms at the beginning of a stock market cycle. Low-quality firm outperformance during the middle of an economic cycle is rare. Smith (2010) asserts that the relatively brief spurts of low-quality outperformance make intuitive sense when analysed in the context of economic, monetary and stock market conditions. Low-quality stocks are more economically sensitive than high-quality stocks because they have a higher reliance on debt markets. This is due to the higher capital intensity and relative inability to finance growth through internal resources. If a recession follows a period of monetary tightening, low-quality stocks will fall further because they are more vulnerable to deteriorating economic and credit market conditions. If credit market conditions ease and Government spending increases, low-quality firms lead the initial phase of a new bull market. This is because bear market laggards have the most to gain from improving credit market and economic conditions (Smith, 2010). Additionally, low quality firms may outperform as the market nears a cyclical peak, the primary reason being that investor speculation is often widespread near stock market tops. In the late stage of a bull market, stock prices have been rising for a sustained period of time, luring unsophisticated investors into the market. As more investors chase the same investment theme, they become less quality conscious and buy stocks of dubious quality and inexperienced management teams. As a result, low-quality stocks may outperform the broad market right up until the market peaks and turns down (Smith, 2010). In an environment of tighter monetary conditions, higher taxes and

slower economic growth investors typically become more risk averse and favour high- over low-quality stocks.

According to Allison (2009), the key challenge for long-term investors is assessing a company's sustainable profitability. This is especially relevant for global franchise funds that invest in concentrated portfolios of high-quality companies with strong intangible assets. These funds typically follow a quality investment style that invests in durable franchises that offer high and sustainable returns on capital employed. Additionally, the ideal quality company will possess a primary competitive advantage supported by a dominant intangible asset.

2.5 CONCLUSION

This chapter has provided important background information and theory necessary to contextualise the study. It was stated that the filtering process plays a key role in investment management as it aids the portfolio manager in reducing the universe of suitable securities to a manageable size. Furthermore, it has reviewed important information regarding the main themes of this study, namely: capital intensity, ROCE and quality investing as an investment style.

Previous studies regarding the concept of capital intensity provided insight to the possible relation between low capital intensity and subsequent stock market performance. Titman *et al*. (2004) found evidence that firms that are able to reduce their capital intensity outperform firms that experience increasing capital intensity. Elmasry (2004) showed that lower capital-intensive firms outperformed more capital-intensive firms over different time horizons. It appeared that capital-intensive companies struggle to generate consistently superior growth in shareholder value. This may be because capital-intensive firms typically rely on tangible assets for their competitive advantage, which is easy to reproduce by rivals. Giovinazzo (2008) used asset intensity as a proxy for the net investment a firm needs to make to attain a given growth rate. The study showed that firms with heavy (light) asset intensity have lower (higher) subsequent stock returns. A long-short portfolio based on this effect yielded abnormal returns of around 0.4 per cent per month. These studies reinforce the notion that low capital-intensity companies generally produce better stock market performance.

Few existing ROCE studies examine the relationship between profitable companies and subsequent stock market performance. The ROCE ratio is used extensively in comparing

relative profitability, both between divisions within a firm, and between different companies (Rutherford, 2002). The literature also shows that the ROCE ratio is a popular measure of management performance (Eilon, 1992). A high ROCE ratio would then be indicative of a company that is operationally profitable as well as efficiently managed. Investors should prefer investing in high ROCE firms as profitable firms will have more funds available to pay out dividends. The increased demand for the company's shares in the market will also drive up the share price. The total return, consisting of dividends and capital appreciation, should be higher for high ROCE firms.

Companies that possess both favourable characteristics of low capital intensity and high ROCE should, in theory, be the best compounders of shareholder wealth. A low reliance on physical capital to generate revenue and high operational profitability are characteristics of quality companies. The investment style known as 'quality investing' and the concept of franchise investing involve finding and investing in companies that have these quality characteristics. Although it could be reasonably expected that quality companies experience superior stock market performance, relatively few studies have examined the stock market performance of quality companies defined along the lines of capital intensity and ROCE.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

In the previous chapter, concepts of capital intensity, ROCE and quality investing were explored. This chapter sets out to explain the research methodology that was followed in order to address the research objectives of this study.

The three primary objectives of this study were to:

- analyse the use of capital intensity as a filter for portfolio inclusion;
- analyse the use of ROCE as a filter for portfolio inclusion; and
- investigate the resulting stock returns of an investment strategy using a combination of capital intensity and ROCE as filters for portfolio inclusion.

In order to best address the objectives, the study was divided into three distinct phases, which each consists of two different research designs. Each research design applicable to the specific phase will be discussed in detail.

The chapter commences with a discussion on investment research, followed by a brief overview of the research process that was followed in order to answer the research question. In the research strategy section, the rationale for the specific research approach is described and the validity of the research is explained. The latter part of the chapter focuses on describing the data and the data processes employed. Finally, the financial metrics are defined, as well as the measures used to quantify them. The last section of this chapter provides a summary of the research methodology.

3.2 INVESTMENT RESEARCH

Investment management firms operate in competitive financial markets and access to timely and accurate information therefore is a necessity. Research is the process of collecting, collating and organising information in a systematic manner in order to address a specific objective (Amedeo, Golledge & Stimson, 2009:45). Wrenn, Stevens and Loudon (2006:2) define research as a formal inquiry into an area to obtain information for use in decision making. When the adjective investment is added to research, the context of the area of inquiry is defined. Investment research is thus the use of the research process

applied within the investment industry. Research intends to provide managers with appropriate information that can serve as the basis for sound and timely decision making (Coldwell & Herbst, 2004:1). The steps that need to be followed in the research process will be discussed in the following section.

3.3 THE RESEARCH PROCESS

In conducting research, the researcher should follow a series of steps designed to achieve a specific objective (Coldwell & Herbst, 2004:6; Gliner & Morgan, 2000:345). These steps are illustrated in Figure 3.1.

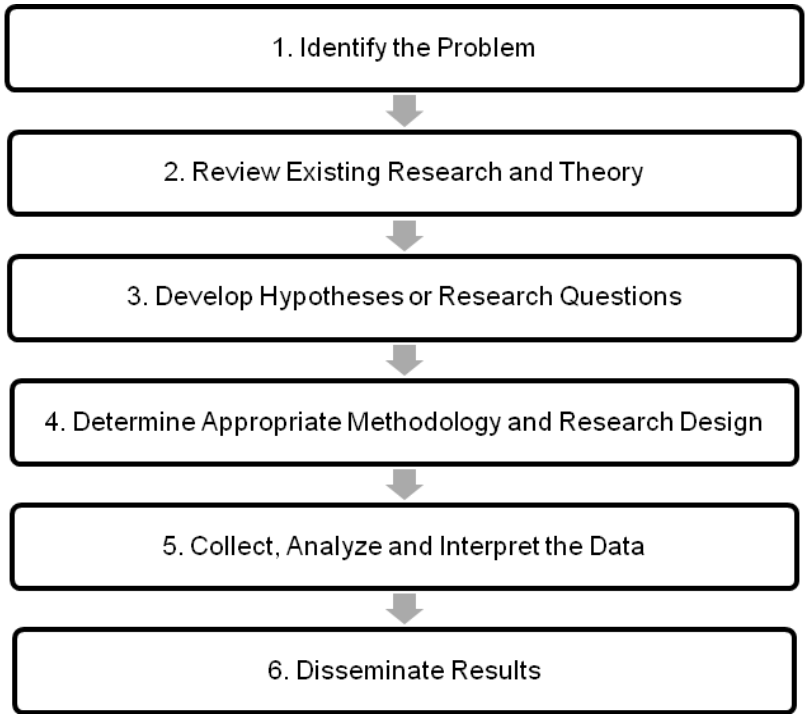

Figure 3.1: A graphical illustration of the research process

Source: Adapted from Wimmer and Dominick, 2010:14.

The basic steps that were followed in the research process for this study are outlined in Figure 3.1.

3.4 HYPOTHESES

This study was undertaken with three different objectives and the hypotheses were developed to address these objectives.

The first objective was to determine whether a causal link existed between the level of capital intensity of firms and subsequent total returns. This objective also included determining whether the average return of the lowest capital-intensity firms outperforms the average return of the highest capital-intensity firms on a consistent basis. From this objective, the first two hypotheses were formulated as:

> H^0: An equally weighted portfolio composed of high capital-intensity stocks will outperform a portfolio composed of low capital-intensity stocks.
>
> H^a: An equally weighted portfolio composed of high capital-intensity stocks will underperform a portfolio composed of low capital-intensity stocks.

The second objective was to determine whether there was a relationship between the ROCE of firms and their subsequent total stock return. This objective included determining whether the average return of the lowest ROCE firms lags the performance of the highest ROCE companies on a consistent basis. The hypotheses were formulated as:

> H^0: An equally weighted portfolio composed of low ROCE stocks will outperform a portfolio composed of high ROCE stocks.
>
> H^a: An equally weighted portfolio composed of low ROCE stocks will underperform a portfolio composed of high ROCE stocks.

The third objective concerned investigating the resulting stock returns of an investment strategy using a combination of capital intensity and ROCE as filters for portfolio inclusion.

> H^0: An equally weighted portfolio composed of stocks with the lowest capital intensity and highest ROCE will underperform a portfolio composed of stocks with the highest capital intensity and lowest ROCE.
>
> H^a: An equally weighted portfolio composed of stocks with the lowest capital intensity and highest ROCE will outperform a portfolio composed of stocks with the highest capital intensity and lowest ROCE.

3.5 RESEARCH STRATEGY

This section contains an overview of the research strategy applied in the study. It covers concepts such as the research approach, the research design and the validity of the research design.

3.5.1 Research approach

Two broad methods of reasoning exist in research, namely deductive and inductive research approaches. Deductive reasoning works from the more general to the more specific (Berg & Latin, 2007:9). It arrives at a specific conclusion based on generalisations. Starting from a limited number of simple statements, more complex statements can be built up from the more basic ones. The conclusion follows logically from the premises (Barney, 2005). A deductive research approach will typically start with a theory or an assumption about reality. This theory is then developed into a hypothesis that can be tested. Observations are then made to test the hypothesis in order to reach a conclusion about the original theory (Trochim, 2006). Inductive reasoning works the other way – moving from specific observations to broader generalisation and theory. This is sometimes referred to as the 'bottom up' approach. Tentative hypotheses are formed by analysing patterns in the observations. Conclusions are likely to be based on premises, as opposed to following on from premises (Brewer & Hunter, 1989:54-58).

A deductive research approach was followed in this study as it started with a specific theory or belief from which the research question and the hypotheses were developed. Following data analysis and data processing presented in Chapter 4, observations are made in order to confirm or reject the stated hypotheses.

As the collected information was numeric and analysed by mathematical techniques, the approach that was followed in this study was that of quantitative research. Information is considered qualitative in nature if it cannot be analysed by mathematical techniques (Coldwell & Herbst, 2004:13), while quantitative research generally involves the collection of numeric data. Essentially, the quantitative approach describes, infers and resolves problems using numbers (Coldwell & Herbst, 2004:15).

3.5.2 Research design

The research design is used to structure the research, to show how all the major components of the study work together to try to address the central research questions

(Trochim, 2006). In line with the requirements of an efficient research design, this study was experimental in nature as well as feasible to implement (Srinagesh, 2006:1).

The structure of the study consisted of three parts, or phases. Each phase contained two different sections that each used a different performance measurement period. As the first objective was to investigate capital intensity and share returns, the first phase of the study focused on exploring the effect of capital intensity on portfolio returns. Two different portfolio performance measurement periods were used in this phase. One approach was focused on measuring the total return of portfolios for the subsequent 12 months after portfolio formation. The other approach focused on measuring the performance effect over the subsequent 5 years after portfolio formation. Both research approaches are discussed in detail in section 3.7 Data Processing.

In line with the second objective of analysing the effect of portfolio formation on the basis of the ROCE financial metric, the second phase of the study was focused on investigating the effect of ROCE on portfolio returns. Like the first phase, the second phase consisted of two different approaches, each designed to measure the effect over different holding periods.

The third phase involved incorporating both capital intensity and ROCE in the portfolio composition process. In this process, both metrics were used as filters for portfolio construction. A matrix was constructed by dividing the sample into quintiles based on the capital-intensity metric, and then arranging the constituents of each quintile into subsets based on their profitability (ROCE). A primary filter (capital intensity) was applied, followed by a secondary filter (ROCE). This process resulted in 25 different portfolios, with each box in the five-by-five matrix representing a portfolio. The portfolios were numbered Box 1 (B1) to Box 25 (B25). Box 1 contained the highest ROCE firms within the least capital-intensive quintile. Box 25 contained the firms with the lowest ROCE within the quintile of firms that exhibit the highest capital intensity.

The total return over subsequent holding periods was then measured. First the 12-month total return was measured for the ‘best’ portfolio (defined as the portfolio consisting of the most favourable metrics) and compared to the ‘worst’ portfolio (consisting of the least favourable firms). The analysis was also extended to investigate the performance of the matrix portfolios for the five-year period after portfolio formation. The average annualised return for each portfolio in the matrix was then compared to the others.

3.5.3 Validity of the research design

Validity refers to the degree to which a study is able to scientifically answer the questions it is intended to answer. It is the approximate truth of conclusions, propositions and inferences (Trochim, 1999:45). The validity of the design of experimental research studies is a fundamental part of the scientific method. Without a valid design, valid scientific conclusions cannot be drawn. Internal validity refers to the degree to which conclusions regarding observed relationships can be made and is only relevant to the specific study in question (Coldwell & Herbst, 2004:40). Generally, internal validity is concerned with whether observed changes in the dependent variable can be attributed to the direct cause (change in the independent variable) and not to other possible variables that could have an impact on the relationship. This study, however, was less concerned with measuring a direct causal relationship between variables than measuring the extent to which two different financial metrics could be used as filters for portfolio construction. Internal validity in this regard was relevant to the accuracy of the conclusions made regarding the differences in portfolio returns. The main question was how valid the conclusions regarding the differences in total returns between the reference portfolios were. This was addressed by conducting t-tests on the differences in mean returns of the constructed portfolios, as discussed in section 3.7.

External validity concerns the extent to which the results of the study can be held true for other cases (McDaniel & Gates, 2001:200). It determines whether or not an observed relationship can be generalised across situations. A major factor influencing external validity is whether the study sample is representative of the general population along relevant dimensions. In this regard it is important to note the nature of the sample of listed industrial firms used in this study, as described in section 3.6. Financial sector firms were excluded from the sample since they differ in nature from industrial sector firms and small capitalisation firms were also excluded from the sample due to their lack of liquidity and possible distortion of the results. Industrial sector firms often vary in size, which could possibly have an effect on the capital intensity and ROCE metrics. It is thus difficult to generalise the findings of this study across situations where all firms (including financial sector firms and small capitalisation firms) are studied, since these were not included in the study.

3.6 DATA

A population is a group of items, units or people that is the main focus of a scientific query (Coldwell & Herbst, 2004:73). A sample is simply a subset of the population, and is drawn from the population using a sampling technique. The sample is therefore the portion of the population that is selected for analysis.

The universe of securities used included all the constituents of the MSCI World Index each year over the sample period of 1988 to 2010. This sample period was selected to provide a sufficient length of time to incorporate the effect of market cycles.

The sample for this study was drawn using a non-probability judgement sampling technique. In a non-probability sample, the individual items are chosen without considering their probability of occurrence. The disadvantages of using this method are a possible lack of accuracy due to selection bias and a lack of being able to generalise the findings (Levine & Stephan, 2009:10). A judgement sample is obtained according to the judgement of a person who is familiar with the relevant population characteristics. The researcher thus uses his own discretion when selecting elements to conform to a given standard (Anderson, Sweeney & Williams, 2008:290).

For this study, only firms with a market capitalisation above USD 1 billion (Schmitt, 2011:87) were included in the sample. Firms with small market capitalisations were excluded from the sample so that results would not be distorted by very small, illiquid firms. A company with a market capitalisation of USD 1 billion in 2007 may not necessarily be comparable to a market capitalisation of USD 1 billion in 1988 due to the time value of money, therefore, the filter was applied using the 2007 MSCI level as the discount factor. This was done because the constituents are international and as such, no national Consumer Price Inflation (CPI) figure would be relevant. In effect, firms with a market capitalisation of less than USD 1 billion in constant 2007 terms were excluded from the universe of securities. In practice the investable equity universe for many global portfolio managers is limited to large capitalisation shares, which tend to be the more liquid asset class (Pradhuman, 2000:145). Micro and small capitalisation shares tend to be more volatile, and small price fluctuations are typically recorded as large percentage return movements, which could skew results when an equally weighted portfolio's return is calculated (Brown, Brown & Bentley, 2002:155).

Firms included in the financial sector were excluded since their financial characteristics and their use of leverage are considerably different from firms in other sectors. The high leverage that is normal for financial firms probably does not have the same meaning as for non-financial firms. Also, the capital-intensity metric is less meaningful as financial institutions typically rely less on physical capital investment to generate revenue and more on human and financial capital (both of which are not reflected in the capital-intensity metric) (Schroeck, 2002:138). Companies located in emerging markets were also excluded from the sample. This was done to limit the exposure of the sample to excessive levels of volatility typical of such companies. Emerging markets only make up a small part of the MSCI World index, so the impact on the sample was limited (MSCI Barra, 2010).

The format of published financial statements may vary among firms and across countries, therefore, standardised annual financial data for each firm, such as sales, earnings before interest and taxes, capital expenditure and capital employed were obtained from *Compustat* via *FactSet*.

Data points should be available for all applicable metrics, namely: sales, capital expenditure, return on capital employed and total return. Financial statement data had to be available for the firm in a specific year for the firm to be included in the universe for that year. For the first part of each phase of the study, which considered the 12-month total return, only companies with all the available data points were considered. Data for consecutive years were not necessary, as portfolio formation was done annually for each specific year. The second part of each phase considered the five-year holding period performance after portfolio formation. Although it was necessary for firms to have available data points for five consecutive years after formation, which means that firms with missing data points were excluded, de-listed firms were not removed. This was done to address the issue of survivorship bias. If a firm was delisted three years after portfolio formation, it was still included in the universe, and the performance of the three listed years was still included in the calculation of the portfolio return. Survivorship bias refers to the tendency to exclude failed or delisted firms from a study, due to the fact that they no longer exist. It often causes the results of a study to skew higher since only firms that were successful enough to survive until the end of the study period were included (Pawley, 2006:21). In order to reduce survivorship bias, both listed and delisted firms were included in this study.

Following Fama and French (1992), all financial statement data were lagged by 90 days in order to avoid look-ahead bias. Look-ahead bias refers to the use of historical data in the wrong time frame (Daniel *et al.*, 2008). It is the bias created by the use of information that

would not have been known or available during the period being analysed. The best example is the release of a company's financial results only after a certain period after year-end for auditing reasons. Thus this lag in financial disclosure could lead to an inherent bias if not addressed.

Another source of possible sample bias was that only listed firms were examined. A study that focuses only on listed firms may only embody a small proportion of the firms in a country (Rajan & Zingales, 1995), thus it was not attempted to make the sample representative of all firms in developed countries.

3.7 DATA PROCESSING

The data processing task consisted of two kinds of operations, namely data reduction, during which the data was summarised; and data analysis. Data reduction is the process of converting raw data to a reduced form which is appropriate for analysis (Kuiper, 2009:365). The raw secondary data was collected from *Compustat* via *FactSet* and was reduced, prepared and converted to a usable format by using *Microsoft Excel 2007*.

The first two phases of the study followed a similar methodology to studies conducted by Fama and French (1992) and Lakonishok *et al.* (1994) into differences in return between value and growth stocks. This involved a portfolio construction technique by which a specific metric was used to rank and divide the sample into subsets, and subsequently track the performance of the portfolios over different time horizons. The third phase involved a different approach which incorporated both capital intensity and ROCE in the portfolio construction process. Descriptive statistics, unpaired t-tests and the Mann-Whitney U-test were used to evaluate the performance of portfolios.

3.7.1 Portfolio construction technique

The study was divided into three broad phases that each consisted of two distinct sections. In the three primary phases, the effect of portfolio returns of two separate metrics as well as a combination of both was investigated.

3.7.1.1 *Phase 1: Capital intensity - Part 1*

In the first phase the exclusive focus was on measuring the effect on portfolio performance when capital intensity is used as a filter. The process of portfolio construction involved dividing the sample into five subsets, or quintiles. This is done by rank ordering the firms in the universe on the basis of capital intensity and then grouping the firms into portfolios.

The companies with the most favourable metric (lowest capital intensity) were assigned to the first quintile and the least favourable to the fifth quintile. This was done annually at the end of June of year *t*. The total return of an equally weighted portfolio was then measured for the subsequent 12 months. The aim was to match the stock returns of a firm for the period from July of year *t* to June of year *t+1* to the accounting data of the firm for the fiscal year between July of year *t-1* and June of year *t*. The portfolios were rebalanced annually and the subsequent 12-month total returns were recorded. The average annual performances of the portfolios were then compared over different time periods, as well as on a cumulative basis.

The research approach within this part of the study measured the compound annual growth rate of annually rebalanced, equally weighted quintiles. The analysis was done over the entire 22-year sample period. Additionally, the return spread between the first and fifth quintile was computed annually. This was done by subtracting the total return of quintile 5 from the total return percentage of quintile 1. This measured the sustainability of the outperformance (if any) of quintile 1 over quintile 5. The difference between the means of quintile 1 and quintile 5 was tested for significance by using unpaired t-tests and the Mann-Whitney U-test. These tests are explained in section 3.7.2. The cumulative performance of a strategy going long (buying) quintile 1 and shorting (selling) quintile 5 was measured and compared to the compound performance of other quintiles.

3.7.1.2 *Phase 1: Capital intensity - Part 2*

As equity portfolios are generally evaluated over longer horizons (Litterman, 2003:30), a one-year holding period may not be a sufficient length of time to evaluate portfolio performance. Similar to most long-only equity portfolio mandates, the stated goal of the Investment Partners' Global Franchise fund is to earn attractive long-term returns while minimising business and valuation risk (Allison *et al.*, 2006). To evaluate an equity investment strategy it is important to measure performance over a full market cycle; this is typically measured from peak-to-peak or from trough-to-trough. Depending on the prevailing market environment, a full market cycle typically lasts three to seven years (Chandra, 2008:622).

Performance measurement is often not applied correctly in practice. According to Chandra (2008), performance is measured too frequently and judgements are formed on the basis of short time frames. Such an approach leads to negative consequences, such as the promotion of market timing. It is thus not feasible to evaluate the ability of a money

manager over a short period of time, when it should be evaluated over a period of five to seven years. Results of performance computation should not be taken as significant until a reasonable period of time, such as a market cycle for equities, has elapsed (Dietz & Kirschman, 1990). A holding period of five years was used in this part of the study.

A longer investment horizon is suited to the nature of companies that earn superior returns on reinvested capital. Using a capital-intensity filter to identify firms that have a lower reliance on physical capital to drive sales should result in portfolios of firms that are superior compounding vehicles. The success of better compounding ability is best measured over longer horizons (Jones, 2008:178). Shorter term investment returns, particularly relative returns, are not good predictors of longer term returns.

For these reasons the example of Lakonishok *et al*. (1994) was followed to examine quintile performance over five-year holding periods. Portfolios were formed annually starting at the end of June 1988 and following the same process in terms of portfolio construction as in Part 1. The subsequent performance of portfolios was measured for the five years after portfolio formation.

3.7.1.3 *Phase 2: ROCE – Part 1*

For the second phase of the study, the potential of using ROCE as a filter to select companies for portfolio inclusion was investigated. Following a similar process as described in section 3.7.1.1, this part of the study involved compiling portfolios by dividing the sample into five subsets on the basis of the firms' ROCE. Firms with the largest ROCE were grouped into quintile 1 and firms with the lowest ROCE into quintile 5. The subsequent 12-month total return after portfolio formation was then measured and recorded. Portfolios were rebalanced annually and the average performances compared over different time periods, as well as on a cumulative basis.

The analysis and tests of the differences in the means in this section are identical to the first part of Phase 1.

3.7.1.4 *Phase 2: ROCE – Part 2*

As in part 2 of the first phase, the performance of quintile portfolios for five-year holding periods after portfolio formation are examined in this section. Portfolios were formed annually on the basis of the firms' ROCE, with the lowest ROCE firms assigned to quintile 5 and the highest ROCE firms assigned to quintile 1. The average annual returns of the

different portfolios were then compared to determine whether high ROCE firms on average outperformed low ROCE firms over five-year holding periods.

3.7.1.5 *Phase 3: Combining capital intensity and ROCE – Part 1*

The third phase of the study involved incorporating both capital intensity and ROCE in the portfolio composition process. This involved constructing a matrix by dividing the universe of shares into quintiles each year based on capital intensity, and then arranging the constituents of each quintile into subsets based on their profitability (ROCE). The capital-intensity metric was applied as a primary filter, followed by ROCE as the secondary filter. This process resulted in the creation of 25 different portfolios, or boxes in the matrix as reflected in Figure 3.2. The first box in the matrix (Box 1) consists of firms with the highest ROCE within the lowest capital-intensity quintile. If the universe of shares for a particular year consisted of 2500 firms, then quintiles based on capital intensity consisted of 500 firms each. Dividing each quintile into five subsets based on ROCE resulted in portfolios containing 100 firms each. In part 1, the focus was on tracking the performance of Box 1 and Box 25 (which consisted of the lowest ROCE firms within the least favourable capital-intensity quintile). The 12-month total return for both Box 1 and Box 25 was recorded after portfolios were rebalanced annually. The average annual returns over different time periods were compared, as well as the cumulative performance of the two portfolios over the entire 22-year period.

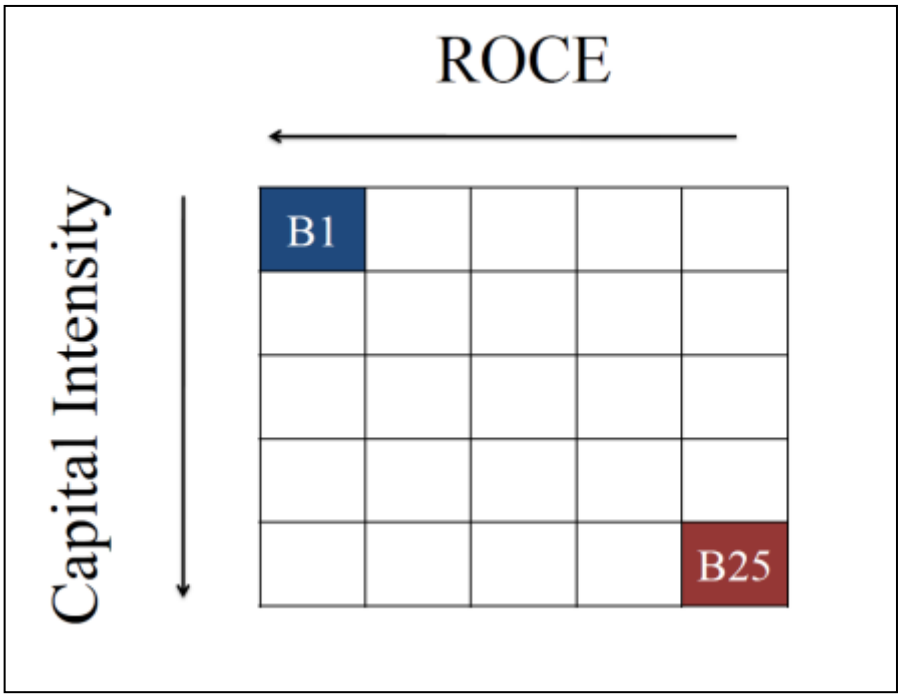

Figure 3.2: Matrix incorporating both capital-intensity and ROCE metrics as filters

Firms that have low reliance on physical assets to generate revenue (low capital intensity), and that are operationally profitable (high ROCE) should in theory produce superior investment returns. To investigate whether Box 1 portfolios consistently performed better than Box 25, the return differences between the two portfolios were examined annually. A strategy of buying Box 1 and selling Box 25 was followed in order to investigate the persistence of relative outperformance of Box 1 over Box 25.

3.7.1.6 *Phase 3: Combining capital Intensity and ROCE – Part 2*

The last phase of the study built on the use of the matrix construction process to incorporate both capital intensity and ROCE metrics as filters, but examining the effect of longer holding periods. Instead of rebalancing portfolios annually (as done in part 1), portfolio performance was recorded for the five years after portfolio formation.

The universe of firms was divided into quintiles based on capital intensity and then the constituents of each quintile were divided into quintiles based on their respective ROCE ratio. This process resulted in 25 different portfolios. Starting on June 30, 1989, the total return performance of Box 1 to Box 25 was measured and recorded over the subsequent five years. Although portfolios were formed annually, they were allowed to run for five years without rebalancing. New 25-portfolio sets were constructed as of June 29, 1990, and every subsequent June 30 through 2005. For each of the new portfolio sets, box-by-box performance was recorded for the five years after the inception date. This process resulted in 17 sets of portfolios that were tracked for five years of box-by-box performance for each one. The last step involved averaging the performance data across the 17 box sets to make comparisons on an annualised basis. Comparing all 25 portfolios in this way allowed one to deduce whether firms with low capital intensity and high ROCE metrics were superior investment vehicles over five-year periods.

3.7.2 Data analysis

The process of data analysis is undertaken to describe facts, detect patterns and generate meaning from the raw data collected. Data analysis involves the systematic application of statistical tools (Lewis-Beck, 1995:1).

Descriptive statistics, t-tests and the Mann-Whitney U-test were used to evaluate and compare portfolio returns. These methods, along with the holding-period rate of return, are discussed in this section.

3.7.2.1 *Holding-period rate of return (HPR)*

A key measure of investors' success is the rate at which their funds have grown during the investment period (Bodie *et al*., 2010:110). The total HPR of a share depends on the change in the price of the share over the investment period, as well as on any dividend income the share has provided. The total return measure is therefore split into two components, namely, capital appreciation and income yield, as can be seen in equation 3.1.

$$\text{HPR} = \frac{\text{Ending Price} - \text{Beginning Price} + \text{Dividend}}{\text{Beginning Price}} \qquad (3.1)$$

The definition of the HPR used assumes that the dividend is paid at the end of the holding period. If dividends are paid earlier, the definition ignores reinvestment income between the receipt of the dividend and the end of the holding period.

3.7.2.2 *Descriptive statistics*

Numerical descriptive statistics were used in this study to determine the nature of the data, and to summarise the data. Measures of central tendency, such as mean and median, and measures of variation including standard deviation and range, were utilised in the analysis.

(a) Arithmetic mean

The arithmetic average of all the items in a data set is calculated by taking the sum of the periodic returns divided by the number of periods.

The formula for the arithmetic mean (μ) is (Medhi, 1992:53):

$$\mu = \frac{\sum \mu_i}{n} \qquad (3.2)$$

Where: μ_i = the return in period i

n = number of periods.

The concept of a mathematical average is easily understood, which makes the mean a useful measure with which to compare different data sets. Each data set has only one mean which describes the entire data set. A disadvantage of the mean is that it could be affected by extreme outlier values that do not represent the rest of the data set. The occurrence of many outliers in a data set will cause the mean to be less representative of the nature of the entire data set (Coldwell & Herbst, 2004:103-104). Another disadvantage

of using the arithmetic mean is that this statistic ignores compounding. It does not represent an equivalent, single periodic rate for longer time periods (Bodie *et al*., 2010:111).

(b) Geometric average

The geometric average is the single per period return that gives the same cumulative performance as the sequence of actual returns. It is calculated by compounding the actual period-by-period returns and then finding the equivalent single per period return. The geometric average return (r_g) is defined by (Bodie *et al*., 2010:111):

$$(1 + r_g)^n = (1 + r_1)\ (1 + r_2)..... (1 + r_n)$$

Where: r_n = the return in period n.

Reducing the above equation, the formula for r_g becomes:

$$r_g = [(1 + r_1)\ (1 + r_2)..... (1 + r_n)]^{1/n} - 1 \qquad (3.3)$$

The geometric average return is a superior measure of long-term investment performance because it takes into account compounding (Reilly & Brown, 2008:11). This statistic is also referred to as the time-weighted average return because it ignores the period-to-period variation in funds under management (Bodie *et al*., 2010:111).

(c) The median

The median is the single value that is most central in the data set. If the data is arrayed in ascending or descending order, the median is the point which has one half of the data set above and one half of the data set below it (Moore, 2009:41). This measure has an advantage over the mean in that it is not affected by extreme outliers (Coldwell & Herbst, 2004:103). It is also easy to understand and calculate.

(d) The data range

The data range is the values of the data from the minimum to the maximum of the sample. It is calculated by taking the difference between the highest and lowest values in the sample (Salkind, 2010:1218). The data range is the simplest measure of the spread of data values around the mean, but it has the disadvantage that extreme outlier values could distort its variability measure (Coldwell & Herbst, 2004:104).

(e) Variance and the standard deviation

The variance is one of the most useful measures of variability in a data set, and measures the dispersion around the arithmetic mean. Variance is calculated by taking the average of the squared deviations from the mean. The formula for variance (σ^2) is (Coldwell & Herbst, 2004:104):

$$\sigma^2 = \frac{\sum(x_i - \bar{x})^2}{n - 1} \qquad (3.4)$$

where: σ = standard deviation;

x_i = i^{th} value in the data set;

$\bar{x}$ = mean of all the values in the data set; and

n = total number of values in the data set.

The standard deviation is the positive square root of the variance. The more widely spread the data, the higher the deviation. The measure is applied to the annual rate of return of an investment to measure the investment's volatility. The formula for the standard deviation of a sample (σ) is (Bajpaj, 2009:128):

$$\sigma = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n - 1}} \qquad (3.5)$$

The standard deviation indicates the proximity to the mean of all the various data points in a sample. If the distribution of the sample is normal, or bell-shaped, then approximately 65 per cent of the observations fall within one standard deviation from the mean.

(f) Kurtosis

Another measure that can provide descriptive information about a distribution is the kurtosis measure. It is a measure of shape, which indicates the degree of peakyness, or flat-toppedness, of a distribution relative to a normal distribution (Crawley, 2005:71). A negative kurtosis, which is referred to as leptokurtic, will indicate that the distribution is more peaked, or have a higher incidence of returns clustered near the mean return (Maginn, 2007:556). The kurtosis of a normal distribution is three. Positive values above three indicate a higher frequency of extreme values to that of the normal distribution (Bodie *et al.*, 2010:118). Such a distribution, which has a lower, flatter peak, is called a platykurtic distribution.

(g) Skewness

Skewness is another statistic used to indicate whether a portfolio's probability distribution differs significantly from normality with respect to possible extreme values. Skewness measures the asymmetry of the distribution (Bajpaj, 2009:136). If the distribution is symmetrical, like the normal distribution, this statistic will have a value of zero. Negative skewness suggests that extreme negative values are more frequent than extreme positive ones (Bodie *et al.*, 2010:118).

(h) Student's t-test

In order to compare the performance of two portfolios, for example high versus low capital-intensity portfolios, a statistical test of the difference in the means is needed. Various statistical methods can be used to compare data groups.

Any statistical test that uses the t-distribution can be called a t-test, or the 'student's t-test', and can be used for different purposes. The t-test for independent samples is used to determine how likely an observed mean difference between two groups would be to occur by chance alone (Bausell & Li, 2002:57). The unpaired t-test is used when two separate sets of independent samples are obtained, one from each of the populations compared. Two assumptions have to be met in order to use the t-test:

- the populations from which the samples are drawn are normal; and,
- the variances of the two populations are approximately equal.

The normality assumption is evaluated by calculating the skewness and kurtosis. If the normality condition is not met, the difference in the means between two data groups is evaluated by using the non-parametric alternative to the t-test: the Mann-Whitney U-test. A non-parametric alternative to the t-test can often have better statistical power (Erceg-Hurn & Mirosevich, 2008). By the central limit theorem, sample means of moderately large samples are often well-approximated by a normal distribution even if the data is not normally distributed (Stevens, 2006:158).

The goal of the independent t-test is to evaluate the mean difference between two populations. The null hypothesis states that there is no difference in the means. Thus, in symbols, the null hypothesis for the independent measures test is:

$$H_0: \mu_1 - \mu_2 = 0$$

Where: μ_1 = mean for the first population,

μ_2 = mean for the second population.

The alternative hypothesis states that there is a mean difference between the two populations:

$$H_a: \mu_1 - \mu_2 \neq 0$$

The hypothesis test is based on a t-statistic. The formula for this t-statistic is (Gravetter & Wallnau, 2008:313):

$$t = \frac{\mu_1 - \mu_2}{S_{(m_1+m_2)}} \tag{3.6}$$

Where:

$$S_{(m_1+m_2)} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} \tag{3.7}$$

Where:

s_i^2 = variance of sample i,

n_i = number of data points in sample i.

Because the independent t-statistic uses two sample means, the formula for the estimated standard error combines the error for the first sample mean and the error for the second sample mean (Gravetter & Wallnau, 2008:313).

After computing the t-statistic, it is compared to the critical t-value obtained from the student's t-distribution according to the specified level of significance and degrees of freedom. The level of significance used in this study was 0.05. The degrees of freedom were computed as (Urdan, 2005:92):

$$df = (n_1 + n_2) - 2 \tag{3.8}$$

The p-level reported with a t-test represents the probability of error involved in failing to reject the null hypothesis. The p-value shows the probability of error associated with rejecting the null hypothesis of no difference between the two categories of observations when, in fact, the hypothesis is true. A small p-value would indicate that there is a significant difference in the mean values of the two portfolios being compared.

Non-zero values for kurtosis and skewness could have important implications for the interpretation of the mean and standard deviations. Since outlier values could possibly distort the results of the study, special attention is paid to these measures. To the extent that these measures indicated a departure from the normal distribution, non-parametric statistical tests were employed in this study. Non-parametric statistical tests are often used if the data set does not have a normal distribution (Corder & Foreman, 2009:18). To test whether the means of portfolios were statistically different from each other in cases where the distribution of the sample was not normal, the Mann-Whitney U-test was used.

(i) Mann-Whitney U-test

The Mann-Whitney U-test is a non-parametric statistical hypothesis test used to determine whether the populations of two samples of independent observations are different from one another (Black, 2009:678). Non-parametric tests are used to overcome the underlying assumption of normality in parametric tests (Coldwell & Herbst, 2004:119). An advantage with this test is that the two samples under consideration may not necessarily have the same number of observations. The test procedure involves the ranking (from small to large) of the observations of the two samples. When rankings are tied, the average rank is computed and assigned to each of the tied observations. The sum of the ranks for both samples are calculated and then used to construct the test statistic (Coldwell & Herbst, 2004:118-119).

The Mann-Whitney test statistic for sample A is calculated as (adapted from Corder & Foreman, 2011:58):

$$U_A = n_A\, n_B + \frac{n_A(n_A+1)}{2} - T_A \qquad (3.9)$$

Where:

n_A = number of observations for sample A,

n_B = number of observations for sample B,

T_A = sum of ranks for sample A.

Similarly the test statistic for sample B is calculated as:

$$U_B = n_A\, n_B + \frac{n_B(n_B+1)}{2} - T_B \qquad (3.10)$$

In order to determine whether there is a significant difference between the samples, the probability of obtaining two different values of U when there is in fact no difference

between the populations should be established (Hinton, 2004:219). The calculated p-value is an indication of the probability of the medians of the two samples being identical. If the sums of the ranks are very different, the p-value will be small. A small p-value will lead to the conclusion that the populations have different medians. However, if the observed p-value is large, the conclusion cannot be made that the overall medians differ (Sheskin, 2004: 423).

In this study the Mann-Whitney U-test was used to determine whether there was a statistically significant difference between the returns of different quintile portfolios. Specifically, the difference in performance between low and high quintiles was tested. A significance level of 0.05 was used. If the result of the test statistic was significant (the determined p-value is less than the level of significance), it indicated that there was a significant difference between the medians of the two samples.

3.8 FINANCIAL METRICS

Each phase of this study involved using a specific metric, or variable, as a filter to create portfolios. In this section, the definition and composition of each metric is discussed.

3.8.1 Capital Intensity

To generate revenue, most companies need to invest capital in their revenue generating process. Capital refers to the plant and equipment used in the production function of a business, as well as its stock of financial assets (Baumol & Blinder, 2011:402). Capital is therefore the term used to refer to the amount invested in plant, property, equipment, inventory and other physical assets (Samuelson & Nordhaus, 2004). Capital expenditure represents the funds used to acquire or upgrade fixed assets other than those associated with acquisitions (Kieso, Weygandt & Warfield, 2010). It includes, but is not restricted to, additions to property, plant and equipment, as well as investments in machinery and equipment. It typically represents the necessary expenditure associated with maintaining or increasing the scope of its operations.

Capital intensity refers to the amount of capital a business requires to generate one unit of revenue. It therefore gives an indication of the amount of plant, property, equipment, and other tangible assets required to produce a unit of sales. This characteristic can be quantified by using the ratio of a company's annual capital expenditure divided by revenues. However, as firms typically go though capital cycles - periods of increased capital expenditure followed by periods of lower capital expenditure - this metric tends to

be unstable over time (Coles, 1997:8). A more stable proxy for capital intensity would be to normalise the capital expenditure over five years and to divide the result by sales. This metric will take into account the effect of the capital cycle most companies are subject to. Five years was chosen because a full market cycle typically lasts three to seven years (Chandra, 2008:622).

This study defined capital intensity as:

$$CI_t = \frac{(CE_{x_t} + CE_{x_{t-1}} + CE_{x_{t-2}} + CE_{x_{t-3}} + CE_{x_{t-4}})/5}{Revenue_t} \quad (3.11)$$

Where:

CI_t = Capital intensity for year t,

CEx_t = Capital expenditure for year t,

$Revenue_t$ = the total amount of sales revenue in year t.

A lower ratio would indicate a lower amount of capital needed per unit of sales produced; consequently a lower ratio would be more favourable.

3.8.2 Return on capital employed (ROCE)

ROCE compares a firm's earnings from its primary operations with the capital invested in the company and can serve as a reliable measure of corporate performance (Bourne & Bourne, 2011:173). ROCE provides a measure to determine how well a company invests funds in its basic business operations (Eilon, 1992), as indicated in equation 3.12. The financial ratio used to express ROCE in year *t* uses operating income in year *t* in the numerator and capital employed during year *t* in the denominator (Elliott & Elliot, 2001). Therefore, it is a ratio that indicates the efficiency and profitability of a company's capital investments. ROCE essentially is the operating profit per unit of capital employed.

$$ROCE_t = \frac{EBIT_t}{Capital\ Employed_t} \quad (3.12)$$

Earnings before interest and taxes (EBIT) is a measure of a firm's profitability that excludes interest and income tax expenses. EBIT indicates the level of operating income the firm is generating (Ratner, Stein & Weitnauer, 2009:65).

Capital Employed is the total amount of share capital and debt that a company has and uses (Leach, 2004:50) and refers to the amount of assets that contribute to a company's

ability to generate revenue. It is the financial resources necessary for the company to continue functioning and engaging in its primary task of revenue generation (Eilon, 1988). Although Capital Employed has many definitions, it is commonly defined as total assets less current liabilities (Dodge, 1997:340; March, 2009:47).

Therefore the formula for ROCE expands to:

$$\text{ROCE}_t = \frac{\text{EBIT}_t}{\text{Total Assets}_t\text{-Current Liabilities}_t} \quad (3.13)$$

As the ROCE gives an indication of management's ability to effectively allocate capital (Leach, 2004; White *et al*., 1998), it should be useful as a filter to indicate profitable companies. The nature of a firm's competitive advantage stems from its basic business function and ROCE measures how well a company invests in its core operations. A high ROCE should typically be indicative of a company that is both well-managed and profitable.

3.9 SUMMARY

In this chapter, the research methodology followed in this study was explained. Investment research was defined and its importance was explained. This was followed by a concise discussion of the research process and the various steps it consists of. The research process is important as it shows the step-wise procedure that was utilised in order to achieve the objectives of the study.

An overview of the research strategy used in this study was given. A deductive research approach was followed as the study started with a specific theory or belief from which the research question and hypotheses were developed. A quantitative, as opposed to a qualitative process was employed.

The research design was explained. This provided an outline of the structure of the study, as well as details of the different phases. The first phase was structured to have an exclusive focus on capital intensity and its use as a decision-making tool. The second phase was focused on ROCE and its use as a filter for portfolio inclusion. The last phase used both capital intensity and ROCE as filters in the portfolio construction process. A matrix was constructed with 25 box portfolios. Capital intensity was used a primary filter and ROCE as a secondary filter in constructing the matrix. Each phase had two parts: one

that investigated a short time horizon and one that examined the effect of longer holding periods.

The issues of internal and external validity were addressed, followed by an explanation of the nature of the data set used. Only listed industrial firms in developed markets were included in the data set. Financial sector firms were excluded since they differ in nature from industrial firms. Small cap firms were also excluded to guard against possible distortion of results caused by very small illiquid firms.

Descriptive statistics were used in this study to indicate the nature of the different portfolios. It included the following measures: mean, median, range, variance, standard deviation, skewness and kurtosis. In order to determine whether the difference in average return from high and low portfolios was statistically significant, independent sample t-tests were used. The Mann-Whitney U-test was used as the non-parametric equivalent of the t-test in instances where there was a departure from normality in the distribution of the data.

The research findings of this study are discussed in the next chapter.

CHAPTER 4

RESEARCH RESULTS

4.1 INTRODUCTION

The previous chapter contained a detailed discussion of the research methodology followed in this study. This chapter focuses on discussing the results obtained from following the process as outlined in Chapter 3. As the study was divided into three distinct phases, this chapter is split into three sections.

The first section of this chapter discusses the results of the first phase of the study, namely investigating the relationship between capital intensity and stock returns. The second phase focuses on the results of analysing the relationship between ROCE and stock returns. This is followed in the final section by a review of the results of combining both capital intensity and ROCE as part of a filtering process in an effort to construct superior portfolios. In the latter case returns are also compared with the MSCI World Total Return (TR) Index.

For each section, the relationship between the given variable and subsequent stock returns was analysed by looking at the compound annual growth rate over the entire sample period as well as the most recent decade. The arithmetic average return of the quintiles was then compared over different time horizons to determine which quintile produced the best results. This was followed by an analysis of the return spread between the most favourable and least favourable quintile. Here, descriptive statistics were employed to determine the nature of each data set. Statistical tests, including t-tests, and the Mann-Whitney U test were used to determine whether the mean quintile returns observed were significantly different from each other. These results were used to test the hypotheses formulated, as well as to address the objectives identified in previous chapters.

In addition to an analysis in which quintiles were rebalanced annually, each section includes a five-year holding period analysis. Portfolios were formed annually but the total return performance was measured for a holding period of five years.

This chapter ends with a summary of the empirical results of the study.

4.2 CAPITAL INTENSITY

The following section outlines the results obtained from the analysis of capital intensity and total stock returns.

4.2.1 Compound annual growth

Table 4.1 shows that in forming portfolios based on capital intensity and rebalancing annually, it is quintile 3 that performed best over the entire sample period. Quintile 3 had the highest absolute compound annual return of 8.70 per cent, and the highest return per unit of risk of 0.56. Return per unit of risk was calculated by dividing the compound annual growth rate by the standard deviation over the specific period. The lowest capital-intensity quintile (Q1) had the lowest performance with 6.04 per cent. Quintile 5 had the highest standard deviation of 18.04 per cent compared with the 15.05 per cent average standard deviation. A market-neutral strategy that focuses on the return spread between the lowest capital-intensity quintile and the highest (Q1-Q5), effectively going long Q1 and short Q5 each year, did especially poorly with -2.69 per cent compound annual return. This contradicts the expectation of sustainable outperformance of low capital-intensity firms compared with high capital-intensity firms.

Table 4.1: The performance of capital-intensity quintiles over the entire sample period of 22 years (June 1989 – June 2010)

	Q1	Q2	Q3	Q4	Q5	Average	Return Spread Portfolio
Compound Annual Growth Rate (CAGR)	6.04%	7.45%	**8.70%**	7.32%	7.64%	7.49%	-2.69%
Standard Deviation	15.61%	**14.75%**	15.40%	14.82%	18.04%	15.05%	10.17%
Return per unit of risk	0.39	0.51	**0.56**	0.49	0.42	0.50	-0.26

Figure 4.1 shows the cumulative performance of annually rebalanced quintiles based on capital intensity over 22 years. The relative outperformance of Q3 is apparent, as is the dismal performance of a strategy based on the return spread between Q1 and Q5.

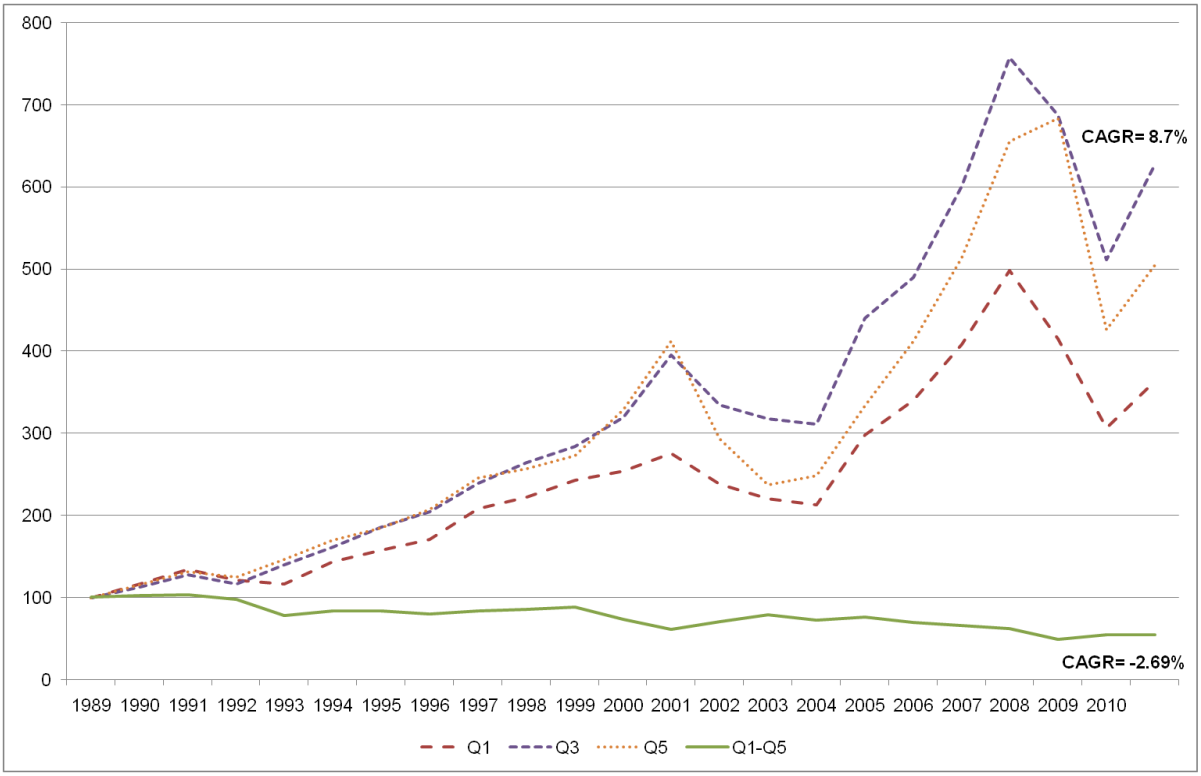

Figure 4.1: Cumulative performance of quintiles based on capital intensity

Performing the analysis over a different sample period did not change the conclusion materially. Table 4.2 shows the performance of annually rebalanced quintiles based on capital intensity over the last 10 years (2001 – 2010) of the sample period. The results were similar to the full period analysis with quintiles 2 and 3 performing best, and quintiles 1 and 5 worst. On a risk-adjusted basis it was the quintile with the highest capital intensity that underperformed with a ratio of 0.08 compared to the average of 0.18. The lowest capital-intensity quintile (Q1) performed poorly on an absolute and relative basis, with a compound annual growth rate of 2.80 per cent. Its standard deviation was in line with the average of all the quintiles, but the return per unit of risk of 0.13 was lower than the average.

Table 4.2: The performance of capital-intensity quintiles over the last ten years of the sample period (June 2001 – June 2010)

	Q1	Q2	Q3	Q4	Q5	Average	Return Spread Portfolio
CAGR	2.80%	**4.82%**	4.72%	3.83%	2.05%	3.79%	-1.06%
Standard Deviation	21.07%	20.72%	21.30%	**19.51%**	25.41%	21.21%	11.45%
Return per unit of risk	0.13	**0.23**	0.22	0.20	0.08	0.18	-0.09

4.2.2 Arithmetic average returns

The arithmetic average returns of the different quintiles over various sample periods paint a similar picture to the compound annual growth results. The different time periods refer to the most recent 3, 5, 10, 15, and 22 years ending June 2010. As can be seen from Table 4.3 it is quintile 1 that underperforms consistently relative to other quintiles across all sample periods. Again it is quintile 3 that performs best over all the sample periods, with the exception of the last 5 years (2006 – 2010). Here, surprisingly, it is Q5 that performs best with an arithmetic average return of 7.46 per cent. Over the most recent 3 years there was negative performance across the board, with quintile 1 registering the largest loss, with -8.10 per cent. Quintile 3 managed the least severe drawdown of the quintiles with -4.08 per cent. No noteworthy pattern can be observed over longer time periods.

Table 4.3: The average return of quintiles based on capital intensity of the most recent 3, 5, 10, 15 and 22 years

Averages	Q1	Q2	Q3	Q4	Q5
3 years	-8.10%	-5.24%	-4.08%	-6.38%	-4.96%
5 years	3.53%	6.90%	7.29%	5.41%	7.46%
10 years	4.73%	6.67%	6.66%	5.49%	5.18%
15 years	6.56%	8.27%	9.17%	8.06%	8.46%
22 years	7.17%	8.46%	9.80%	8.34%	9.34%

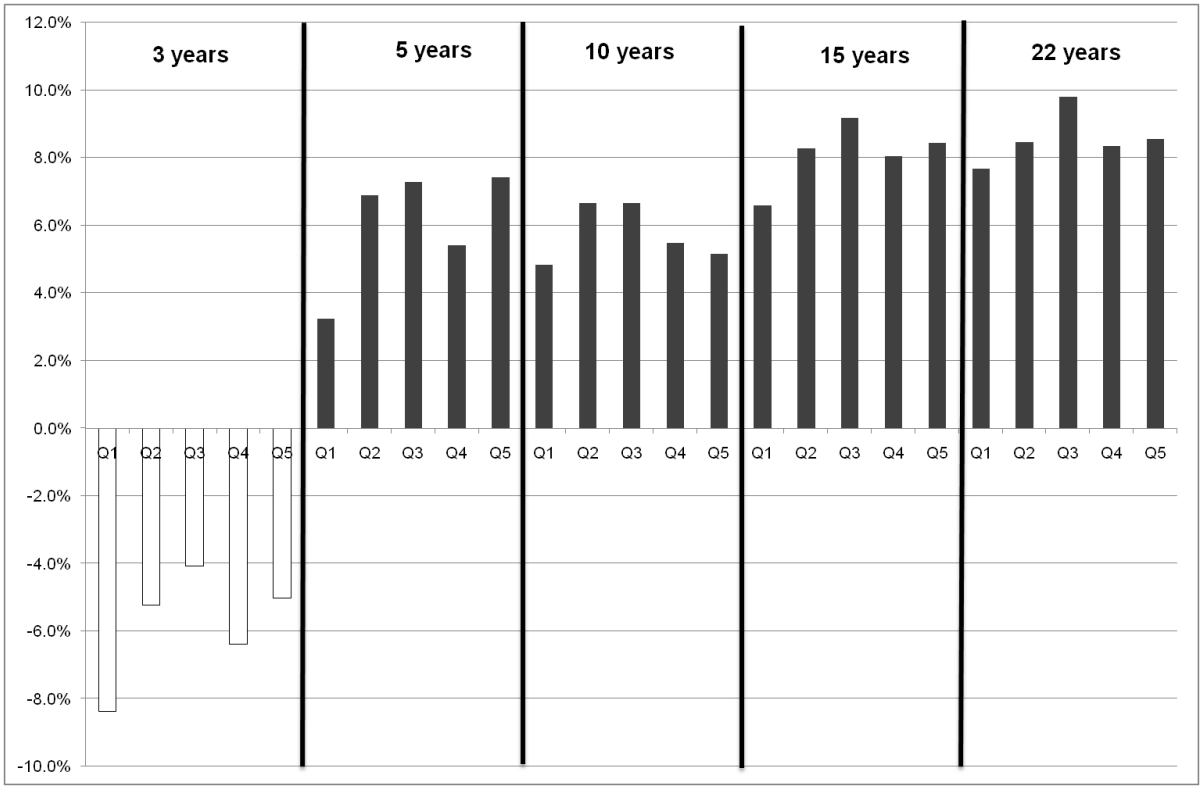

Figure 4.2: The average return of annually rebalanced quintiles based on capital intensity over different time periods

The returns summarised in Table 4.3 are graphically depicted in Figure 4.2. It remains inconclusive whether any significant deductions can be made regarding the usability of capital intensity in successful stock selection that results in increasing shareholder wealth over time.

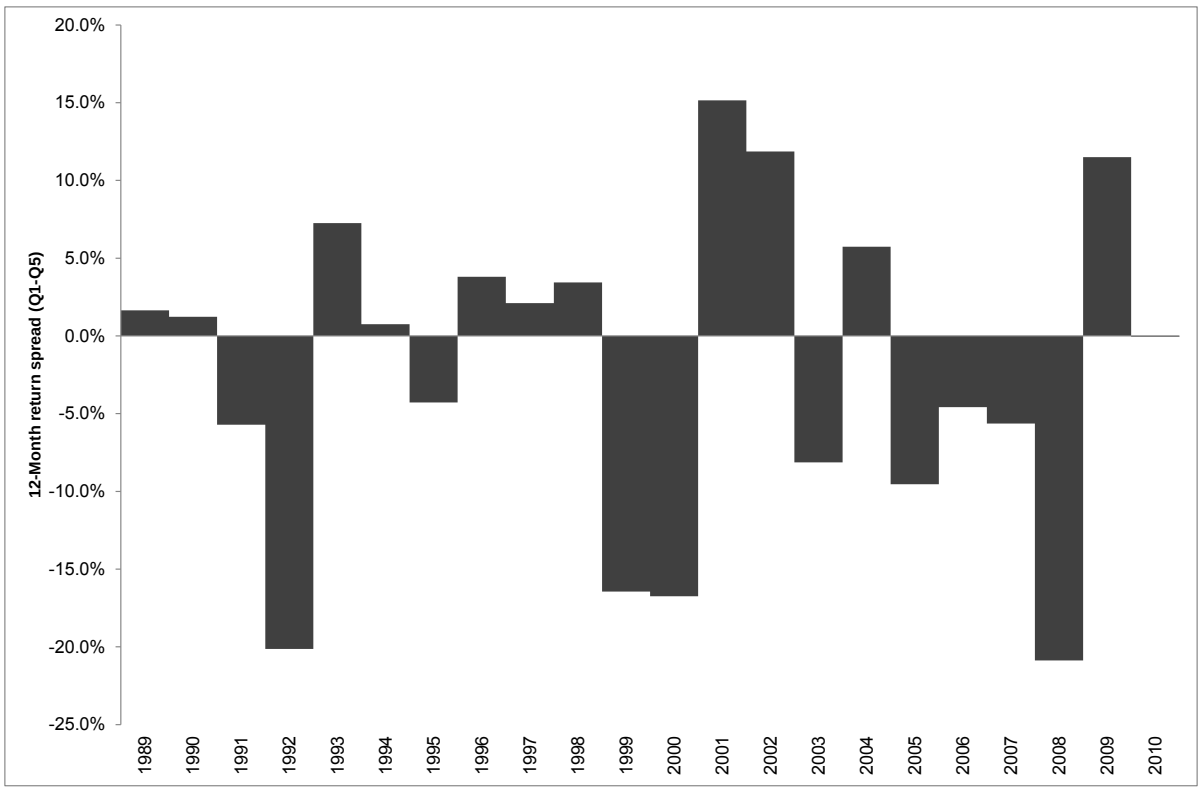

Figure 4.3: Capital-intensity quintile 1 versus quintile 5 return spread (Q1 – Q5) over time

Figure 4.3 graphically depicts the return spread between quintile 1 (low capital-intensity) and quintile 5 (high capital-intensity) on an annual basis over the entire sample period. It is evident that there is not a sustainable positive spread between the two quintiles, but rather a significant fluctuation in the spread over time. Also evident from Figure 4.3 is the sustained negative spread between 2005 and 2008, consistent with the global bull market. This leads to the deduction that when stocks are rising globally, the highest capital-intensity firms perform better than their lowest capital-intensity counterparts. In periods of extreme market optimism, such as from 1999 to 2000, it is the firms with high capital intensity that actually perform better compared to low capital-intensity firms.

4.2.3 Student's t-test

Although it is apparent from Figure 4.3 that the difference between Q1 and Q5 has fluctuated from year to year, and that there is no discernable pattern of outperformance of low capital-intensity firms, it was necessary to determine whether the observed differences were statistically significant. In order to reject the hypothesis that low capital-intensity firms do not outperform high capital-intensity firms, the mean return of Q1 should be consistently higher than Q5, and the difference in the mean should be statistically significant. Table 4.4

displays the results of the t-test conducted. The fourth column in the table shows the t-statistic computed for each year, and the fifth column displays the degrees of freedom of the test. The level of significance used in this study was 0.05. The p-value in the last column shows the probability of error associated with rejecting the null hypothesis of no difference between the two quintiles when, in fact, the hypothesis is true. A small p-value would indicate that there is a significant difference in the mean values of the two portfolios being compared. The years in which a p-value of less than 0.05 was observed, are highlighted in bold.

Table 4.4: The results of the Student's t-test on the differences in the mean value of Q1 and Q5

	Q1	Q5			
Year	**Mean**	**Mean**	**t-value**	**df**	**p**
1989	17.27	15.63	0.742	730	0.458
1990	14.93	13.69	0.502	789	0.616
1991	**-10.17**	**-4.46**	**-3.224**	**836**	**0.001**
1992	**-3.20**	**16.94**	**-3.287**	**852**	**0.001**
1993	**22.89**	**15.63**	**2.447**	**882**	**0.015**
1994	9.60	8.85	0.400	893	0.689
1995	8.09	12.37	-1.888	896	0.059
1996	22.06	18.25	1.560	910	0.119
1997	6.65	4.54	0.882	1046	0.378
1998	9.54	6.10	1.008	999	0.314
1999	**4.32**	**20.77**	**-4.052**	**935**	**0.000**
2000	**8.57**	**25.31**	**-3.220**	**858**	**0.001**
2001	**-13.70**	**-28.84**	**5.240**	**929**	**0.000**
2002	**-7.15**	**-19.01**	**4.742**	**979**	**0.000**
2003	**-3.44**	**4.69**	**-3.605**	**1030**	**0.000**
2004	**39.75**	**34.01**	**2.014**	**1029**	**0.044**
2005	**14.19**	**23.72**	**-4.116**	**1156**	**0.000**
2006	20.04	24.61	-1.865	1188	0.062
2007	**21.90**	**27.54**	**-2.402**	**1198**	**0.016**
2008	**-16.67**	**4.21**	**-9.032**	**1224**	**0.000**
2009	**-26.15**	**-37.65**	**7.723**	**1166**	**0.000**
2010	18.52	18.57	-0.019	830	0.985

The t-tests were conducted for each year from 1989 to 2010. In nine of the 22 years the mean returns between the quintiles were sufficiently similar to produce p-values in excess of 0.05, which means that there is a higher than 95 per cent chance that the returns were identical. If two portfolios were constructed based on capital intensity at the start of the particular year, there would be a 95 per cent chance that the total returns of the two portfolios would have been the same. Of the 13 years in which there was a significant difference in the mean returns, Q1 only outperformed Q5 in five of the years. Therefore, companies with low capital intensity significantly outperformed high capital-intensity companies in only five of the 22 years in the sample period. This does not constitute conclusive evidence of low capital intensity outperformance.

4.2.4 Skewness and kurtosis

The t-tests conducted in section 4.2.3 were subject to two conditions:

- the populations from which the samples were drawn were normal; and
- the variances of the two populations were approximately equal.

If these conditions were not met, the t-tests may not have been an appropriate measure to determine whether there was a significant difference between the quintiles over different time periods. The normality assumption was evaluated by calculating the skewness and kurtosis. Skewness is a statistic used to indicate whether a portfolio's probability distribution differs significantly from normality with respect to possible extreme values. If the distribution is symmetrical, like the normal distribution, this statistic will have a value of zero. Positive skewness indicates that extreme positive values in the distribution are more frequent than extreme negative ones (Bodie *et al.*, 2010:118). Kurtosis is a measure of shape, which indicates the degree of peakyness, or flat-toppedness, of a distribution relative to a normal distribution. The kurtosis of a normal distribution is three. Positive values above three indicate a higher frequency of extreme values to that of the normal distribution (Bodie *et al.*, 2010:118).

Table 4.5 shows the skewness and kurtosis of Q1 over the sample period. It is evident from the table that there are certain years, for instance 1993 and 1999, during which the skewness was larger than zero and the kurtosis much larger than 3, the value of a normal distribution. The maximum and minimum values for the quintile are shown to indicate the range of values around the mean. Extreme positive and negative observations can result in a high kurtosis measure. The median, or middle value in the quintile, is shown in the fourth column. If the median and mean values differ significantly, it also is an indication that the distribution of the quintile is not symmetric. Only a few years in the sample period registered skewness and kurtosis levels consistent with a normal distribution. The condition of normality for Q1 was not met for all the years in the sample period. The values in bold indicate years in which skewness and kurtosis were especially high.

Table 4.5: The results of the tests for normality of capital intensity for quintile 1

	Valid N	Mean	Median	Minimum	Maximum	Skewness	Kurtosis
1989	366	17.27	11.99	-63.60	182.10	1.26	3.79
1990	397	14.93	9.98	-87.81	255.85	1.47	6.39
1991	421	-10.17	-11.65	-84.56	162.04	1.13	5.58
1992	427	-3.20	-11.06	-70.70	208.20	1.39	3.60
1993	443	22.89	17.43	-84.44	713.02	**6.53**	**87.60**
1994	449	9.60	8.56	-69.92	150.18	0.55	2.17
1995	451	8.09	5.41	-66.74	181.77	1.15	2.94
1996	457	22.06	15.54	-74.36	304.33	1.64	7.31
1997	525	6.66	3.67	-74.67	361.67	1.82	9.78
1998	501	9.54	2.93	-89.85	570.21	2.77	**19.40**
1999	470	4.32	-3.69	-87.23	876.18	**7.32**	**92.91**
2000	430	8.57	-5.74	-96.55	592.34	**3.06**	**17.94**
2001	467	-13.70	-16.60	-96.73	141.47	0.42	-0.04
2002	491	-7.15	-8.14	-99.26	126.24	0.13	0.06
2003	517	-3.44	-3.45	-99.02	139.29	0.35	1.44
2004	516	39.75	34.83	-71.95	548.39	**3.56**	**36.22**
2005	581	14.19	11.01	-85.36	238.62	1.06	3.53
2006	595	20.04	15.77	-82.98	349.41	1.44	6.61
2007	602	21.90	17.77	-89.26	273.61	1.05	3.95
2008	613	-16.67	-19.67	-96.04	139.19	0.76	1.54
2009	584	-26.15	-26.42	-92.64	102.33	0.55	1.71
2010	416	18.52	17.71	-79.30	170.34	0.72	2.62

Table 4.6 shows the skewness and kurtosis of Q5 over the entire sample period. There are a number of years in which a high level of kurtosis was observed, indicating the presence of outliers. In 1992, 1996, 1999 and 2003 kurtosis was especially high, which means that a higher frequency of extreme values compared to a normal distribution was present. The skewness measure deviated from zero in many years, which leads to the conclusion that the normality assumption is not valid for Q5. The values in bold indicate years in which skewness and kurtosis were especially high.

Table 4.6: The results of the tests for normality of capital intensity for quintile 5

	Valid N	Mean	Median	Minimum	Maximum	Skewness	Kurtosis
1989	366	15.63	14.87	-59.21	158.04	0.94	2.71
1990	394	13.69	10.75	-78.45	179.35	1.01	3.46
1991	417	-4.46	-5.29	-91.70	203.22	1.25	9.76
1992	427	16.94	10.06	-79.82	2429.95	**18.50**	**368.05**
1993	441	15.63	13.41	-80.55	175.71	0.80	1.77
1994	446	8.85	4.24	-75.27	142.69	0.74	2.09
1995	447	12.37	9.94	-79.76	218.41	2.00	9.80
1996	455	18.25	16.91	-95.48	371.68	**3.11**	**29.26**
1997	523	4.54	2.03	-83.63	163.30	0.77	2.21
1998	500	6.10	4.13	-93.78	222.91	0.92	1.99
1999	467	20.77	7.91	-73.38	537.66	**3.88**	**23.61**
2000	430	25.31	3.53	-83.21	575.32	**2.89**	**11.34**
2001	464	-28.84	-28.09	-99.84	93.84	0.12	-0.84
2002	490	-19.01	-11.60	-99.91	107.61	-0.12	-0.35
2003	515	4.69	2.77	-97.07	462.93	**3.81**	**32.99**
2004	515	34.01	26.54	-87.61	403.82	**3.24**	**19.67**
2005	577	23.72	20.66	-76.84	263.23	1.29	5.79
2006	595	24.61	17.65	-74.80	247.16	1.47	3.98
2007	598	27.54	24.32	-85.17	382.19	**2.23**	**14.41**
2008	613	4.21	-2.05	-88.73	298.24	1.55	5.26
2009	584	-37.65	-38.00	-92.44	58.57	0.27	-0.01
2010	416	18.57	13.51	-78.19	190.03	1.06	2.58

The second condition that needs to be met in order for the t-test to be valid is that the variances of the two populations should be approximately equal. If the variances of Q1 and Q5 were approximately equal, column 3 in Table 4.7 below, which shows the difference between the standard deviations between Q1 and Q5, should be close to zero. As can be seen in the table, this was not the case for many years in the sample period. There are some years that register extreme differences in the calculated standard deviations, such as 1992 with a difference of -85.84, and 2000 with a difference of -19.69.

Table 4.7: Standard deviation of quintile 1 and quintile 5 over the sample period

	1	2	3
	Std. Dev.	Std. Dev.	
	Q1	Q5	Q1-Q5
1989	30.53	29.25	1.28
1990	35.85	33.42	2.44
1991	25.43	25.85	-0.42
1992	35.60	121.44	-85.84
1993	49.13	38.43	10.70
1994	27.59	28.44	-0.86
1995	35.10	32.77	2.33
1996	39.96	33.50	6.46
1997	43.15	33.76	9.39
1998	58.82	48.65	10.17
1999	61.20	63.04	-1.85
2000	65.77	85.46	-19.69
2001	44.72	43.46	1.27
2002	38.67	39.68	-1.02
2003	29.68	41.80	-12.12
2004	43.53	47.84	-4.31
2005	37.42	41.34	-3.92
2006	44.12	40.47	3.65
2007	39.71	41.61	-1.89
2008	33.73	46.24	-12.51
2009	24.66	26.21	-1.55
2010	32.16	37.78	-5.62

If the normality assumption is not met, the difference in the means between the two data groups is evaluated by using the non-parametric alternative to the t-test: the Mann-Whitney U test.

4.2.5 The Mann-Whitney U test

The non-parametric Mann-Whitney U test is often used to compare the sums of ranked data groups when the data sets do not have normal distributions. Observations are ranked, tied and averaged in order to determine the sum of ranks for the two samples. If

the sum of ranks is very different, the p-value will be small. A small p-value then leads to the rejection of the notion that the difference in medians is a coincidence. The conclusion can then be made that the populations have different median values. However, when a large p-value is observed, it cannot be stated that the median values differ (Sheskin, 2004:423; Motulsky, 1999).

Table 4.8 below shows the result of the Mann-Whitney U test conducted to compare the median returns of Q1 and Q5. In eight of the 22 years in the sample period, a p-value of higher than 5 per cent is observed, in these years the median values are similar. In the other 14 years, a small p-value is observed, which leads to the conclusion that during these years the quintiles had different median values. In only five of the 14 years did Q1 outperform Q5. A strategy focused on investing in low capital-intensity companies would only have meaningfully outperformed a strategy focused on investing in high capital-intensity firms in five years over the 22-year sample period.

Table 4.8: The results of the Mann-Whitney U test for quintile 1 and quintile 5

	Q1	Q5			Q1	Q5
	Rank Sum	Rank Sum	U	p-value	Valid N	Valid N
1989	134552	133726	66565	**0.885**	366	366
1990	157160	156076	78157	**0.987**	397	394
1991	163190	188351	74359	0.000	421	417
1992	154995	210091	63617	0.000	427	427
1993	205973	185197	87736	0.009	443	441
1994	204979	195981	96300	**0.322**	449	446
1995	193072	210579	91146	0.013	451	447
1996	211641	204687	100947	**0.448**	457	455
1997	276131	273545	136519	**0.875**	525	523
1998	252279	249223	123973	**0.780**	501	500
1999	197594	241859	86909	0.000	470	467
2000	173202	197028	80537	0.001	430	430
2001	236456	197390	89510	0.000	467	464
2002	258426	223245	102950	0.000	491	490
2003	250722	280243	117852	0.002	515	515
2004	283625	247340	114470	0.000	515	515
2005	305061	361374	138308	0.000	577	577
2006	343883	364763	166573	**0.078**	595	595
2007	340352	375454	161251	0.003	598	598
2008	321985	430166	133794	0.000	613	613
2009	384030	298666	127846	0.000	584	584
2010	176749	169780	83044	**0.315**	416	416
Totals	237548	245216				

4.2.6 Five-year holding period analysis

The first part of the study utilised annual rebalancing of the quintiles, which means that a one-year holding period was considered. If it is accepted that low capital-intensity firms will typically take longer than one year to show signs of superior performance compared to high capital-intensity firms, then longer holding periods should be considered. In an effort to address this mismatch, the research design was altered. This part of the study followed Lakonishok *et al.* (1994), and can be condensed into three basic steps. First, the sample of companies as of June 30, 1989 was divided into quintiles based on capital intensity. Second, the aggregate performance of each quintile was tracked for the next five years on

each 30 June. Finally, the first and second steps were repeated for each June from 1989 through 2005.

Firms with the lowest capital intensity were grouped into quintile 1. For each consecutive quintile, the capital intensity increased, culminating in stocks with the highest capital intensity forming quintile 5. This process created 5 separate portfolios, each with an inception date of June 30, 1989. From that date the performance for quintiles 1 through 5 was tracked over the subsequent five years. Additionally, new five-quintile sets were constructed as of June 29, 1990 and every subsequent June 30 through 2005. For each of these new sets, quintile-by-quintile performance was recorded for the five years after the inception date. After completing this process, 17 sets of quintiles had been created and five years of quintile-by-quintile performance for each one were tracked. Next, the performance data was averaged across the quintiles to compare low with high capital-intensity firms.

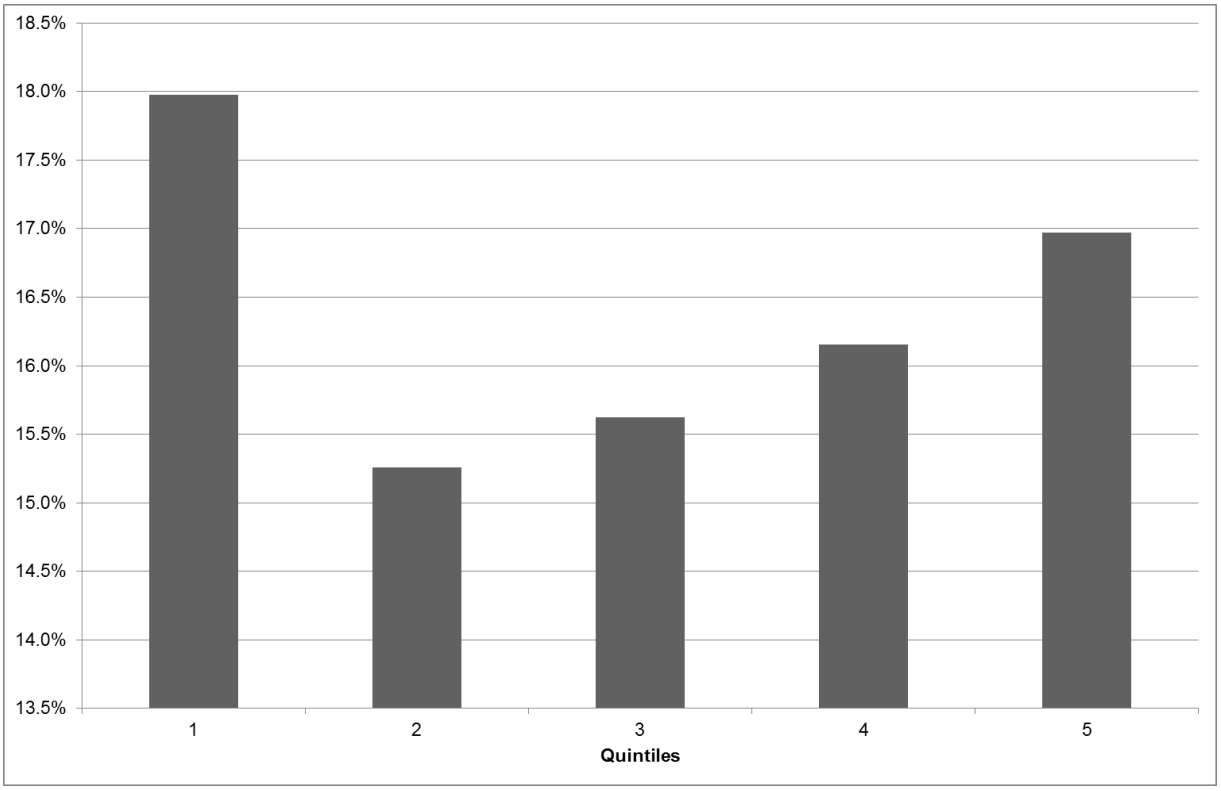

Figure 4.4: Average annualised five-year holding period returns for capital-intensity quintiles (June 1989 – June 2010)

As Figure 4.4 indicates, it was found that low capital-intensity firms outperformed higher capital-intensity firms. However, there was not a consistent decrease in performance. For capital intensity to conclusively indicate likely future performance, a monotonic decline in

performance should be witnessed along the quintiles. The difference in average annualised performance between quintile 1 and quintile 5 was 100 basis points (18.0 per cent versus 17.0 per cent), whereas the difference between quintile 1 and the worst performing quintile (Q2) was 270 basis points. It does, however, indicate that longer holding periods have a noteworthy effect when constructing portfolios based on capital intensity.

Table 4.9 shows the annualised returns for each of the 17 sets of portfolios created. It is clear that, although quintile 1 did have the highest overall average, it was not the top performer in every five-year period. In fact, for the portfolios commencing in 1989 through 1992, quintile 5 was the best performing quintile. There were eight five-year periods in which quintile 5 was the best performing quintile amongst the portfolios. In the table, the best performing quintile for each period is highlighted in bold.

Table 4.9: The annualised performance for each of the 17 sets of quintiles based on capital intensity

	Annualised Return				
Composition Date	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**
30/06/1989	11.40%	13.60%	12.10%	12.40%	**17.90%**
29/06/1990	11.70%	11.70%	12.10%	12.60%	**13.80%**
28/06/1991	9.10%	9.10%	12.80%	13.30%	**14.20%**
30/06/1992	18.80%	18.70%	19.60%	19.30%	**20.40%**
30/06/1993	**22.30%**	19.40%	21.30%	22.10%	18.80%
30/06/1994	**30.80%**	24.40%	24.70%	22.60%	17.70%
30/06/1995	**36.00%**	26.80%	22.50%	19.60%	22.50%
28/06/1996	**30.90%**	22.90%	21.30%	21.50%	22.80%
30/06/1997	**18.70%**	12.00%	12.70%	11.30%	16.60%
30/06/1998	**9.40%**	5.80%	5.40%	7.40%	8.80%
30/06/1999	3.80%	2.70%	3.70%	4.70%	**6.20%**
30/06/2000	**8.90%**	8.30%	8.50%	7.90%	5.60%
29/06/2001	**12.00%**	9.30%	8.40%	11.00%	9.40%
28/06/2002	18.60%	15.10%	16.90%	**19.40%**	18.10%
30/06/2003	30.30%	31.00%	27.90%	33.50%	**34.10%**
30/06/2004	26.10%	24.30%	30.20%	30.80%	**33.20%**
30/06/2005	6.80%	4.50%	5.40%	5.30%	**8.60%**
Mean	**18.00%**	15.30%	15.60%	16.20%	17.00%

4.3 RETURN ON CAPITAL EMPLOYED

The results obtained from the analysis of ROCE are outlined in the following section.

4.3.1 Compound annual growth

The cumulative performance of quintiles formed on the basis of ROCE is summarised in Table 4.10. The table shows the compound annual growth rate, standard deviation of returns and the returns per unit of risk for each quintile. Quintiles were formed using ROCE as selection criterion. The companies with the highest ROCE (the most favourable ratio) were assigned to quintile 1. For each consecutive quintile, ROCE ratios decreased, culminating in the lowest ROCE firms forming quintile 5. The 'Average' column refers to information for the average of the entire sample set. The column labelled 'Return Spread Portfolio' shows the results for a portfolio that employed a strategy focused on the annual return spread between quintile 1 and quintile 5 each year. The pattern is clear, with quintile 1 significantly outperforming all the other quintiles with a compound annual return of 9.97 per cent. Additionally, the performance tapers off as one progresses down the quintiles. Generally the low profitability quintiles have higher volatility, as shown by the computed standard deviation in Table 4.10. This is also reflected in the large differences in return-per-unit-of-risk figures. Q1 has the highest return per unit of risk of 0.69, and Q5 the lowest with 0.06. There is a clear outperformance of high profitability firms over low profitability firms.

Table 4.10: Relative performance of ROCE quintiles over the full sample period of 22 years (June 1989 – June 2010)

	Q1	Q2	Q3	Q4	Q5	Average	Return Spread Portfolio
CAGR	**9.97%**	9.08%	7.94%	3.88%	1.32%	6.72%	5.96%
Standard Deviation	14.48%	**13.47%**	14.74%	18.09%	22.76%	15.47%	15.36%
Return per unit of Risk	**0.69**	0.67	0.54	0.21	0.06	0.43	0.39

Figure 4.5 visually displays the relative performance of selected quintiles over time. The extent to which quintile 1 outperformed the other quintiles is evident. The underperformance of Q5 over the entire 22-year period as indicated in Figure 4.5,

produced a dismal 1.32 per cent CAGR compared to 9.97 per cent for Q1. The red line on the chart indicates the cumulative total return of a portfolio composed of the return spread between Q1 and Q5. This portfolio, which essentially went long Q1 and short Q5 each year, would have produced a compound annual return of 5.96 per cent, which is 76 basis points lower than the average of all the quintiles.

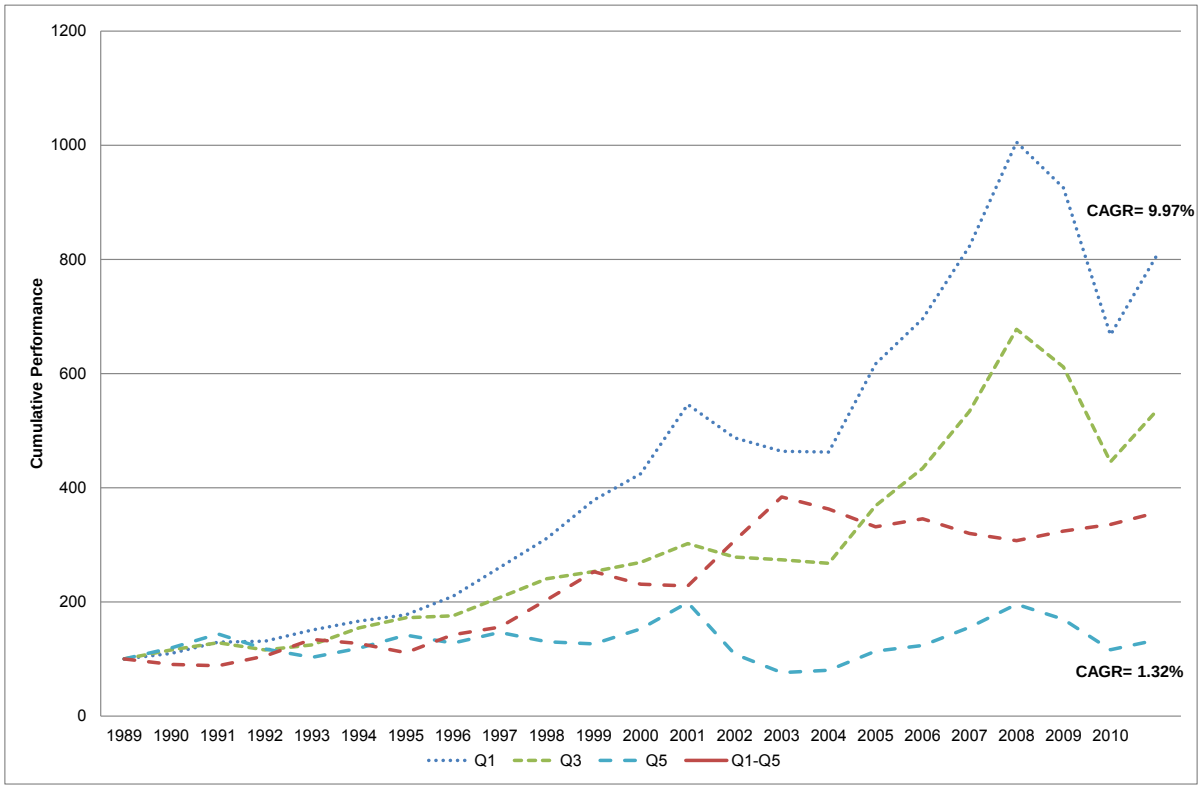

Figure 4.5: Cumulative performance of quintiles based on ROCE

In a sample period of over 20 years it is possible that structural changes in the global economy could have occurred. To determine whether the pattern of high ROCE firms outperforming their lower ROCE counterparts persisted, the analysis was repeated with a start date of June 2000, in effect testing whether the pattern would remain if the analysis had been started in 2000 instead of 1989. Portfolio performance of annually rebalanced quintiles was tracked and is presented in Table 4.11. The pattern of substantial outperformance of high ROCE quintiles is slightly less pronounced.

Table 4.11: The relative performance of ROCE quintiles over the most recent 10 years in the sample period (June 2001 – June 2010)

	Q1	Q2	Q3	Q4	Q5	Average	Return Spread Portfolio
CAGR	3.33%	**5.25%**	4.90%	4.07%	-3.26%	3.06%	3.80%
Standard Deviation	**18.90%**	19.12%	20.30%	21.73%	28.94%	21.32%	14.18%
Return per unit of Risk	0.18	**0.27**	0.24	0.19	-0.11	0.14	0.27

Quintile 1 (highest ROCE) did not perform best over the most recent 10-year period. However, quintile 5 still significantly underperformed relative to other quintiles. Quintile 5 registered a negative compound annual growth of -3.26 per cent, which was 632 basis points below the average compound growth rate of 3.06 per cent. So, although the highest ROCE firms did not perform best, it was still the least profitable firms that performed worst. This should make intuitive sense as one would expect that non-profitable firms would be avoided by investors.

Volatility as measured by standard deviation of returns increased incrementally from quintile 1 through quintile 5. Compared to the average standard deviation of all the quintiles, the standard deviation of quintile 1 was 2.42 percentage points lower, whereas the lowest ROCE quintile showed a standard deviation of 28.94 per cent (7.62 percentage points higher than the average).

Over 10 years, the relative return strategy (Q1 – Q5) delivered risk-adjusted performance in line with the best performing quintile (quintile 2 with a ratio of 0.27). This was mostly due to the significantly lower standard deviation of 14.18 per cent, compared with the average of above 20 per cent. As can be seen in Figure 4.6, the significant losses sustained by quintile 5 at the beginning of the decade increased the return spread between quintile 1 and quintile 5. This strategy would have worked extremely well for the first five years of the decade (2001 - 2005), producing a cumulative total return in excess of 50 per cent.

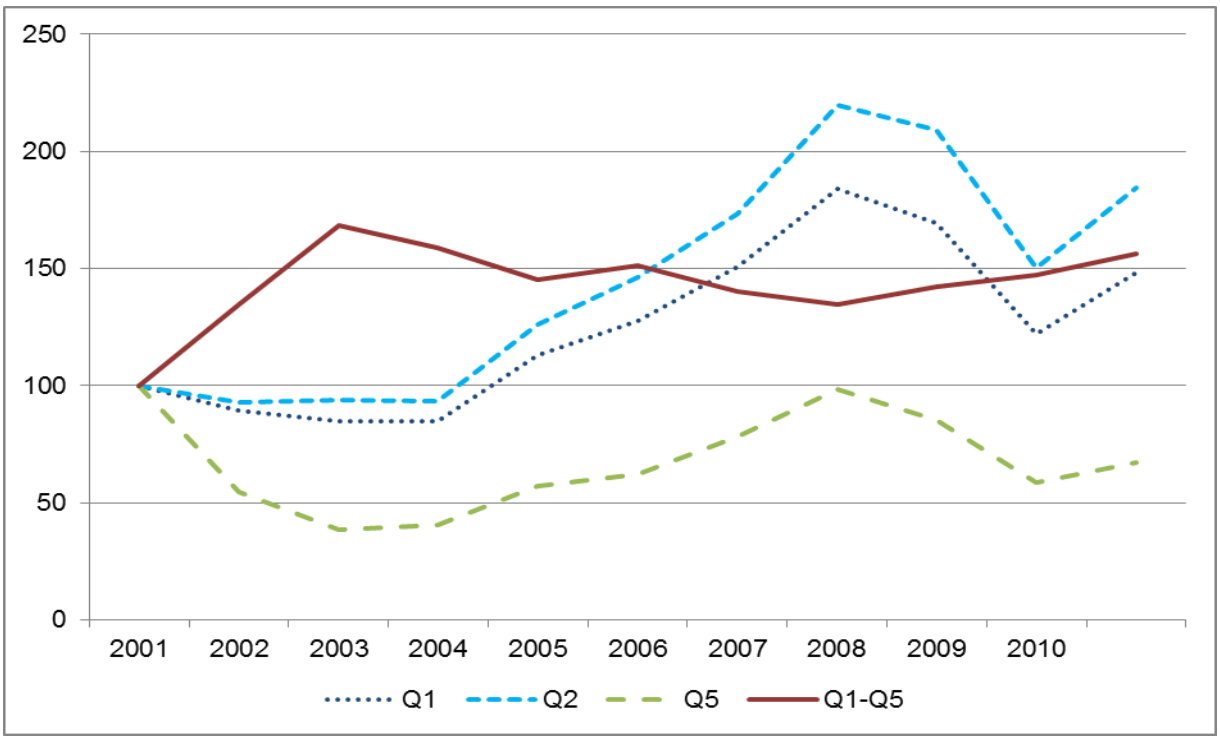

Figure 4.6: Cumulative performance of quintiles based on ROCE over most recent 10-year period (2001 – 2010)

4.3.2 Arithmetic average returns

The arithmetic average returns of the different quintiles over various sample periods paint a similar picture to the compound annual growth results. The different time periods refer to the most recent 3, 5, 10, 15, and 22 years ending June 2010.

Table 4.12: The arithmetic average return of quintiles based on ROCE of the most recent 3, 5, 10, 15 and 22 years

Averages	Q1	Q2	Q3	Q4	Q5	Average
3 years	-4.87%	-3.37%	-5.48%	-5.43%	-10.01%	-5.83%
5 years	5.16%	7.04%	6.68%	7.03%	4.35%	6.05%
10 years	5.62%	7.96%	7.72%	6.93%	0.24%	5.69%
15 years	10.81%	9.48%	9.00%	6.25%	3.60%	7.82%
22 years	10.97%	9.95%	8.95%	5.39%	4.00%	7.85%

It is apparent from both Table 4.12 and Figure 4.7 that there is a clear pattern of high ROCE outperformance over longer periods (15 and 22 years). Over the entire sample period of 22 years, there was a monotonic decline in performance from quintile 1 through quintile 5. Over the most recent shorter time periods the distinction became less

prominent, although it is seen that the lowest ROCE firms always underperformed. Quintile 5 underperformed the average of the quintiles by 418 basis points over the most recent three years and by 385 basis points over the entire 22 years. When the earlier years of the sample period are incorporated into the analysis, the effect of ROCE becomes more apparent.

As shown in Figure 4.7, a comparison of the past 15 years with the past 10 years shows a different pattern of returns across quintiles. Over the most recent 15 years quintile 1, on average, outperformed the average of all quintiles by 299 basis points (10.81% compared to 7.82%). However, over the most recent decade, quintile 1 actually underperformed the average by seven basis points on average. As would be expected, there appears to be a long-term constraint on a low ROCE firm's ability to generate consistently superior growth in shareholder value.

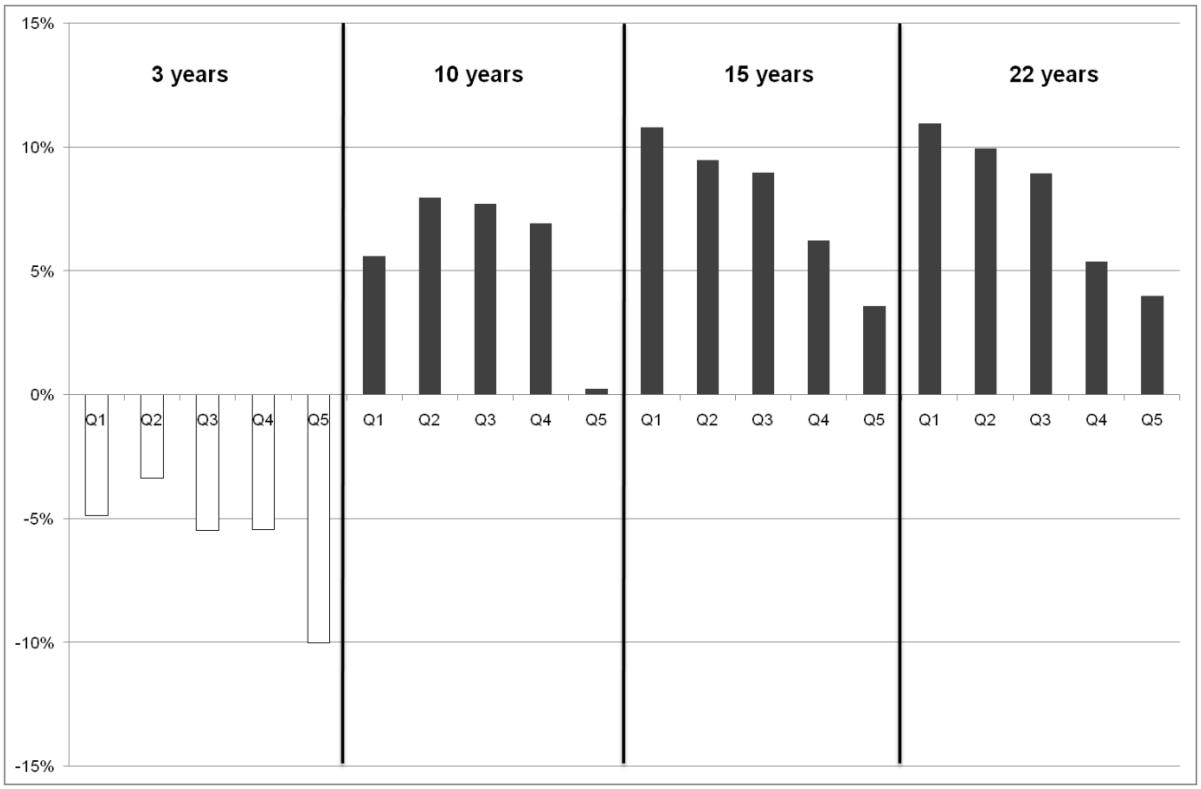

Figure 4.7: The average return of annually rebalanced quintiles based on returns on capital employed over different time periods

Figure 4.8 shows the annual deviation in returns between quintile 1 and quintile 5. Although there are large positive differences in the middle and latter part of the first decade of the sample period, the second decade paints a different picture.

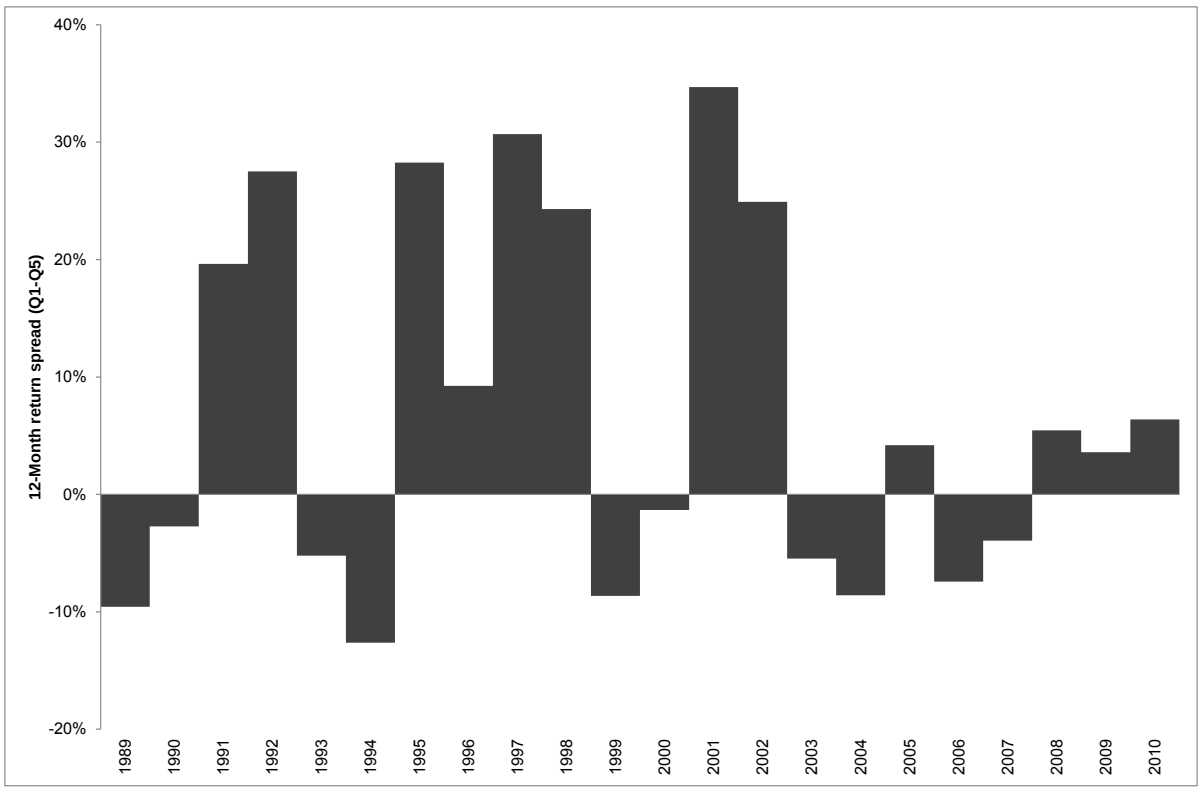

Figure 4.8: Quintile 1 versus Quintile 5 return spread over time over the entire sample period

In three of the first six years of the new millennium, quintile 5 did better than quintile 1. The extreme discrepancy in performance during the period 1999 to 2002 was probably due to investors favouring firms with higher operating profitability after the bursting of the global technology stock bubble in 2000. There was no sustained positive return spread between quintile 1 and quintile 5, as would have been expected.

4.3.3 Student's t-test

Table 4.13 shows the results of the t-test conducted to determine whether the observed differences between the means of Q1 and Q5 were statistically significant. In 17 of the 22 years in the sample period there were statistically significant differences between the means of Q1 and Q5 (highlighted in bold). In only 11 of the 17 years in which the difference in mean returns was significant, did Q1 outperform Q5. Therefore, high ROCE firms meaningfully outperformed firms with low ROCE ratios in 50 per cent of the years in the sample period.

Table 4.13: Results of the Student's t-test on the differences in the mean value of Q1 and Q5

	Q1	Q5			
Year	**Mean**	**Mean**	**t-value**	**df**	**p**
1989	**9.76**	**17.87**	**-3.575**	**730**	**0.000**
1990	17.31	19.97	-1.013	789	0.312
1991	**3.29**	**-16.86**	**10.928**	**836**	**0.000**
1992	**18.19**	**-1.19**	**8.434**	**852**	**0.000**
1993	8.4	12.02	-1.326	882	0.185
1994	**5.93**	**20.14**	**-6.967**	**893**	**0.000**
1995	**24.21**	**-2.84**	**11.533**	**896**	**0.000**
1996	**22.86**	**12.8**	**4.188**	**909**	**0.000**
1997	**19.74**	**-9.02**	**11.796**	**1046**	**0.000**
1998	**22**	**-1.04**	**6.376**	**999**	**0.000**
1999	**11.01**	**21.23**	**-2.591**	**935**	**0.010**
2000	26.64	30.54	-0.608	858	0.543
2001	**-9.58**	**-45.31**	**12.155**	**929**	**0.000**
2002	**-5.23**	**-30.01**	**10.137**	**979**	**0.000**
2003	**-0.25**	**5.06**	**-2.07**	**1030**	**0.039**
2004	**33.48**	**42.07**	**-2.912**	**1029**	**0.004**
2005	**12.69**	**8.18**	**2.133**	**1156**	**0.033**
2006	**18.14**	**25.6**	**-3.108**	**1188**	**0.002**
2007	22.26	26.4	-1.68	1198	0.093
2008	**-8.03**	**-13.17**	**2.197**	**1223**	**0.028**
2009	-27.83	-30.78	1.791	1168	0.074
2010	**21.13**	**14.88**	**2.467**	**830**	**0.014**

4.3.4 Skewness and kurtosis

Following on the explanation in section 4.2.4 of the conditions for the validity of the t-tests conducted, it was necessary to perform similar tests for the ROCE portfolios. To determine whether the normality assumption was violated, the skewness and kurtosis of quintile 1 and quintile 5 were computed for each year. Table 4.14 contains the output of the skewness and kurtosis computation for quintile 1 over the sample period.

Table 4.14: Result of the tests for normality of ROCE quintile 1

	Valid N	Mean	Median	Minimum	Maximum	Skewness	Kurtosis
1989	397	17.31	15.80	-78.45	208.68	0.86	3.90
1990	421	3.29	3.38	-83.30	162.04	0.66	2.90
1991	421	3.29	3.38	-83.30	162.04	0.66	2.90
1992	427	18.19	17.33	-68.54	208.20	0.59	2.17
1993	443	8.40	3.74	-84.44	260.00	1.99	**8.12**
1994	449	5.93	4.35	-81.37	109.62	0.28	0.96
1995	451	24.21	16.95	-60.85	227.42	1.57	4.50
1996	457	22.86	19.06	-74.36	213.76	1.00	2.73
1997	525	19.74	16.42	-85.63	361.67	1.54	**8.52**
1998	501	22.00	16.71	-93.78	277.98	0.96	2.37
1999	470	11.01	2.80	-80.33	318.55	1.59	5.18
2000	430	26.64	-1.67	-84.62	502.97	2.49	**8.35**
2001	467	-9.59	-13.62	-93.18	265.29	1.06	3.10
2002	491	-5.23	-4.35	-93.67	118.24	0.22	0.49
2003	517	-0.25	-1.50	-88.24	201.78	0.69	4.33
2004	516	33.48	27.58	-57.00	239.33	1.25	3.50
2005	581	12.69	10.80	-76.77	185.97	0.56	1.66
2006	595	18.14	13.73	-70.95	349.41	1.82	**9.28**
2007	602	22.26	18.08	-89.26	377.94	2.14	**13.99**
2008	612	-8.03	-11.86	-92.33	276.84	1.62	**7.30**
2009	586	-27.83	-28.21	-89.12	78.61	0.32	0.58
2010	416	21.14	19.39	-61.52	209.11	1.06	4.25

Skewness was larger than zero and the kurtosis much larger than 3, the values of a normal distribution in a number of years. The maximum and minimum values for the quintile are shown to indicate the range of values around the mean. Extreme positive and negative observations can result in a high kurtosis measure. The median, or middle value in the quintile, is shown in the fourth column. If the median and mean values differ significantly, it is also an indication that the distribution of the quintile is not symmetric. Only a few years in the sample period registered skewness and kurtosis levels not consistent with a relatively normal distribution. Although the condition of normality was not met for all the years in the sample period, the number of extreme deviations from normality is few. The values in bold indicate years in which kurtosis was relatively high.

Table 4.15: **Result of the tests for normality of ROCE quintile 5**

	Valid N	Mean	Median	Minimum	Maximum	Skewness	Kurtosis
1989	394	19.98	13.4	-87.81	179.35	0.91	1.75
1990	417	-16.86	-17.36	-92.86	73.98	0.47	2.63
1991	417	-16.86	-17.36	-92.86	73.98	0.47	2.63
1992	427	-1.19	-3.68	-73.21	145.64	0.98	2.08
1993	441	12.02	7.72	-97.86	160.88	0.61	0.79
1994	446	20.14	15.64	-60.22	186.18	1.05	3.71
1995	447	-2.84	-7.17	-78.37	208.77	1.38	5.7
1996	454	12.8	10.78	-95.48	145.77	0.51	2.45
1997	523	-9.02	-15.8	-83.63	166.06	1.21	2.71
1998	500	-1.04	-12.18	-97.49	570.21	2.54	**15.67**
1999	467	21.23	6.88	-78.1	544.88	**3.64**	**19.76**
2000	430	30.54	3.28	-95.32	592.34	2.84	**10.4**
2001	464	-45.31	-51.03	-99.84	193.91	1.05	1.94
2002	490	-30.01	-28.22	-99.91	170.04	0.53	0.43
2003	515	5.06	-4.57	-97.07	462.93	2.83	**16.46**
2004	515	42.07	33.83	-81.2	548.39	2.74	**17.95**
2005	577	8.18	5.34	-76.84	238.62	0.97	3.1
2006	595	25.6	20.6	-82.98	247.16	1.05	3.3
2007	598	26.4	21.46	-85.17	312.11	1.81	8.01
2008	613	-13.17	-17.28	-96.92	298.24	2.29	**11.68**
2009	584	-30.78	-32.85	-96.07	133.58	0.49	0.93
2010	416	14.88	10.19	-79.3	186.19	0.81	1.55

Table 4.15 contains the results of the skewness and kurtosis tests for quintile 5 over the 22-year sample period. In many years in the sample period the conditions for normality were not present. The years highlighted in bold show particularly high values of kurtosis. Although the skewness measure never reached the extreme values observed in the capital-intensity quintiles, it still deviated from zero during many years in the sample period. The observed differences in the mean and median figures are also an indication that the conditions for normality were not met for quintile 5.

In order to confirm that the t-test is not the most appropriate test to use, the variances of the quintile 1 and quintile 5 were compared, as shown in Table 4.16. The t-test can be used to compare the means of two sets of data if the additional condition of similar variances is adhered to. The differences in the standard deviation of the quintiles for each year are shown in column 3. If the variances of the quintiles were consistently similar over the sample period, a value close to zero would be observed in column 3. This, however, is

not the case, which confirms that the t-test is not the most appropriate measure to test the differences in the mean values observed. A non-parametric test, like the Mann-Whitney U test would be more appropriate.

Table 4.16: Standard deviation of quintile 1 and quintile 5 over the sample period

	1	2	3
	Std. Dev.	Std. Dev.	
	Q1	Q5	Q1-Q5
1989	26.558	34.340	-7.78
1990	34.319	39.557	-5.24
1991	29.881	23.026	6.85
1992	34.402	32.705	1.70
1993	39.529	41.474	-1.94
1994	29.315	31.674	-2.36
1995	39.588	29.975	9.61
1996	41.128	30.569	10.56
1997	43.360	35.120	8.24
1998	51.811	62.049	-10.24
1999	49.130	69.854	-20.72
2000	87.589	100.079	-12.49
2001	45.730	43.929	1.80
2002	32.915	42.995	-10.08
2003	29.352	50.332	-20.98
2004	38.025	55.136	-17.11
2005	33.091	38.646	-5.56
2006	40.776	42.090	-1.31
2007	39.423	45.798	-6.37
2008	39.114	42.652	-3.54
2009	24.414	31.455	-7.04
2010	31.660	40.934	-9.27

4.3.5 The Mann-Whitney U test

A Mann-Whitney U test for the difference in the mean returns of quintile 1 and quintile 5 was conducted for each year in the sample period. The results are summarised in Table 4.17 below. The years highlighted in bold were years in which a p-value of higher than zero was calculated. A p-value of zero indicated that the difference in median returns was not a coincidence. The conclusion could then be made that the populations had different median values. As can be seen in Table 4.17, the median returns of the two quintiles were only statistically identical in six of the 22 years. Of the other 16 years where a statistically significant difference was observed, 12 years showed a higher median return for Q1. This result strengthens the argument for using ROCE as a metric in portfolio construction.

Table 4.17: **The results of the Mann-Whitney U test for quintile 1 and quintile 5**

	Q1	Q5			Q1	Q5
	Rank Sum	**Rank Sum**	**U**	**p-value**	**Valid N**	**Valid N**
1989	125924	142355	58763	0.004	366	366
1990	157147	156089	78144	**0.984**	397	394
1991	216480	135061	47908	0.000	421	417
1992	214528	150557	59179	0.000	427	427
1993	190192	200978	91846	**0.124**	443	441
1994	174763	226198	73738	0.000	449	446
1995	248761	154890	54762	0.000	451	447
1996	223803	191613	88328	0.000	457	454
1997	336755	212922	75896	0.000	525	523
1998	288045	213456	88206	0.000	501	500
1999	213215	226238	102530	**0.082**	470	467
2000	182805	187425	90140	**0.526**	430	430
2001	266597	167250	59370	0.000	467	464
2002	284873	196798	76503	0.000	491	490
2003	268978	261987	129117	**0.464**	515	515
2004	253530	277435	120660	0.012	515	515
2005	348364	318071	151318	0.007	577	577
2006	333147	375498	155837	0.000	595	595
2007	350885	364921	171784	**0.240**	598	598
2008	393069	356631	169053	0.003	612	612
2009	353672	329024	158204	0.033	584	584
2010	185551	160978	74242	0.000	416	416
Totals	255049	227562				

4.3.6 Five-year holding period analysis

Using the same methodology as in section 4.2.6, quintiles were created on the basis of ROCE. Starting in June 30, 1989, the sample of companies was divided into quintiles with the highest ROCE companies grouped into quintile 1. For each consecutive quintile, ROCE decreased, culminating in the lowest ROCE firms forming quintile 5. Again this created 17 sets of 5 separate portfolios each. The subsequent five-year total return was recorded for each quintile and then annualised.

Figure 4.9 shows that there is a pattern of high ROCE companies outperforming low ROCE companies. Average annualised five-year returns for low ROCE quintiles were lower than returns for quintiles at the high end of the ROCE spectrum. Quintile 1 exceeded the annualised returns of quintile 5 by 620 basis points (20.6% versus 14.4%).

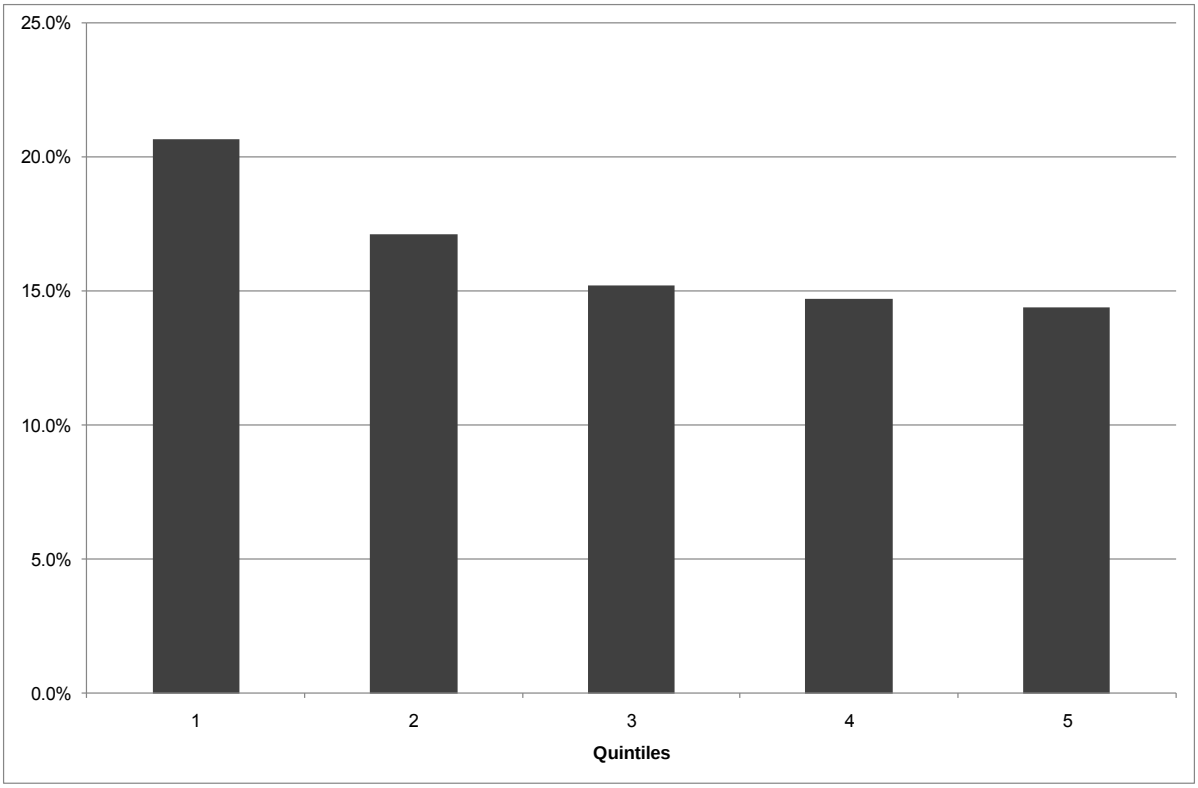

Figure 4.9: The average annualised return for ROCE quintiles over five-year holding periods

Although Figure 4.9 indicates that high ROCE companies were able to produce higher average returns, it does not indicate how consistent high profitability outperformance was from one five-year period to the next. It is not clear from Figure 4.9 whether an investment strategy based on ROCE would have delivered meaningful results if it were started at different intervals over the 22-year sample period.

From Table 4.18 below, it is evident that this outperformance was not persistent during the latter half of the sample period (1999 – 2010).

Table 4.18: The annualised performance for each of the 17 sets of quintiles based on ROCE

	Annualised Return				
Composition Date	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**
30/06/1989	**18.6%**	12.0%	15.6%	10.1%	10.9%
29/06/1990	**15.5%**	13.3%	10.1%	11.5%	11.4%
28/06/1991	**18.2%**	12.2%	10.4%	9.5%	8.3%
30/06/1992	**24.4%**	23.1%	17.6%	18.0%	13.7%
30/06/1993	**25.9%**	23.3%	18.7%	17.3%	18.7%
30/06/1994	**40.2%**	23.8%	23.2%	15.6%	17.5%
30/06/1995	**40.7%**	30.1%	21.3%	24.0%	11.1%
28/06/1996	**43.5%**	24.4%	19.4%	15.0%	17.1%
30/06/1997	**28.0%**	13.8%	11.0%	8.5%	10.1%
30/06/1998	**11.5%**	9.3%	6.7%	4.6%	4.7%
30/06/1999	**5.8%**	3.1%	3.1%	4.0%	5.1%
30/06/2000	7.2%	8.4%	7.7%	**8.9%**	7.1%
29/06/2001	7.7%	11.7%	**12.3%**	11.3%	7.0%
28/06/2002	13.4%	18.5%	17.9%	18.1%	**20.1%**
30/06/2003	25.2%	31.7%	28.7%	31.9%	**39.4%**
30/06/2004	19.4%	26.8%	29.2%	**34.7%**	34.5%
30/06/2005	5.7%	5.0%	5.4%	7.1%	**7.4%**
Mean	**20.6%**	**17.1%**	**15.2%**	**14.7%**	**14.4%**

The best performing quintile over each five-year period is highlighted in Table 4.18. For the first decade of the sample period, quintile 1 notably and consistently outperformed other quintiles. This pattern almost completely reversed during the latter years of the sample period, where it was the lower ROCE quintiles that performed best.

4.4 COMBINING BOTH CAPITAL INTENSITY AND ROCE

The following section outlines the results obtained from the analysis of a combination of both capital intensity and ROCE.

4.4.1 Matrix analysis with a focus on Box 1 and Box 25

The third phase of the study involved incorporating both capital intensity and ROCE in the portfolio composition process. Following the methodology described in Chapter 3, a matrix was created by using capital intensity as a primary filter and ROCE as a secondary filter. The result was 25 boxes or 25 different portfolios. The annual return of equally weighted portfolios was calculated for Box 1 (which contained the highest ROCE firms within the lowest capital-intensity quintile) and Box 25 (which contained the lowest ROCE firms within the highest capital-intensity quintile). Each portfolio was rebalanced annually at the end of June and the subsequent 12-month total return was recorded. Table 4.19 shows the annual returns of Box 1 (B1), Box 25 (B25) and the return spread (B1-25), over the entire sample period.

Table 4.19: Annual return of Box 1 (B1) and Box 25 (B25) of the constructed matrix, over the entire sample period

Year	B1	B25	B1-B25
1989	10.07%	14.06%	-3.99%
1990	14.89%	19.91%	-5.02%
1991	4.18%	-12.94%	17.12%
1992	14.75%	5.90%	8.85%
1993	9.88%	11.85%	-1.97%
1994	-0.34%	18.29%	-18.63%
1995	23.59%	4.72%	18.87%
1996	25.50%	11.80%	13.70%
1997	26.44%	-8.69%	35.13%
1998	34.09%	8.00%	26.09%
1999	5.28%	44.21%	-38.92%
2000	20.99%	53.74%	-32.75%
2001	-20.35%	-67.73%	47.38%
2002	-5.82%	-58.65%	52.82%
2003	0.97%	18.90%	-17.93%
2004	39.68%	37.26%	2.42%
2005	8.04%	-0.94%	8.98%
2006	23.13%	28.01%	-4.88%
2007	12.96%	19.59%	-6.63%
2008	-19.80%	-8.32%	-11.48%
2009	-27.02%	-43.43%	16.41%
2010	17.63%	17.02%	0.61%
Average	**9.94%**	**5.12%**	**4.83%**

During the period 1988 – 2010, Box 1 only performed better than Box 25 a total of 12 times, thus Box 25 surprisingly fared better in 10 out of the 22 years. However, the arithmetic average return for B1 over the entire sample period was 9.94 per cent, which was 483 basis points above the average annual return of B25 (5.12%).

4.4.2 Compound annual growth

As shown in Table 4.20 below, the compound annual growth of B1 (8.51%) was significantly higher than B25 (-0.67%). The difference in return per unit of risk was even more pronounced, as the standard deviation of B25 (30.1%) was significantly higher than that of B1 (17.24%). B25, which contained firms with the 'worst' metrics, produced the lowest returns over the sample period. Investing in these firms actually would have

destroyed shareholder wealth over the 22-year period. The Return Spread Portfolio, which is essentially a portfolio that goes long B1 and short B25 each year, delivered a compound annual growth rate of 2.33 per cent over the sample period.

The return per unit of risk was the highest for B1 with 0.5. The negative CAGR for B25 resulted in a negative return per unit of risk of -0.02 for B25. The MSCI World TR Index registered a return per unit of risk 0.35.

Table 4.20: The performance of Box 1, Box 25 and the MSCI World TR index over the entire sample period

	B1	B25	Return Spread Portfolio (B1-B25)	MSCI World TR
CAGR	8.51%	-0.67%	2.33%	5.69%
Standard Deviation	17.24%	30.10%	23.10%	14.75%
Return per unit of Risk	0.5	-0.02	0.1	0.35

As can be seen in Figure 4.10, B1 performed better than the MSCI World Total Return Index, which produced a CAGR of 5.69 per cent over the comparable period. Although the MSCI World TR had a lower standard deviation (14.75%) compared to that of B1 (17.24%), the return per unit of risk of B1 (0.50) was still higher compared to the Index (0.35).

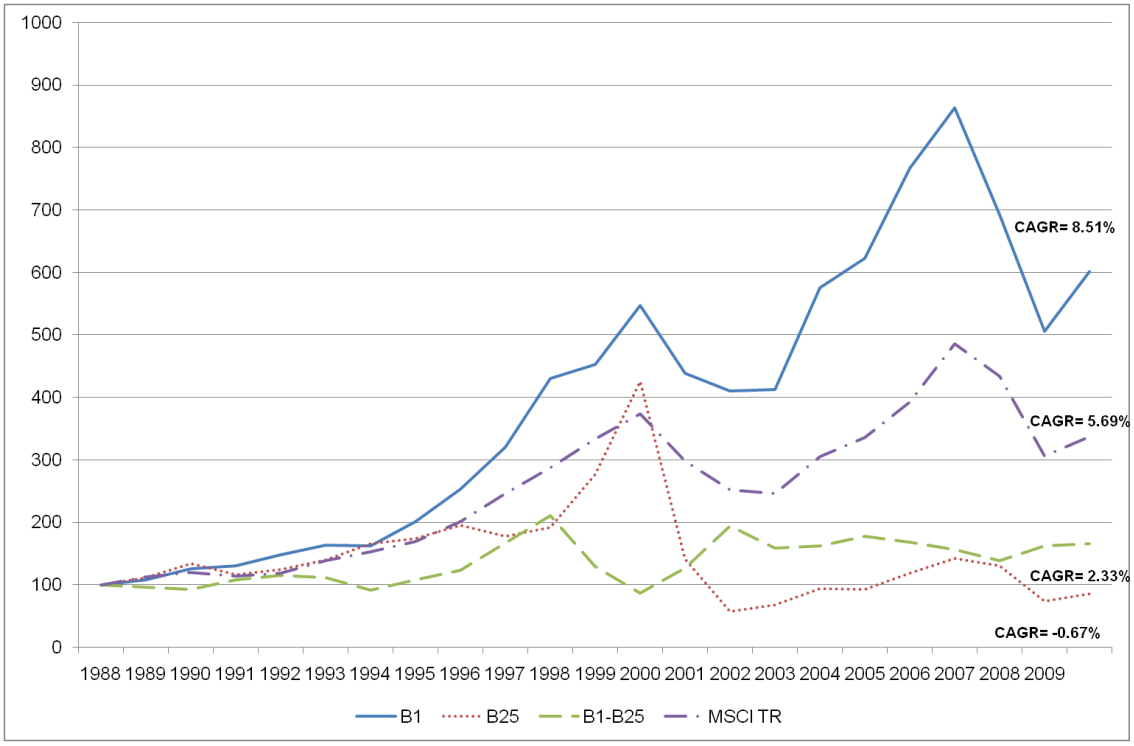

Figure 4.10: The cumulative performance of Box 1, Box 25 and B1-B25

Although B1 on average outperformed B25, it is evident from Figure 4.11 that this outperformance did not occur on a consistent basis. Theoretically, B1 should have performed better than B25 on a consistent basis, as B1 not only contained firms that have had a low dependency on physical assets, but also firms that have been well managed in terms of operational profitability. B25, on the other hand, contained firms that rely heavily on physical capital as measured by capital intensity, as well as those that have poor ROCE ratios.

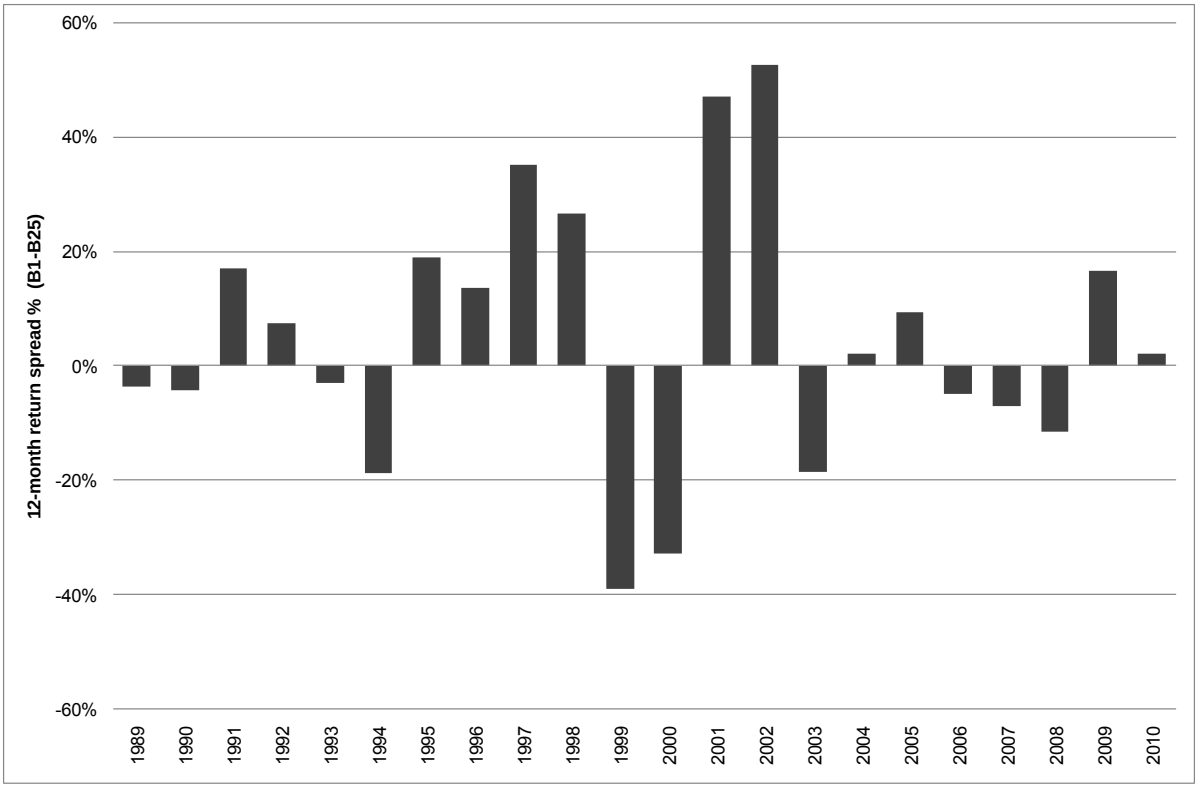

Figure 4.11: Capital intensity and ROCE matrix 12-month return spread (B1 – B25)

Counter-intuitively there were extreme fluctuations prevalent in the return spread over the 22-year sample period. The period 1998 to 1999 in particular saw an extreme deviation from the positive trend in the spread with -39 per cent and -33 per cent for 1999 and 2000 respectively. The following years (2001 to 2002) showed a return to positive territory as the technology bubble burst and there was a return to 'sanity' in the financial markets. However, the following eight years provided no discernible pattern in the return spread. This led to the conclusion that one cannot rely on the consistent outperformance of B1 over B25 on an annual basis. It must be emphasised that the portfolios were rebalanced on an annual basis, so a one-year time horizon perhaps is not sufficient to allow for significant results to be observed.

4.4.3 Arithmetic mean returns

The average returns over different time periods are shown in Table 4.21.

Table 4.21: **The arithmetic average annual return of the most recent 3, 5, 10, 15, and 22 years for Box 1, Box 25 and B1-B25**

Averages	B1	B25	B1-B25
3 years	-9.73%	-11.58%	1.85%
5 years	1.38%	2.57%	-1.19%
10 years	2.94%	-5.83%	8.77%
15 years	9.45%	3.38%	6.06%
22 years	9.94%	5.12%	4.83%

The average returns over different time periods are shown in Table 4.21. Box 1 fared better than Box 25 over all time periods except for the past five years. During the period 2005 to 2010, B25 outperformed the average return of B1 by 119 basis points. The largest difference in average performance was over the past decade, during which the spread amounted to 877 basis points.

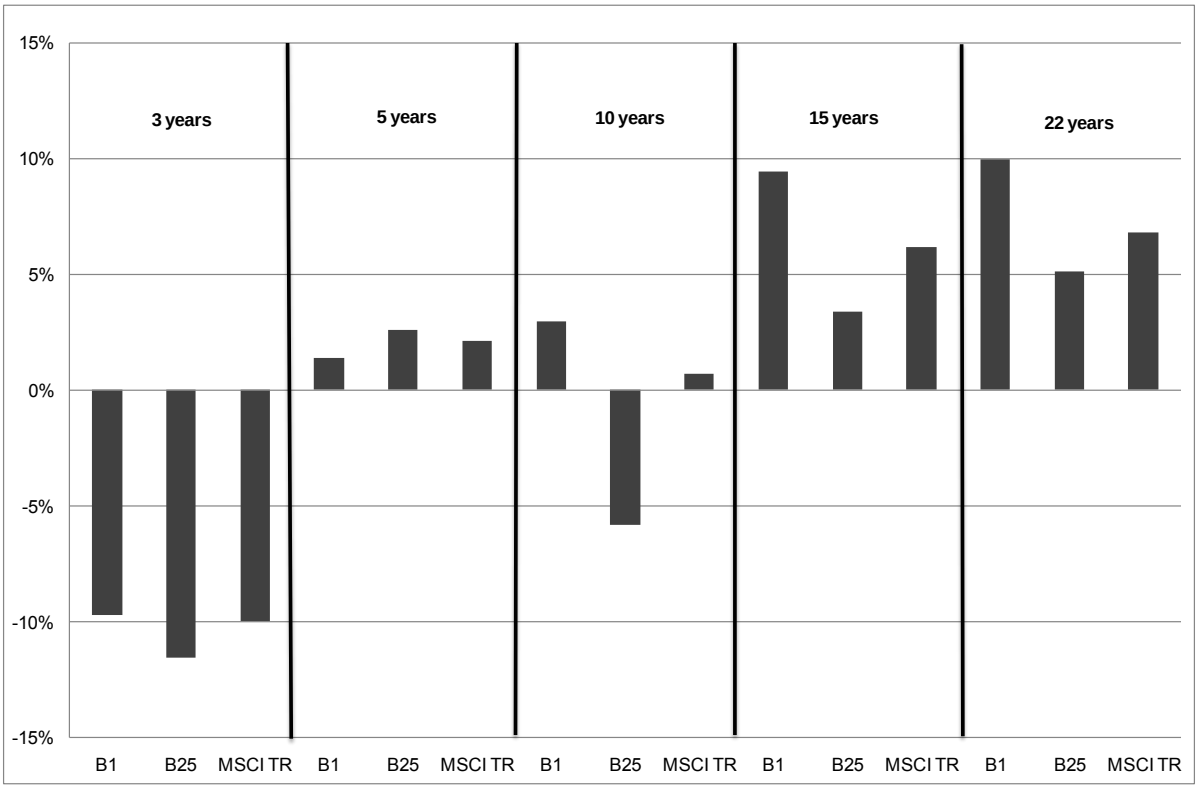

Figure 4.12: The average return of annually rebalanced portfolios based on capital intensity and ROCE over different time periods, compared to the MSCI World TR Index

As shown in Figure 4.12, the performance of B1 compared favourably to B25 and the MSCI World TR Index, outperforming over all time periods but one. The results for the period 2005 to 2010 are counter-intuitive, as a portfolio composed of firms with the highest capital intensity and lowest ROCE performed better on average than a portfolio comprising the least capital-intensive firms with high operating profitability. Additionally, B25 outperformed the MSCI World TR Index on average over the most recent five-year period.

Over the most recent decade, B25 realised an average return of -5.83 per cent, mostly due to large negative returns in 2001 (-67.7%), 2002 (-58.7%) and 2009 (-43.4%). The superior average performance of B1 suggests that there is evidence to support a focus on capital intensity and ROCE in the investment decision process.

4.4.4 Student's t-test

To determine whether the difference in the mean returns between B1 and B25 were statistically significant, t-tests were conducted. The results of the t-tests are summarised in Table 4.21 below. Statistically significant differences in the mean returns were observed in only 13 of the 22 years in the sample period. These years are highlighted in bold. Of the 13 years in which a significant difference was observed, only eight showed a higher return for B1. This result reduces the strength of the argument in favour of using a combination of capital intensity and ROCE as filters for portfolio construction.

Table 4.22: Results of the Student's t-test on the differences in the mean value of B1 and B25

	Box 1	Box 25			
	Mean	Mean	t-value	df	p
1989	8.712	12.402	-0.768	144	0.444
1990	15.426	19.680	-0.704	158	0.482
1991	**4.057**	**-12.880**	**3.814**	**168**	**0.000**
1992	13.935	6.546	1.180	170	0.239
1993	9.933	12.886	-0.438	176	0.662
1994	**-0.336**	**18.296**	**-3.602**	**178**	**0.000**
1995	**23.768**	**4.827**	**3.198**	**180**	**0.002**
1996	**25.596**	**11.892**	**2.267**	**182**	**0.025**
1997	**26.439**	**-8.690**	**5.386**	**208**	**0.000**
1998	**34.299**	**7.732**	**3.035**	**200**	**0.003**
1999	**5.283**	**44.207**	**-3.408**	**186**	**0.001**
2000	**20.991**	**53.741**	**-1.978**	**170**	**0.050**
2001	**-19.919**	**-66.885**	**8.613**	**186**	**0.000**
2002	**-6.435**	**-59.057**	**10.012**	**196**	**0.000**
2003	**0.653**	**19.105**	**-2.392**	**206**	**0.018**
2004	39.438	37.218	0.282	206	0.778
2005	8.105	-1.351	1.737	232	0.084
2006	23.127	28.011	-0.709	236	0.479
2007	12.685	19.612	-1.258	240	0.210
2008	**-19.800**	**-8.321**	**-2.134**	**244**	**0.034**
2009	**-26.982**	**-43.566**	**4.790**	**234**	**0.000**
2010	19.021	16.795	0.360	168	0.720

4.4.5 Skewness and kurtosis

The t-test conducted in section 4.4.4 explicitly assumed that the returns in both portfolio B1 and B25 follow a normal distribution for every year in the sample period. In order to use the results of the t-test with confidence, it is necessary to conduct tests for the normality of the return distribution for each portfolio, for every year in the sample period. Table 4.23 provides the results of the tests for skewness and kurtosis for Box 1 over the entire sample period. Although there were not many instances of extreme deviations from normality, there were a few years in which a skewness measure in excess of zero and a kurtosis measure well in excess of three were registered. These instances are highlighted in bold in Table 4.23. The range of values of the returns for each year is indicated in the minimum and maximum columns. It is clear that there are instances where extreme outliers were

present relative to the median values. These outliers would have had a definitive impact on both the skewness and kurtosis measure, thereby impacting the normality of the return distribution every year.

Table 4.23: The results of the tests for normality of Box 1 of the matrix

	Valid N	Mean	Median	Minimum	Maximum	Skewness	Kurtosis
1989	74	10.07	4.85	-63.6	109.51	0.66	1.43
1990	80	15.43	15.69	-67.12	97.12	-0.19	0.18
1991	**85**	**4.06**	**4.93**	**-65.84**	**162.04**	**1.56**	**7.17**
1992	86	13.93	11.72	-55.03	208.2	1.35	4.39
1993	89	9.93	2.77	-68.24	161.47	1.9	4.35
1994	90	-0.34	-4.27	-69.92	109.62	0.5	0.86
1995	91	23.77	14.15	-60.85	181.77	1.46	2.91
1996	92	25.6	23.04	-74.36	177.27	0.72	1.14
1997	**105**	**26.44**	**18.54**	**-69.96**	**361.67**	**2.45**	**11.77**
1998	101	34.3	27.46	-85.36	216.13	0.66	0.42
1999	94	5.28	0.59	-80.33	186.48	1.03	1.54
2000	86	20.99	-0.62	-84.62	321.04	1.21	2.41
2001	94	-19.92	-28.53	-92.15	99.04	0.49	-0.35
2002	99	-6.43	-9.36	-93.67	118.24	0.3	0.26
2003	104	0.65	1.43	-88.24	75.16	-0.16	0.23
2004	104	39.44	31.3	-37.47	222.02	1.27	2.6
2005	117	8.1	7.35	-76.77	98.67	0.15	-0.44
2006	**119**	**23.13**	**21.69**	**-62.95**	**349.41**	**2.28**	**11.03**
2007	121	12.69	10.83	-89.26	168.67	0.56	2.13
2008	123	-19.8	-23.21	-90.56	65.86	0.31	-0.56
2009	118	-26.98	-27.21	-83.58	36.36	0.23	-0.27
2010	84	19.02	19.17	-61.52	134.7	0.47	1.6

The results of the tests for skewness and kurtosis for portfolio B25 are given in Table 4.24. There were a few instances of high skewness, with only one year in which skewness was as high as 3. There were at least five years in the sample period in which high levels of kurtosis were present. These years are indicated in bold in Table 4.24. High kurtosis indicates the presence of outliers in the data, and suggests that a non-parametric test of the average returns between the portfolios would have been more appropriate than a t-test.

Table 4.24: The results of the tests for normality of Box 25 of the matrix

	Valid N	Mean	Median	Minimum	Maximum	Skewness	Kurtosis
1989	74	14.02	10.49	-48.87	131.86	0.85	1.21
1990	80	19.68	15.61	-62.66	179.35	1.13	2.72
1991	85	-12.88	-16.04	-91.70	73.74	0.55	1.87
1992	86	6.55	6.09	-73.21	140.00	1.08	2.12
1993	89	12.89	6.57	-76.52	160.88	0.95	1.57
1994	90	18.30	14.60	-60.22	142.69	0.76	1.98
1995	**91**	**4.83**	**-1.63**	**-58.33**	**208.77**	**2.22**	**10.12**
1996	92	11.89	9.85	-95.48	108.73	0.07	1.03
1997	105	-8.69	-10.37	-83.63	136.06	0.97	2.32
1998	101	7.73	-1.79	-90.53	222.91	1.34	2.23
1999	**94**	**44.21**	**14.56**	**-65.63**	**537.66**	**2.66**	**9.39**
2000	86	53.74	15.32	-83.21	575.32	1.93	3.83
2001	94	-66.89	-76.39	-99.83	38.15	1.01	0.38
2002	99	-59.06	-67.33	-99.91	52.87	1.28	1.48
2003	**104**	**19.10**	**5.13**	**-80.70**	**462.93**	**3.00**	**14.29**
2004	**104**	**37.22**	**22.75**	**-81.20**	**377.24**	**2.04**	**6.88**
2005	117	-1.35	-2.97	-76.84	161.57	1.01	1.58
2006	119	28.01	16.62	-74.80	247.16	1.07	2.06
2007	**121**	**19.61**	**20.40**	**-85.17**	**306.29**	**1.69**	**9.81**
2008	123	-8.32	-19.28	-88.73	205.54	1.59	3.89
2009	118	-43.57	-47.14	-92.44	28.89	0.44	-0.46
2010	84	16.79	10.72	-78.19	154.55	0.62	0.68

In order to confirm that the t-test was not the most appropriate test to use, the standard deviations of B1 and B25 were compared in Table 4.25. The t-test can be used to compare the means of two sets of data if the additional condition of similar variances is adhered to. The differences in the standard deviation of the quintiles for each year are shown in column 3. If the variances of the quintiles were consistently similar over the sample period, then a value close to zero would be observed in column 3. This, however, is not the case, which confirms that the t-test was not the most appropriate measure to test the differences in the mean values observed. A non-parametric test, like the Mann-Whitney U test would have been more appropriate.

Table 4.25: Standard deviation of Box 1 and Box 25 over the sample period

	1	2	3
	Box 1	Box 25	
	Std.Dev.	Std.Dev.	B1-B25
1989	26.582	31.295	-4.712
1990	30.913	44.293	-13.381
1991	31.255	26.445	4.811
1992	43.274	38.689	4.585
1993	42.780	47.101	-4.321
1994	32.998	36.314	-3.316
1995	43.131	36.481	6.650
1996	47.657	33.005	14.651
1997	56.078	36.348	19.729
1998	60.687	63.699	-3.011
1999	51.962	97.794	-45.831
2000	70.784	136.296	-65.512
2001	42.787	31.049	11.738
2002	40.578	32.991	7.587
2003	31.130	72.247	-41.117
2004	44.061	67.013	-22.952
2005	37.903	45.036	-7.133
2006	54.801	51.366	3.435
2007	37.068	47.881	-10.813
2008	31.735	50.507	-18.771
2009	24.290	28.713	-4.423
2010	31.964	47.283	-15.320

4.4.6 The Mann-Whitney U test

From the results shown in Table 4.23 and Table 4.24, it is evident that neither of the two portfolios followed a normal distribution in every year of the sample period; as such it was necessary to conduct a Mann-Whitney U test for the difference in the mean returns for each year in the sample period. The results of this test are summarised in Table 4.26 below.

Table 4.26: The results of the Mann-Whitney U test for Box 1 and Box 25

	B1	B25			B1	B25
	Rank Sum	Rank Sum	U	p-value	Valid N	Valid N
1989	5367	5659	2592	**0.576**	74	74
1990	6421	6459	3181	**0.948**	80	80
1991	8578	5957	2302	0.000	85	85
1992	7865	7013	3272	**0.192**	86	86
1993	7677	8254	3672	**0.401**	89	89
1994	6851	9439	2756	0.000	90	90
1995	9571	7082	2896	0.000	91	91
1996	9222	7798	3520	0.049	92	92
1997	13588	8567	3002	0.000	105	105
1998	11706	8797	3646	0.000	101	101
1999	7720	10046	3255	0.002	94	94
2000	7224	7654	3483	**0.510**	86	86
2001	11697	6069	1604	0.000	94	94
2002	13277	6424	1474	0.000	99	99
2003	10369	11367	4909	**0.250**	104	104
2004	11512	10224	4764	**0.138**	104	104
2005	14924	12571	5668	0.023	117	117
2006	13885	14556	6745	**0.528**	119	119
2007	13976	15427	6595	**0.183**	121	121
2008	14489	15892	6863	**0.209**	123	123
2009	16412	11554	4533	0.000	118	118
2010	7356	6840	3270	**0.413**	84	84
Totals	**10440**	**9257**				

A p-value of zero in the Mann-Whitney U test would indicate that there was significant statistical evidence to conclude that the average of the two portfolios were dissimilar. The years highlighted in bold were years in which a p-value of higher than zero was calculated. In only 11 of the 22 years were p-values of less than 0.05 calculated. This means that the

observed difference in the median returns in the other 11 years of the sample period could have been coincidental. In two of the 11 years that showed a significant difference in returns, it was Box 25 that outperformed Box 1. In only eight of the 22 years in the sample period, the difference between the returns of B1 and B25 were statistically significant and B1 outperformed B25. This result does not overwhelmingly support a portfolio construction method based on capital intensity and ROCE.

4.4.7 Five-year holding period analysis

The analysis was extended to examine the effect of longer holding periods on portfolios compiled by using both ROCE and capital intensity as filters. The universe of stocks was divided into quintiles based on capital intensity and the constituents of each quintile then were divided into quintiles based on their respective ROCE ratios. This gave 25 different portfolios to track. Starting June 30, 1989, the annual performance of Boxes 1 to 25 was tracked over the subsequent five years. Additionally, new 25-box sets were constructed as of June 29, 1990, and every subsequent June 30 through 2005. For each of these new sets, box-by-box performance was recorded for the five years after the inception date. After completing this process, there were 17 sets of portfolios that were tracked for five years of box-by-box performance for each one. Next, the performance data were averaged across these 17 box sets to compare low capital intensity/high ROCE with high capital-intensity/low ROCE firms.

As Figure 4.13 below indicates, the performance of portfolios in which low capital intensity and high ROCE dominated exceeded the performance of portfolios composed of high capital-intensity and low ROCE firms. Box 1, composed of firms with the highest ROCE within the lowest capital-intensity quintile, registered an average annual percentage return of 22.47 per cent over five years. In comparison, Box 25, which contains the lowest ROCE firms within the most capital-intensive quintile, only averaged 12.99 per cent. Additionally, there was a steady reduction in returns when moving diagonally down the matrix. This suggests that there is a related worsening in performance when the capital intensity increases and ROCE decreases.

ROCE

Capital Intensity	Q1	Q2	Q3	Q4	Q5	Mean
Q1	22.47	17.91	16.16	14.95	13.65	**17.03**
Q2	16.30	15.82	13.50	12.94	15.67	**14.85**
Q3	19.59	17.07	13.71	14.13	14.35	**15.77**
Q4	19.98	16.76	14.83	13.60	14.29	**15.89**
Q5	24.02	18.17	18.71	15.58	12.99	**17.89**
Mean	**20.47**	**17.15**	**15.38**	**14.24**	**14.19**	**16.29**

Figure 4.13: Matrix showing the average percentage returns over five-year holding periods starting 1989 through 2010

It is also apparent from Figure 4.13 that the ROCE effect is more pronounced than the capital-intensity effect. The top left boxes in the matrix generally have higher averages than portfolios located in the bottom right hand corner. There is a clear downward progression in performance when decreasing the ROCE (moving from left to right on the grid). In line with the results of previous parts of this study, the pattern moving down the capital-intensity axis of the grid is less pronounced. There is no steady deterioration in performance when increasing capital intensity.

The results suggest that, based on historic performance, there is a definite advantage in focusing on low capital-intensive firms with high operational profitability.

4.5 SUMMARY

This chapter is divided into three main sections detailing the results of the three phases of the study.

Phase one of the study was focused solely on the use of capital intensity and its use as a metric to construct portfolios. Performance results for portfolios that were rebalanced annually, as well as the results over rolling five-year holding periods have been discussed. Both methods produced inconclusive and inconsistent results. Low capital-intensity quintiles did not consistently nor significantly outperform high capital-intensity quintiles. A strategy focused only on capital intensity would not have delivered consistently superior results.

Phase two discussed results of portfolios constructed using ROCE as a filter for portfolio inclusion. Again the performance results over different holding periods were considered. Companies with higher operational profitability produced higher compounded growth rates with lower risk, as well as higher average returns over different time periods. Additionally, the five-year holding period analysis showed a clear pattern confirming the initial expectations. The consistency of this outperformance of high ROCE firms was examined by looking at the return spread between Q1 and Q5 over time. In only 11 of the 22 years in the sample period did Q1 significantly outperform Q5. During the other years, either Q5 outperformed or the difference in the total return was not statistically significant.

The final section of the chapter was focused on the combined effect of both capital intensity and ROCE. Companies that use minimal physical assets and rely on intangible assets like brands, patents, licenses and distribution networks, while also having high operating profitability should be able to sustain superior rates of return on capital and create shareholder wealth. By using capital intensity as a primary filter and ROCE as a secondary filter, it was possible to construct a grid of 25 portfolios. The performance of the ‘best’ portfolio (lowest capital intensity and highest ROCE) was compared to the ‘worst’ portfolio (highest capital intensity and lowest ROCE) as well as the MSCI World TR Index. On a compounded growth and arithmetic average basis, Box 1 significantly outperformed Box 25. Box 1 also outperformed the MSCI World TR Index over most periods, although the outperformance was less pronounced. With regard to longer holding periods, there was also evidence that there is a distinct benefit in focusing on low capital-intensive firms with high operational profitability. However, the results from the statistical tests on the

differences in returns observed, indicated that B1 significantly outperformed B25 in only eight of the 22 years in the sample period.

CHAPTER 5

SUMMARY AND RECOMMENDATIONS

5.1 INTRODUCTION

Assessing a company's sustainable profitability is a key challenge for long-term investors. A profitable firm that is able to produce a steady revenue stream with modest capital expenditure requirements should be able to compound shareholder wealth at a superior rate over time. There are certain investment styles, such as Franchise investing, which invest in high quality companies with strong intangible assets and high returns on capital employed. Anecdotal evidence would suggest that a company whose key assets are intangible rather than physical, and thereby requires less continued capital expenditure, would produce higher total stock market returns. The question that arose concerned whether a focus on firms with low capital intensity and high ROCE ratios produce better returns than investing in companies with high capital intensity and low ROCE ratios? This paper reports on the investigation undertaken to find empirical evidence to answer this question.

Having demonstrated by means of the literature review that capital intensity and ROCE are important concepts to consider in investment management, but that they have remained largely theoretical and that little empirical evidence has been published, the next task was to clarify and measure the effect of the concepts in the market. The importance of such a step is outlined by Thomas and Pollock (1999:137) who have stated: 'If a construct is conceptually clear but empirically impossible to measure, then it is of limited utility in advancing our quest for knowledge.'

This chapter is focused on conclusions that can be drawn and implications from previous chapters. Apart from the introduction, this chapter consists of three sections. The first of these sections is dedicated to methodological and theoretical developments. This is followed by a section containing the major results and conclusions obtained from the research. Finally, the chapter is concluded with a discussion of some limitations of the study and of possible future research related to the topic.

5.2 SUMMARY

The primary objective of this study was to determine whether capital intensity and ROCE could be used to construct equity portfolios that produce long-term superior returns. The study was divided into three different phases to address the three different aspects, namely capital intensity, ROCE and a combination of both metrics.

The first phase involved determining whether stock markets on average tend to reward companies that make relatively modest use of tangible assets, and whether those that are more capital intensive are penalised in the market. Logic would suggest that the degree of capital intensity in a business plays an important role in its ability to create shareholder wealth. The following hypotheses were formulated:

> H^0: An equally weighted portfolio composed of high capital-intensity stocks will outperform a portfolio composed of low capital-intensity stocks.
>
> H^a: An equally weighted portfolio composed of high capital-intensity stocks will underperform a portfolio composed of low capital-intensity stocks.

In the second phase, using ROCE as a proxy for profitability, tests were conducted to investigate whether companies with high profitability tend to outperform companies with lower profitability. To the extent that ROCE is also an indication of management efficiency at firm level, it could be expected that firms with higher ROCE would consistently perform better. It is possible to argue that historical information is already reflected in share prices, and that a strategy focused on historic ROCE ratios should not produce significantly higher compounded shareholder wealth over time. The analysis in the second phase examined the merit of this argument. The following hypotheses were formulated:

> H^0: An equally weighted portfolio composed of low ROCE stocks will outperform a portfolio composed of high ROCE stocks.
>
> H^a: An equally weighted portfolio composed of low ROCE stocks will underperform a portfolio composed of high ROCE stocks.

In order to address the primary objectives and the hypotheses formulated, a thorough and comprehensive research methodology was used. Similar research designs and structures were followed for the first two phases. This involved constructing equally weighted quintile

portfolios for each year in the sample period, and measuring the subsequent total return of the portfolios. The arithmetic as well as geometric average returns were computed and presented for all the quintiles. The results were also considered over different time periods. Various statistical tests were used to validate the differences in the mean returns observed between the highest and lowest quintile portfolios for each metric. Lastly, the performance of the portfolios was measured over five-year holding periods as opposed to one-year holding periods. Instead of annually rebalancing the quintiles, portfolios were formed annually, but the total return performance was measured for a holding period of five years.

The final phase of the study was focused on the combined effect of both capital intensity and ROCE. Companies that use minimal physical assets and rely on intangible assets like brands, patents, licenses and distribution networks, and also have high operating profitability would be expected to be able to sustain superior rates of return on capital and create shareholder wealth. By using capital intensity as a primary filter and ROCE as a secondary filter, it was possible to construct a grid of 25 portfolios. The performance of the 'best' portfolio (lowest capital intensity and highest ROCE) was compared to the 'worst' portfolio (highest capital intensity and lowest ROCE). The hypotheses were formulated as follows:

> H^0: An equally weighted portfolio composed of stocks with the lowest capital intensity and highest ROCE will underperform a portfolio composed of stocks with the highest capital intensity and lowest ROCE.
>
> H^a: An equally weighted portfolio composed of stocks with the lowest capital intensity and highest ROCE will outperform a portfolio composed of stocks with the highest capital intensity and lowest ROCE.

A research layout similar to the first two phases was followed in the third phase of the study; the focus, however, was primarily on the 'best' and 'worst' portfolios constructed according to the grid design. Each phase of the study followed a systematic arrangement and was presented in the following layout:

- An analysis of the compound annual growth of the constructed portfolios
- An analysis of the arithmetic average returns over different time periods
- The student's t-test for significance of return differences observed
- Skewness and kurtosis tests for normality in the distribution of returns

- Non-parametric Mann-Whitney U tests for statistical significance of return differences observed
- Results of the five-year holding period analysis.

5.3 CONCLUSIONS

Each of the research objectives and hypotheses identified in the first section were addressed. Various computations, analyses and statistical tests were conducted to address the identified objectives. The results of the analyses were presented in Chapter 4 of the study.

5.3.1 Capital intensity

Using a strategy of composing annually rebalanced quintiles based on capital intensity, it was found that quintile 3 had performed best on a compound annual basis over 22 years. The quintile with the lowest capital intensity actually had the worst performance among the quintiles. The results were similar over the last ten years of the sample period, with quintile 3 performing best. Quintile 5 (with the highest capital intensity) presented the worst performance. Arithmetic average returns over different time periods confirmed these counterintuitive results. Compared to the other quintiles, quintile 1 (low capital-intensity firms) underperformed over all time periods considered. A return spread analysis to compare quintile 1 and quintile 5 (high capital-intensity firms) was also performed. However, no discernable pattern emerged. In some years quintile 1 performed better and in other years quintile 5 outperformed. A strategy focused only on capital intensity would not have delivered consistently superior results.

Various statistical tests were conducted to confirm the observations and deductions derived from the analysis. The differences in the annual total returns that were observed between quintile 1 and quintile 5 were tested for significance using the Student's t-test. It was found that Q1 outperformed Q5 in only five of the 13 years in which there was a significant difference in the mean returns. The Student's t-test implicitly assumes that the return distributions of the quintiles are normal. However, after testing for normality by computing skewness and kurtosis, it was clear that the quintiles did not have a normal distribution for many years in the sample period. This necessitated the use of a non-parametric test for significance of the observed differences in the mean returns. The Mann-Whitney U test was used to compare the returns of quintile 1 and quintile 5, and it confirmed the results of the Student's t-test, thereby indicating that a strategy focused on

investing in low capital-intensity companies would only have meaningfully outperformed a strategy focused on investing in high capital-intensity firms in five years over the 22 year sample period.

In the second part of the first phase, the effect of longer holding periods was investigated. Not rebalancing the portfolios annually, but rather letting the portfolios run for five years after inception, resulted in more intuitive outcomes. The lowest capital-intensity portfolios on average performed better than any other quintile; there was no steady deterioration in performance from quintile to quintile, however. Quintile 5, for example, had the second best average performance. This result could have been due to a growth effect. Companies that are in the formative stage of their lifecycle require capital to grow and expand their operations. This capital expenditure could be high relative to the revenue that the company is generating at that stage, which would translate into a high capital-intensity ratio. However, investors might anticipate the future growth in revenue and earnings, which would increase the demand for the companies' shares and, in turn, lead to outperformance of the shares. Conversely, the performance of low capital-intensity companies could also be explained from a growth point of view. Companies with a low capital-intensity ratio may be more inclined to be mature low growth companies. Although sales are high relative to capital expenditure, the low growth prospects may hamper share price performance going forward. If a company has a high valuation coupled with poor growth prospects, it may result in subsequent total returns being mediocre. If the growth prospects of these firms do not improve, the ensuing share price performance may be disappointing.

Not enough empirical evidence could be found to reject the null hypothesis. However, the results do not indicate that an equally weighted portfolio composed of high capital-intensity stocks will deliver superior results compared to a portfolio composed of low capital-intensity stocks. It therefore remains inconclusive whether there would be value in using the financial metric of capital intensity in the stock selection process.

5.3.2 Return on capital employed

Perhaps the most distinctive result came from the analysis of ROCE. Higher ROCE firms produced superior performance results regardless of the research design used. Companies with higher operational profitability produced higher compounded growth rates with lower risk over the full sample period, as well as higher average returns over different time periods. An annually rebalanced portfolio composed of the firms with the highest ROCE ratios produced an annualised total return of 9.97 per cent, compared with 1.32 per

cent for the lowest ROCE firms. To put this result into context, $100 000 invested in quintile 1 at the start of the sample period would have grown to $809 157 in 2010, compared to only $133 442 for quintile 5. This stark difference in performance over time suggests that investors favour firms with proven profitability.

The statistical tests used to determine the significance in the observed difference in mean returns showed that Q1 significantly outperformed Q5 at the 5 per cent level for more than half of the sample period. This result strengthens the argument for using ROCE as a metric in portfolio construction.

Additionally, the five-year holding period analysis showed a clear pattern of decreasing returns as ROCE decreases. Quintile 1 exceeded the annualised returns of quintile 5 by 620 basis points (20.6% versus 14.4%).

Based on the empirical evidence, the null hypothesis, which states that an equally weighted portfolio composed of low ROCE stocks will deliver superior results compared to a portfolio composed of high ROCE stocks, can be rejected in favour of the alternative hypothesis. The empirical results overwhelmingly support the alternative hypothesis:

> H^a: An equally weighted portfolio composed of low ROCE stocks will underperform a portfolio composed of high ROCE stocks.

It may thus be concluded that the market rewards firms with high operational profitability, and that there is value in considering a ROCE screen when constructing a long-term equity portfolio.

5.3.3 Combination of capital intensity and ROCE

On a compounded growth and arithmetic average basis, Box 1 outperformed Box 25. Box 1 produced a CAGR of 8.51 per cent over the sample period, compared to -0.67 per cent for Box 25. This result suggests that firms with high capital intensity and low ROCE actually destroy value over time. The standard deviation for Box 25 was also significantly higher (30.1%), compared to Box 1 (17.24%). The MSCI World TR Index delivered an annualised 5.69 per cent return over the 22-year sample period. Box 1 therefore produced an annualised alpha of 282 basis points above the MSCI World TR Index. It thus may be concluded that firms with the combination of favourable ROCE and capital intensity are superior compounders of wealth over time. Similarly, with regard to longer holding periods,

there was evidence that there is a distinct benefit in focusing on low capital-intensive firms with high operational profitability.

The results obtained in the third phase of the study showed that, although the performance advantage of high-quality stocks (low capital intensity and high ROCE) appears to hold over the longer term, deviations are certainly possible over the shorter term. The results of the statistical tests conducted, as well as the relative return analysis performed, suggest that the outperformance of B1 over B25 was not consistent. Statistically significant differences in the mean returns were observed in only 13 of the 22 years in the sample period. Of the 13 years in which a significant difference was observed, only eight showed a higher return for B1. This result reduces the strength of the argument in favour of using a combination of capital intensity and ROCE as filters for portfolio construction. This leads to the conclusion that one cannot rely on the consistent outperformance of B1 over B25 on a year-to-year basis. A short-term trading strategy based on B1 and B25 would not have produced meaningful results.

The brief periods of outperformance of low quality stocks (high capital-intensity and low ROCE firms) during certain periods makes intuitive sense in the context of economic, monetary and stock market conditions. Firstly, low-quality firms are more economically sensitive than high-quality firms because they are more reliant on debt markets. Since capital-intensive firms have high demand for financial capital they are typically less able to finance growth through internal resources, especially if they do not have operational profitability. This economic sensitivity is exacerbated if firms have low levels of cash generation and low profitability.

If a recession follows a period of monetary tightening, the share prices of low-quality companies may fall further than those of high quality because they are more vulnerable to deteriorating economic and credit market conditions. If credit market conditions ease due to looser monetary policy, low-quality companies will lead the initial phase of the new bull market, mainly because bear market laggards have the most to gain from improving credit and economic conditions. This could possibly explain the observed difference in performance between B1 and B25 during the period 1998 to 1999. As the market nears a cyclical peak, the outperformance of lower quality companies may be due to factors such as sentiment rather than fundamentals driving pricing in the market. It is often near stock market tops where investor speculation is widespread.

If prices have been rising for a sustained period of time, less sophisticated investors are drawn into the market, resulting in an increased number of investors chasing the same investment theme. Investors become less quality conscious and may continue to purchase shares of firms that have less effective management teams. This could explain a scenario where firms with low ROCE and high capital intensity outperform.

In an environment of tighter monetary conditions, higher taxes and slower economic growth, investors typically become more risk averse and favour high-quality over low-quality stocks. This could possibly explain the return differences observed in the period immediately following the burst of the technology bubble in 2000.

From the results of the compound and arithmetic average computations, as well as the longer holding period analysis, it may be concluded that an equally weighted portfolio composed of stocks with the lowest capital intensity and highest ROCE will outperform a portfolio composed of stocks with the highest capital intensity and lowest ROCE. The null hypothesis defined earlier in the study can thus be rejected in favour of the alternative hypothesis.

5.3.4 Managerial implications

The fairly unconvincing results, especially in the application of the capital-intensity metric, do not discourage the use of franchise or quality investing as a viable investment strategy. The results, however, do not support an active trading strategy based on the financial metrics of capital intensity and ROCE. Franchise investing considers a multitude of factors in addition to capital intensity and ROCE; these include cash flow and various valuation metrics.

The implications for money managers concerned with long-term returns from equity investing are quite clear: allocation of investment capital to capital-intensive companies with low operational profitability seems likely to impair long-term returns. On the other hand there may be value in a focus on low capital-intensity firms that are able to generate high returns on capital employed. Companies that use minimal physical assets and rely on intangible assets like brands, patents, licenses and distribution networks, and also have high operating profitability, should be able to sustain superior rates of return on capital and create shareholder wealth.

5.4 LIMITATIONS AND AREAS FOR FUTURE RESEARCH

The focus of the research for this paper was on examining the historical performance of firms based on capital intensity and ROCE, using a variety of research designs. While the study was not intended to propose a specific trading strategy, it does highlight the difference in performance between highly profitable, low capital-intensive firms and less profitable, highly capital-intensive companies. The results of this study provide support to an investment strategy that focuses on these two metrics in its investment process.

Although no similar research on these topics could be found in the related literature discussed in Chapter 2, most researchers provide little or no justification for their preferred definition of capital intensity. This study has outlined the motivation for the definition chosen in Chapter 1. It is possible that the chosen capital-intensity measure could have a significant impact on the results. Erasmus *et al*. (2000) investigated the suitability of various definitions of capital intensity. Future studies could examine the use of these different definitions of capital intensity by employing a similar research design to the one used for this study.

In Chapter 1 it was stated that the study focused on developed markets and that emerging markets were excluded. A limitation of this study is that the conclusions from the empirical evidence cannot necessarily be extended to emerging market shares. A possible future research project could apply the same research design to emerging markets.

Investigating the correlation of the different quintile portfolios with variables such as interest rates and economic growth could prove to be an interesting expansion to this study. Analysing the outperformance of various capital-intensity and ROCE quintiles could possibly indicate under which circumstances investors favour firms with quality characteristics and when pricing is influenced by other factors such as sentiment.

The scope of the research could be expanded by including a valuation metric. As price is a key determinant of total return, a quality company bought at an excessively high valuation may produce poor stock market returns. This study did not consider any valuation metrics, but focused only on financial statement data. It is possible that a low capital-intensity ratio may not always imply that the stock represents good value. The possibility that the characteristics evaluated, namely capital intensity and ROCE, may have been reflected in the market price of the security was not considered for this research paper. In accordance

with the Efficient Market Hypothesis (EMH), investors may have taken the historical financial information into account at any given point in time over the sample period. The conviction of the market as to the impact of capital intensity and/or ROCE may be reflected in the share price, thus measuring the total return after the fact may not produce any meaningful results. The inclusion of a valuation metric in the research design could possibly address this limitation. Two feasible valuation metrics for a possible future study would be the price-to-earnings (P/E) ratio and the price-to-free-cash-flow (P/FCF) ratio.

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