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The Impact of Corporate Hedging on Stock Price Performance

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A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of

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ABSTRACT

This study explores the extent and benefit of corporate hedging in South Africa by examining the disclosure of financial derivative instruments in the annual reports of non-financial companies listed on the JSE. The conflicting academic theory on hedging and the shortage of empirical evidence to support corporate hedging provide decision-makers, especially in South Africa, with poor information on the impact of hedging on the market value of their companies and, therefore, the total return provided to their shareholders.

A database of derivative usage was constructed from the annual reports of all non-financial JSE-listed companies. The data was used to quantify the extent of derivative usage in South African and to construct the portfolios necessary to calculate the risk factors for the regression model. The Fama and French four-factor model was used as the basis for the regression analysis necessary to show whether or not hedging has a positive impact on annual stock price performance.

The results show that hedging is prevalent in South Africa. However, the results provide evidence that corporate hedging through the use of derivative instruments is only a value-adding strategy for firms that exclusively use currency derivatives. The use of commodity or interest rate derivatives is not a value-adding strategy, nor is the use of currency derivatives in conjunction with commodity or interest rate derivatives.

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DECLARATIO

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Masters of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination at any other University.

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1 INTRODUC H PROBLEM

As countries like South Africa open up their economies to trade, companies are exposed to the turbulence and unpredictability of world markets. As a result, risk management, and specifically the process of hedging market risk through the use of derivative financial instruments, is receiving increased attention in companies around the world and in South Africa (Vorster, Koornhof, Oberholster and Koppeschaar, 2004). In 2003 the International Swaps and Derivatives Association (ISDA) released a derivative usage survey that reported that 92% of the world's 500 largest companies use derivatives for risk management.[1] This prompted the Chief Executive Officer of ISDA to say: "The survey demonstrates that derivatives today are an integral part of corporate risk management among the world's leading companies. Across geographic regions and industry sectors, the vast majority of these corporations rely on derivatives to hedge a range of risks to which they are exposed in the normal course of business."[1]

While hedging is not new, the scale and diversity of hedging are far greater than they used to be and hedging instruments are becoming increasingly more sophisticated. When executed properly, hedging can be good and even essential for competition. However, if carried out incorrectly, hedging can increase the risk it is trying to mitigate, waste resources and generate large, widely publicised losses, as was the case with the South African Airlines recent R6.3 billion jet fuel and foreign currency loss.[2]

[1] http://www.isda.org/statistics/surveynewsrelease030903v2.html
[2] http://business.iafrica.com/news/98492.htm

Unfortunately for n initiate or expand their hedging programmes, there are conflicting schools of academic theory regarding the impact of corporate hedging on the financial performance and market value of listed companies (Nelson, Moffitt and Affleck-Graves, 2005). Academic research is available to support theories that hedging positively impacts on market value, destroys market value and has no impact at all on market value. In addition, despite the conflicting range of academic theories on hedging, there is also little empirical evidence on the impact of hedging on market performance. With the conflicting academic theories and little empirical evidence to support corporate hedging, decision-makers, especially in South Africa, have poor information on the impact of hedging on the market value of their companies and, consequently, the total return provided to their shareholders.

1.1 Research Objectives

A recent article by Nelson *et al* (2005) examined the annual stock price performance of non-financial United States (U.S.) firms that disclosed the use of derivatives to hedge their market risk over the period 1995 to 1999. The authors used several methods to examine the long-run performance of firms that disclosed the use of derivative instruments, but their primary focus was on the Fama and French (1993) four-factor regression method (as amended by Carhart, 1997 and Brav, Géczy and Gompers, 2000). The regression method uses company size, book-to-market value, prior share performance (momentum) and the market risk premium as the four factors that assist in explaining share returns. It was found that only 21.6% of publicly traded U.S. corporations in their sample hedged with derivative instruments and that this

was concentrated in s showed that companies that hedged their market risk outperformed other securities by 4.3% per year on average, but this was exclusively due to larger firms that hedge currency.

The research by Nelson *et al* (2005) is one of only a few studies that have investigated the extent of derivative usage to hedge market risk and the impact that the use of derivatives have on company performance. This research will extend the work of Nelson *et al* (2005) into a South African context by using the Fama and French four-factor regression method, as well as additional regression models, to specifically study non-financial companies listed on the Johannesburg Stock Exchange (JSE) in the three-year period from July 2003 to June 2005.

Although a range of multifactor pricing models is found in the literature, in the area of empirical asset pricing little contemporary research is immune from the influence of Fama and French, and specifically their landmark paper, Fama and French (1993) (Faff, 2004). As the Fama and French multifactor model is not only well-respected in academia, but also well-defined and relatively simple to use, it was selected as the basis for this research and used to establish the following:

1. The extent of hedging in South Africa at a broad level, but also by commodity, interest rate and currency hedging.
2. The extent to which hedging is a value-adding strategy for non-financial companies in South Africa.
3. The extent to which the hedging of commodity, interest rate or currency risk has an impact on a company's annual share performance.

4. The extent t factors in the Fama and French four-factor model – company size, book-to-market value, momentum and market risk premium – have an impact on the market value of a company.
5. Whether the resource sector on the JSE is effective in explaining over- or underperformance of companies that disclose the use of derivative instruments to hedge their market risk.

In order to meet the research objectives, it was first necessary to build a comprehensive database detailing the use of derivative instruments by South African companies. An examination of the annual reports of all non-financial companies listed on the JSE in the three-year period (2003 to 2005) showed that more than 67% of companies utilised derivative instruments to hedge market risk, well in excess of the 21.6% found in the U.S. (Nelson *et al*, 2005). In addition to finding significant differences in the extent of hedging between South Africa and the U.S., the results showed that derivative usage in South Africa has a negative effect on company stock performance. Where U.S. companies using derivatives experienced a 4.3% increase in stock price, South African companies experienced a negative 10% to 17%.

Although corporate hedging plays an increasingly significant role in the financial policies of many South African companies today, there is no consensus on the theoretical benefits of hedging, nor is there empirical evidence to show that hedging it is a value-adding strategy. This research will provide decision-makers in South African companies with evidence suggesting that corporate hedging may not necessarily be a value-adding strategy. In addition, it is also the first

South African resea decision-makers to make more informed decisions on the use of derivative instruments for corporate hedging.

2 LITERATUF

This section of the study provides a review of the academic research carried out on the subject of corporate hedging from a theoretical and empirical perspective. In addition, it also provides the theoretical background to the research method and a brief overview of the factors that could impact on the application of the theory in a South African context.

2.1 Clarification of Corporate Hedging

Businesses are continuously exposed to a multitude of risks from various sources and develop specific risk management activities to mitigate these risks. Insurance policies are used to insure against the risk of damage to vehicles and factories, supply risk is mitigated through duel supply strategies and wide product ranges are employed to ensure cash flow even if one product fails. Each of these risk management techniques has the purpose of either neutralising or offsetting a particular risk. Hedging, as discussed by Brealey and Myers (1996), is no different in that it is a risk management technique used to reduce a firm's exposure to financial risk by taking on one risk to offset the other. Stephens (2000, 10) therefore states that hedging, "at its most basic level, is an avoidable financial risk that is intentionally taken in order to offset another financial risk which is both unavoidable and undesirable."

Corporate hedging, as referred to in the title of the study, therefore includes all the hedging activities that a company will engage in to mitigate, as far as possible, any financial risk to the business. The process of corporate hedging involves the buying and selling of financial derivative instruments (also known

as derivative securi hat represent a claim to another financial asset. They are called this because they derive their value from the value of some other financial instrument or commodity. They are traded for what underlies them and not for their own sake (Stephens, 2000). The following section provides more detail about the nature of derivative instruments and the specific types that are available to the market.

2.1.1 Tools of Hedging Financial Risk

The previous section mentioned that in order to hedge an existing risk, it is necessary for a business to take on additional risk by means of some appropriate derivative instrument. By definition, therefore, to hold a derivative instrument is to hold risk, financial risk in this case, and consequently derivatives need to be well-understood before a business engages in any hedging activity (Stephens, 2000). Derivatives can take the form of forward contracts, futures, swaps and options.

2.1.1.1 Forward Contracts

A forward contract is the most basic of derivative instruments and is defined by Firer, Ross, Westerfield and Jordan (2004, 706) as “a legally binding agreement between two parties calling for the sale of an asset or product in the future at a price agreed upon today.” Forward contracts require one party to deliver goods to the other party on a prescribed date, called the settlement date, in return for payment at a previously agreed forward price. A procurement contract between a buyer and seller for the delivery of a set tonnage of maize on a specific day and at a specific price is an example of a forward contract. The main forward market, however, is in foreign currency where banks quote prices at which they

will buy and sell for e years or more into the future (Brealey and Myers, 1996).

2.1.1.2 Futures Contracts

Futures contracts (typically just referred to as futures) are the oldest actively traded financial derivative instruments and were originally developed for agricultural commodities (Brealey and Myers, 1996). They are typically traded on exchanges that have the sole function of providing the necessary facilities for members to buy and sell either commodity or financial futures. Futures are similar to forward contracts, except for three significant differences (Firer *et al*, 2004):

1. Whereas forward contracts are tailor-made for the buyers' needs, futures are standardised items such as one metric tonne of grade one yellow maize.
2. A loss or gain on a forward contract is only made on the settlement date, whereas the gains or losses on futures contracts are realised on a daily basis.
3. Forward contracts are usually settled by the exchange of a physical good or service as per the contract. Futures on the other hand are rarely settled with a physical exchange. A futures contract is most often sold or bought back from the market before the expiration date and a financial gain or loss made.

2.1.1.3 Swaps

A swap contract is similar to a portfolio of forward contracts where two parties agree to exchange or swap specified cash flows at specific intervals. However,

unlike a forward co e of goods and payment between a buyer and seller, swaps have a multitude of exchanges (Steiner, 2001). Swaps typically fall into one of three categories: currency swaps, interest rate swaps and commodity swaps.

2.1.1.4 Options

In a forward, future or swap contract both parties are obligated to complete the transaction. By contrast, an option contract is an agreement that gives the owner of the contract the right, but does not place him under an obligation, to buy or sell some asset at a specified price and time. For the flexibility of deciding whether to exercise this right or not, the person buying the option needs to pay an upfront cash premium to the seller to compensate for the risk. The option allows the buyer to insist on the deal if it is profitable compared to the current market price or let the option lapse if it is not (Steiner, 2001). There are two types of options, a put and a call option, defined by Steiner (2001, 160) as follows:

> "A call option is a deal giving one party the right, without obligation, to buy an agreed amount of a particular instrument or commodity, at an agreed rate, on or before an agreed future date. The other party has the obligation to sell if so requested by the first party."

> "A put option is deal giving one party the right, without obligation, to sell an agreed amount of a particular instrument or commodity, at an agreed rate, on or before an agreed future date. The other party has the obligation to buy if so requested by the first party."

2.1.2 Speculation

There are two major groups – speculators and hedgers – who benefit from entering into derivative positions and the difference between the two is important: Whereas a hedger enters into a derivative market in order to reduce a pre-existing risk, a speculator is in the pursuit of profit, thereby accepting an increased risk. Identifying exactly what speculation is or who speculators are, is difficult, but it is best explained as a person or company that enters into a derivative market in which they have no large risk exposure. Their primary purpose would therefore be to extract profit through reading the market correctly and not using the market to protect against a risk exposure. The lines between speculation and hedging can be blurred when a person or company, heavily exposed to hedgeable risk, not only hedges existing risk, but also enters into additional positions purely for extracting additional gain (Kolb, 2000).

2.1.3 Disclosure of Derivative Usage

In 1989 the International Accounting Standards Committee (IASC) and the Canadian Institute of Chartered Accountants (CICA) initiated a joint project to develop a standard on the recognition, measurement and disclosure of financial instruments (Vorster, Koen, Koornhof, Oberholster and Koppeschaar, 2003). The project was divided into two phases, namely -

1. classification and disclosure of financial instruments; and
2. recognition and measurement of financial instruments.

The first phase resulted in the International Accounting Standard (IAS) 32, locally known as AC 125. AC 125 (Financial Instruments: Disclosure and Presentation) is applicable to financial periods commencing on or after

1 January 1998. ject known as IAS 39 internationally and AC 133 locally (Financial Instruments: Recognition and Measurement) is applicable to all financial years commencing on or after 1 January 2001 (Vorster *et al*, 2003).

AC 125 and AC 133 are two complementary standards that are usually applied in conjunction with each other. AC 125 deals with the types and management of financial risks, as well as the presentation of financial instruments that include -

- classification of financial instruments between liabilities and equity;
- classification of related interest, dividends, losses and gains; and
- the circumstances in which financial assets and financial liabilities should be offset.

AC 133 on the other hand starts by stating the recognition requirements of financial instruments, assets and liabilities before dealing with how financial instruments are valued through the fair value process. AC 133 then proceeds to the topic of hedging and the accounting treatment thereof (Vorster *et al*, 2003).

The two accounting standards, AC 125 and AC 133, conclude with a joint section on the disclosure of financial instruments. The standards address many possible disclosures, but few are mandated requirements. The purpose is to provide information in the financial statements that will assist in understanding the impact of the financial instruments on a firm's financial position, performance and cash flow, and assist in determining the amount, timing and certainty of future cash flows associated with the instruments. The standards also encourage firms to provide a discussion on the extent to which financial instruments are used, the associated risks and the purpose for entering into the

positions. Neither A(exact format or location of disclosure in the financial statements.

2.2 Risk

A risk free investment is one that is guaranteed to provide a specific rate of return to an investor at a specific time. Risk free investments are scarce, however, and for most investments an investor will demand a higher rate of return to compensate for additional risk. This increase in the rate of the return over a risk free investment is termed the "risk premium" (Reilly and Brown, 2003). The sources of risk that would add to the risk premium are discussed below.

2.2.1 Systematic versus Unsystematic Risk

Systematic risk is the type of unexpected risk that influences a large number of assets and, because it affects the whole market, it is often called market risk. Unsystematic risk on the other hand is also unexpected risk, but it only affects a single asset or a small, distinct group of assets. Unsystematic risk is often termed "unique" or "asset-specific" risk, as it is specific to one company or a small group of companies (Firer *et al*, 2004).

Total risk is defined as the sum of systematic and unsystematic risk. However, as unsystematic risk can essentially be eliminated by diversification, the expected return on an asset depends only on the asset's systematic or market risk (Firer *et al*, 2004).

2.2.2 Major Sour

2.2.2.1 Business Risk

Business risk is described as the risk that is due to the uncertainty of income flows caused by the nature of the firm's business. An investor will demand a higher risk premium due to the uncertainty of the firm's income stream and, therefore, the uncertainty of the income stream to pay the investor (Reilly and Brown, 2003).

2.2.2.2 Financial Risk

The method that a firm selects to finance its investments introduces risk into the business. If the business is only financed by equity, the firm only experiences business risk, but if investments are financed by debt, the investor will demand a risk premium due to the fixed financing charges that the business will have to pay. The financing charges that are payable due to the debt increase the uncertainty of the investor receiving the required return (Reilly and Brown, 2003).

2.2.2.3 Liquidity Risk

An investor will rarely hold an investment for ever and will at some stage want to sell it. The more difficult it will be for the investor to sell the asset in the future, the higher the risk premium that is required (Reilly and Brown, 2003).

2.2.2.4 Exchange Rate Risk

Exchange rate risk is the uncertainty of return to an investor who acquires assets denominated in a foreign currency. An investor will require a risk premium for the specific type of asset that was purchased and for the

uncertainty of holdi gn currency (Reilly and Brown, 2003).

2.2.2.5 Country Risk

Country or political risk is due to the uncertainty created by the political and economic circumstances of the country in which the investor has invested (Reilly and Brown, 2003).

2.2.3 Market Risk

Although Section 2.2.1 defines market risk as a synonym for systematic risk, it is not uncommon to see the phrase market risk used slightly differently in the literature on corporate hedging and derivative usage. As an example, Nelson *et al* (2005) describe market risk as the risk a business is exposed to through commodity price changes, interest rate movement and changes in foreign currency exchange rates. This research follows on similarly, grouping commodity, interest rate and currency hedging as market risk hedging.

2.3 Theoretical Support for Hedging and Firm Value

Finance theory is unclear as to whether hedging is a value-adding strategy or not and three broad schools of academic thought on the matter have emerged over the last 50 years. There is literature on corporate hedging that supports hedging being a positive Net Present Value (NPV) decision, a negative NPV decision and also a zero NPV decision. All three of these schools are discussed below.

2.3.1 Hedging as

Modigliani and Miller (1958) propose that hedging is a zero NPV decision because, in the absence of market imperfections, financial policy and capital structure cannot affect the value of a firm, but it can affect how the value is distributed among the claim holders. They propose that the only way hedging can create value is when a firm uses hedging activities for speculative purposes and then either the markets are imperfect, or speculation is part of the normal business operations.

2.3.2 Hedging as a Negative NPV Decision

Smith and Stulz (1985) argue that hedging is a negative NPV decision and that hedging destroys firm value. They assert that hedges are costly to implement, but managers who have poorly diversified portfolios will still be encouraged to hedge exposure to protect their personal risk at no cost to themselves.

2.3.3 Hedging as a Positive NPV Decision

The literature on corporate hedging, however, has identified several market imperfections that may support firms engaging in hedging activities. These market imperfections are detailed below.

2.3.3.1 Reduced Costs of Financial Distress

Research by Smith and Stulz (1985), and later by Stulz (1996), suggests that hedging reduces the cost of financial distress. As the probability of financial distress increases, the cost of direct and indirect bankruptcy increases. Hedging can be used to reduce the variance of future cash flows and reduce the chance

of firms with debt erefore, a risk reducing strategy that uses hedging can assist in avoiding the costs of financial distress and hence increase the value of a firm.

Where there is a non-negligible chance of bankruptcy, underinvestment is the main factor in the reduction of a company's value (Gay and Nam, 1998). When a business is in financial distress, shareholders are reluctant to provide additional funding for potentially value-adding projects, because part of the added value will go to lenders. Hedging should therefore increase value by reducing the chance of financial distress and the underinvestment problem.

2.3.3.2 Reduced Conflict of Interest between Bondholders and Shareholders

The cost of underinvestment is also reduced because hedging results in a decreased agency conflict between bondholders and shareholders as discussed by Fok, Carroll and Chiou (1997) who furthered the work of Smith and Stulz (1985) and Mayers and Smith (1987). Bondholders and shareholders know that hedging results in a lower probability of financial distress and a lower cost of borrowing. However, bondholders know that it is not in the shareholders' best interest to hedge after the bond issue is sold at a high price and consequently they are reluctant to offer a lower cost of borrowing. This is especially true for firms with a large number of high growth opportunities. If shareholders have to pay the higher cost of borrowing, they have little incentive to hedge as wealth is simply transferred from stockholders to bondholders. Shareholders therefore have an incentive not to hedge even though they have

promised bondholde the borrowing at a lower rate (Fok *et al*, 1997).

Hedging, however, overcomes the problem described above as there are two factors that can encourage stockholders to hedge and reduce the agency problem of debt. First, if firms are active in the capital markets and often require debt, they can damage their reputation by not hedging and consequently reduce their ability to raise cheaper debt at a later stage. Second, hedging can reduce the likelihood that restrictive bond covenants, designed to reduce the probability of financial distress, become binding. These two points encourage the firm to continue practicing value-maximising behaviour.

2.3.3.3 Reduced Risk for Firms' Managers

Most firms hedge to reduce risk to the business. As managers have a vested interest in the company for which they work, they will be encouraged to reduce their own risk. As a large percentage of a managers' portfolio is tied up in the company in the form of wages, bonuses and potential shares/options, they have a large incentive to hedge and reduce their portfolio's risk and, therefore, business risk. As managers are 'forced' into acting in the shareholders' best interest with respect to hedging, the agency costs of equity are reduced. Shareholders are no longer compelled to incur costs to ensure that managers are acting in their best interest (Kolb, 2000). There is some dispute over this particular incentive to hedge since Section 2.3.2 describes this same example as a reason why hedging may destroy firm value.

2.3.3.4 Reduced C

Smith and Stulz (1985), following earlier work by Mayers and Smith (1982), argue that if a company's tax schedule is progressive, with higher marginal tax rates for higher income levels, companies with more volatile earnings will pay a higher tax on average than companies with the same average earnings but less volatility.

In addition to reducing volatility, which impacts on the actual tax paid, a firm's available tax credits can also impact on the firm's ability to increase value through hedging. A tax credit can only be used if the firm owes tax. If the before-tax income of a firm is zero, it cannot take any benefit from the tax credit in that year. Hedging allows a firm to almost guarantee a positive income (*ceteris paribus)* and guarantees the use of the available tax credit. With hedging, therefore, a firm is able to increase its expected after-tax income and the value of the firm (Kolb, 2000).

2.4 Empirical Evidence for the Value of Hedging

Despite the range of theories on the impact of hedging, there is little empirical evidence as to the impact on firm value and even less that attempt to quantify the value. The few studies that have been done can be divided into three categories:

- Broad studies looking into the prevalence of hedging activity, primarily in the U.S.
- Studies that attempt to disprove the market imperfections that academic literature proposes as the reason why hedging adds value.

- Studies that i n hedging and firm value from a general perspective and specific to certain business activities, such as the purchasing of jet fuel in the airline industry.

2.4.1 Prevalence of Hedging Activity

In addition to the anecdotal evidence regarding the increased evidence of corporate hedging, there is also growing empirical evidence supporting the increased corporate use of hedging. Studies by Bodnar, Hayt and Marston (1995) and Mian (1996) provide evidence that many corporations actively hedge their risk through the use of derivatives. Géczy, Minton and Schrand (1997), using a sample of Fortune 500 companies, found that 52.1% used currency derivatives, 44.2% used interest rate derivatives and 11.3% used commodity derivatives. Allayannis and Ofek (2001) focus only on the use of currency derivatives and they found that 42.6% of their sample of 378 non-financial firms on the Standard & Poors 500 used currency derivatives. In their study of 425 firms, Hentschel and Kothari (2001) found that the use of derivatives increased from 19.5% in 1990 to 41.4% in 1993.

Nelson *et al* (2005), as part of their study into the increased value of corporate hedging, documented the extent of derivative usage by studying over 5 700 U.S. firms. Unlike earlier studies, which used fairly small sample sizes, Nelson *et al* (2005) found hedging activity in only 21.6% of the sample, but consistent with other studies, they found that hedging activity concentrated in larger firms. They specifically found that 12.4% of the sample employed some form of currency hedging, 11.5% used interest rate derivatives and only 4.7% employed

commodity hedging ıat 26.8% of these users used multiple types of derivatives.

2.4.2 Impact of Market Imperfections on Firm Value

Section 2.3.3 of this study details the market imperfections that may support firms engaging in hedging activities. This section documents the empirical work that has recently been carried out that either support or refute the academic literature on the determinates of corporate hedging discussed in Section 2.3.3, namely -

1. reduced costs of financial distress;
2. reduced conflict of interest between bondholders and shareholders (agency cost of debt);
3. reduced risk for firms' managers; and
4. reduced corporate tax liability.

More research is available on empirical investigation of the effect of hedging and market imperfections on firm value than on the quantifiable relationship between hedging and firm value discussed in the proceeding section. However, the work that is available is inconclusive due to inconsistent findings and varying research methods and samples. Most of the academic research focuses on the issue of financial distress, agency cost of debt and corporate tax liability, but few researchers focus on risks for managers.

Table 1 draws on a summary by Graham and Rogers (1999) of the most recent empirical papers that have studied the determinants of corporate hedging. The table has been updated with further academic work carried out in the field post-

1999. The numbers he bulleted numbers two paragraphs above. Where a cell is blank, the specific determinant was not studied; a "Y" indicates that the determinant was studied and the author concluded it added to firm value; and an "N" indicates that the determinant was studied, but the author concluded that it did not add to firm value.

Table 1: Summary of empirical research on why firms hedge with derivatives

Study	Sample	1	2	3	4
Dolde (1993)	Fortune 500	Y	Y		Y
Berkman and Bradbury (1996)	New Zealand public firms	Y	Y	Y	Y
Tufano (1996)	Gold mining firms	N	Y	Y	N
Géczy et al (1997)	Fortune 500	Y	Y	N	
Fok et al (1997)	S&P 500	Y	Y	Y	N
Graham and Rogers (1999)	EDGAR	Y	Y		N
Foo and Yu (2005)	Fortune 500	N	N	N	N
Clark and Judge (2005)	United Kingdom 500 (FT500)	Y	Y		

Source: Based on work by Graham and Rogers (1999)

The table shows that research on the issues of derivative usage and firm value has continued in the last ten years and, although there is evidence to suggest a positive link between derivatives and value, it is not conclusive and further work is required.

2.4.3 Relationship between Hedging and Firm Value

2.4.3.1 Related Research

Few researchers have tried to place a financial value on the impact of corporate hedging. Allayannis and Weston (2001), however, examined the use of foreign currency derivatives (in a sample of 720 large U.S. non-financial firms between

1990 and 1995) and e. Using Tobin's Q as an approximation for the firm's market value, they found a positive relationship between firm value and the use of foreign currency derivatives. They found that the hedging premium over the market was statistically and economically significant and, on average, equal to 5.7% of firm value.

Carter, Rogers and Simkins (2003), using methodology similar to that used by Allayannis and Weston (2001), investigated jet fuel hedging behaviour of firms in the U.S. airline industry during the period 1994 to 2000. By means of regression analysis they found that hedging jet fuel with commodity derivatives was associated with an increase in firm value. The approximately 16% increase in value was argued to be the result of jet fuel hedging reducing underinvestment costs, as a more stable cash-flow allows for expansion into previously unavailable investment opportunities.

In one of the few studies that questions the empirical evidence supporting findings that hedging creates firm value, Guay and Kothari (2003) state that the small gains created by hedging are modest in relation to firm size, operating cash-flow and investing cash-flow. They state that corporate derivative usage is only a small piece of a non-financial firm's overall risk profile and that this suggests the need to rethink past research that advocates the importance of derivative usage.

2.4.3.2 Closely Related Research

In a recent study on the subject of hedging and increased firm value, Nelson *et al* (2005) examined the annual stock performance of U.S. non-financial firms

that disclosed the u the period 1995 to 1999. They found statistically significant evidence that companies that hedged using derivatives consistently outperformed the market by 4.3% per year on average. However, on closer examination they found that the increased return was limited to companies that disclosed the use of foreign exchange derivatives. Companies that disclosed the use of derivatives to hedge commodity and interest rates underperformed on average against the market.

In addition to looking at the effect of the different types of derivative on hedging, Nelson *et al* (2005) also looked at the effects of firm size, value versus growth firms, market risk premium and momentum. They assert that -

- hedging is skewed towards larger firms;
- hedged firms, on average, have a lower systematic risk;
- there is no book-to-market bias in hedged firms indicating that there is no additional return for either value or growth firms;
- momentum bias does not exist in the hedged portfolios of firms; and
- there is no immediate increase in a company's market value after the initial disclosure of new hedging activity.

Graham and Roger's (1999) provide additional evidence that small firms hedge less than large firms. They state that their results are inconsistent with the notion that small firms face substantial informational asymmetry and therefore should hedge more than large firms. They conclude that there is a large fixed-cost component to implementing a hedging programme and that small firms are less likely to achieve sufficient benefits to offset this cost.

2.5 Asset Pricir

Explaining past stock returns and reliably predicting future performance have been major issues in finance and specifically investment finance literature for many years (Maringer, 2004). The relationship between risk and return of an asset (or portfolio of assets) and the method of determining the required or accepted rate of return on the risky asset have been the heart of the debate. The Sharpe-Lintner-Mossin Capital Asset Pricing Model (CAPM) was developed using capital market theory and represents the foundation for understanding the connection between risk and return in financial markets (Reilly and Brown, 2003).

Reilly and Brown (2003) extend the discussion of asset pricing models from CAPM to multifactor models, because CAPM only designates a single risk factor to account for volatility inherent to individual securities or a portfolio of securities. The most popular alternative to CAPM is the arbitrage pricing theory (APT) developed by Ross (1976). He expands on CAPM by specifying several risk factors that allow for a more expansive definition of systematic risk. The APT, however, also has its limitations as the model does not specify what the risk factors are or how many risk factors there should be. To overcome this problem multifactor models attempt to convert the APT into a more workable tool by turning theory into practice. The models differ greatly in their application and also the number and type of risk factors that range from macroeconomic to microeconomic variables. Macroeconomic variables attempt to capture variations in the underlying reasons an asset's cash flows and investment returns might change over time (e.g. inflation and interest rates). Microeconomic

factors on the othe teristics of the securities themselves (e.g. firm size and book-to-market value) (Reilly and Brown, 2003).

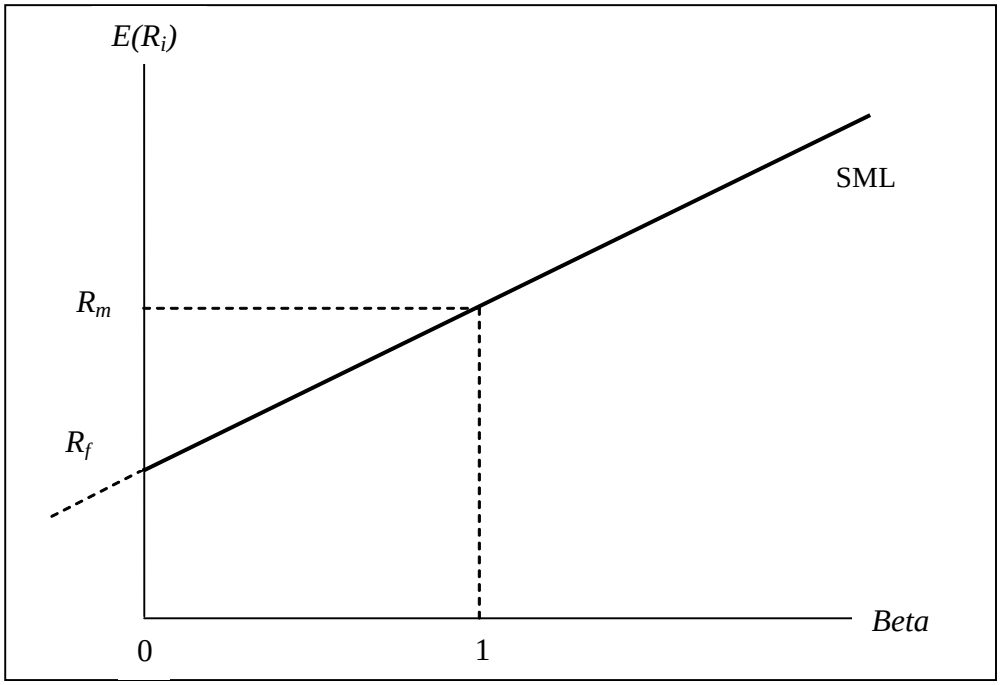
Although a wide variety of macroeconomic and microeconomic multifactor models have been used in practise, the focus of this section is on microeconomic multifactor models in investment finance and in particular the seminal work of Fama and French in the landmark paper of 1992 and later enhanced by the authors in further research (Fama and French, 1993, 1995, 1996 and 1998). The reason for this focus is to provide a more meaningful comparison with the research by Nelson *et al* (2005). The authors used the Fama and French four-factor model to enable them to answer specific propositions related to the underlying sample of firms being studied. For example, the size factor (to be discussed in Section 2.5.3.1) allowed Nelson *et al* (2005) to show that the potential benefits of hedging may be concentrated in larger firms. In addition to the documentation on the Fama and French three-factor model, the section starts with a brief discussion on the practical use of CAPM and APT, and ends with the impact of the South African market specifically on multifactor pricing models.

2.5.1 CAPM

CAPM has been the foundation of finance theory for over 30 years and is a model that indicates what the expected or required rate of return on a risky asset should be. The creation of a line representing the relationship between risk and return on an asset is the key to the derivation of the model and it is called the security market line (SML). The equation of the SML can generate expected or required rates of return for any asset based on its systematic risk.

The graph below sh between expected return ($E(R_i)$) and beta with a normalised systematic risk (Reilly and Brown, 2003). R_f is the risk free rate and R_m the return for the market portfolio.

Figure 1: SML with normalised systematic risk



Source: Reilly and Brown (2003, 249)

The graph represents the relationship between expected (required) risk and return for a risky asset and it is determined by the R_f plus a risk premium for the individual asset. The risk premium in turn is determined by the systematic risk of the asset (β_i) and the prevailing market risk premium ($R_m – R_f$). The graphical representation can be written as the equation below (Reilly and Brown, 2003, 250):

$$E(R_i) = R_f + \beta_i [E(R_m) – R_f] \qquad \text{Equation 1}$$

where:

$E(Ri)$ = the ex the risky asset *i*;

Rf = the risk free rate of return;

βi = the asset's beta – standardised measure of systematic risk; and

$E(R_m)$ = the return for the market portfolio.

$[E(R_m) - R_f]$ is also termed the market risk premium (MRP).

2.5.2 APT

The APT developed by Ross (1976) is based on fewer and less restrictive assumptions than the CAPM discussed in Section 2.5.1 and it is more general in that more than one risk factor is used to explain the asset's return. (Reilly and Brown, 2003). Unlike CAPM that asks which portfolios are efficient, it starts by assuming that each asset's return depends partly on pervasive macroeconomic influences or factors and is partly due to events that are unique to the company (Brealey and Myers, 1996).

The theory is based on three major assumptions (Reilly and Brown, 2003), namely -

- capital markets are perfectly competitive;
- investors always prefer more wealth to less wealth with certainty; and
- the stochastic process of generating asset returns can be expressed as a linear k-factor model (discussed below).

The derived k-factor model, using some theoretical manipulation with linear algebra, can be expressed as follows (Reilly and Brown, 2003, 281):

$$E(R_i) = \lambda_o + \lambda$$ Equation 2

where:

$E(R_i)$ = the expected (required) rate of return for the risky asset *i*;

λ_o = the expected return on an asset with zero systematic risk;

λ_j = the risk premium related to the j_{th} common risk factor; and

b_{ij} = the pricing relationship between the risk premium and the asset: that is, how responsive asset *i* is to the j_{th} common factor (called factor betas or factor loading).

One of the theory's weaknesses is that it does not say what the factors are or how many there should be. Whereas CAPM defines a single, market-wide risk factor, APT defines several unidentified factors that capture the salient nuances of the market-wide risk. Both models, however, propose linear relationships based on the fact that investors are compensated for committing capital and bearing risk. Whereas CAPM defines a line connecting risk and expected return (security market line), APT defines a plane (security market plane) with k+1 dimensions, where k is a risk factor. The added k dimension is for the asset's expected return (Reilly and Brown, 2003).

2.5.3 Multifactor Models

Multifactor models extend APT by emphasising practical implementation over theory. The implementation of CAPM in an empirical study is dependent on accurately predicting the market portfolio that first requires identifying the relevant population. However, once an accepted portfolio has been identified (R_m) and the remaining parameters estimated (R_f and *MRP*), it is relatively

straightforward to estimate the asset's or portfolio's characteristic equation. Reilly and Brown (2003, 291) state that the following excess return form of CAPM is typically used in empirical studies and is displayed below:

$$(R_{it} - R_{ft}) = \alpha_i + \beta_i (R_{mt} - R_{ft}) + e_{it} \qquad \text{Equation 3}$$

where:

R_{it} = the rate of return for asset *i* during period t;

R_{mt} = the rate of return for the market portfolio m during period *t*;

R_f = the risk free rate of return;

α_i = the constant term, or intercept, of the regression;

β_i = the systematic risk (beta) of asset *i*; and

e_{it} = the random error term.

CAPM has the advantage over APT in that there is a single risk factor, whereas finding a practical, implementable APT relies on finding the identity of the underlying risk factors for the specific application. To solve the problem a different approach to developing an empirical model similar to APT is used. Multifactor models use the essence of APT but rely on the direct specification of the form of the relationship to be estimated. The researcher/investor will specify the exact number and nature of the risk factors based on market knowledge and previous research in the field. The equation below is then used to estimate a useful regression model (Reilly and Brown, 2003, 292):

$$R_{it} = a_i + [b_{i1} F_{1t} + b_{i2} F_{2t} + b_{i3} F_{3t} + . \ . \ . \ . \ . + b_{ik} F_{kt}] + e_{it} \qquad \text{Equation 4}$$

where:

R_{it} = the excess return to asset *i* (either expressed as nominal or excess return as displayed in Equation 3);

a_i = the constant term, or intercept, of the regression;

b_{ij} = the pricing relationship between the risk premium and the asset;

F_{jt} = the return to the j_{th} designated risk factor; and

e_{it} = a random error term.

The advantage of this approach is that the researcher/investor can specify the exact risk factors that need to be estimated to fit the regression equation. The disadvantage is that the model is then developed with little theoretical guidance as to the real risk-return relationship and can involve a lot of educated guess work and a trial and error approach. The wide variety of models that have been developed over the years all tend to focus on two groups of risk factors, namely macroeconomic or microeconomic factors. The test of a good multifactor model is one that is broad enough to capture the major risk nuances, but specific enough to provide meaningful results.

2.5.3.1 Fama and French Three-Factor Model

Fama and French (1993) developed one of the most widely used multifactor models. The model specifies risk in microeconomic terms using certain characteristics of the underlying sample of assets (securities). The characteristic-based approach to forming a multifactor model resulted in Fama and French (1993) augmenting the traditional CAPM with two additional risk factors, namely size and book-to-market ratio. Drawing on the excess return

model discussed in the following time series regression equation:

$$(R_{it} - R_{ft}) = \alpha_i + \beta_{i1}(R_{mt} - R_{ft}) + \beta_{i2}SMB_t + \beta_{i3}HML_t + e_{it} \quad \text{Equation 5}$$

where:

R_{it} = the rate of return for asset *i* during period *t*;

R_{mt} = the rate of return for the market portfolio m during period *t*;

R_f = the risk free rate of return;

α_i = the constant term, or intercept, of the regression;

β_i = the systematic risk (beta) of asset *i*;

SMB = (i.e. small minus big) the return to a portfolio of small capitalisation stocks less the return to a portfolio of large capitalisation stocks;

HML = (i.e. high minus low) the return to a portfolio of stocks with high ratios of book-to-market values less the return to a portfolio of low book-to-market stocks; and

e_{it} = a random error term.

The *SMD* risk factor captures the risk associated to firm size, while *HML* is the book-to-market factor that differentiates between growth firms (low book-to-market) and value firms (high book-to-market). The three-factor model has been amended since its inception by the addition of a forth risk factor, momentum. Carhart (1997) and Brav *et al* (2000) amended the three-factor model with WML (winners minus losers), also termed UMD (up minus down) - a momentum factor calculated as the average return on two high prior-return portfolios minus the average return on two low prior-return portfolios. L'Her, Masmoudi and

Suret (2004) undert arket using the Fama and French (1993) model which was modified with momentum and called the new model the Fama and French four-factor model. The model is similar to Equation Five above, but the UMD factor has been added:

$$(R_{it} - R_{ft}) = \alpha_i + \beta_{i1}(R_{mt} - R_{ft}) + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}UMD_t + e_{it} \quad \text{Equation 6}$$

where:

UMD = (i.e. up minus down) a momentum factor which is the average return on the high prior-return portfolio less the return on the low prior-return portfolio.

2.5.4 Specific South African Asset Pricing Issues

Each country around the world has specific nuances that are particular to asset pricing in that market. There is, therefore, no single pricing model that can be applied across the board in any country. This is especially true when using multifactor models that are market specific due to the more “art” than “science” derivation. South Africa is therefore no different and the market peculiarities need to be identified.

2.5.4.1 Momentum Factor

Robertson and Van Rensburg (2001) undertook a study of JSE securities listed from 1990 to 2000 to investigate the influence of characteristic factors on the returns of the JSE. Using a multivariate cross-section model for stock returns based on selected candidate factors (price-to-net asset value [NAV]), dividend yield, price-to-earnings, cash-flow-to-price, price-to-profit and size), they found

support for a two-fac e and price-to-earnings as the independent variables. They did not, however, find support for any momentum effects. Robertson and Van Rensburg (2001, 9) state that the two factors, size and price-to-earnings, "capture the central intuition behind the international evidence of the style effects relating to value and size (Fama and French, 1992, 1993, *inter alia)*". Two later papers published by Van Rensburg and Robertson in 2003 (Van Rensburg and Robertson, 2003a, 2003b) further supported this work.

2.5.4.2 Resource Anomalies

The JSE is heavily weighted with resource stocks due to South Africa's resourced-based economy and is therefore an important factor to consider in developed multifactor pricing models (Achour, Harvey, Hopkins and Lang, 1998). In addition, the resource sector is not composed of homogenous macroeconomic drivers, for example the platinum price will have a significant effect on platinum stocks, but not on gold and *vice versa* (Robertson and Van Rensburg, 2002). Robertson and Van Rensburg (2002, 10), however, assert: "there is no compelling evidence that the attributes related to resource stock returns have a substantially different identity or sign from those documented for the rest of the JSE."

In addition to the findings on resource stocks, Robertson and Van Rensburg (2002) report the following findings:

- On average, the value factor effects are stronger in the financial and industrial sectors than in the resource sector.
- The small size effect is the same across all sectors.

- The small siz um in South Africa as in other emerging and developed countries.
- Attributes associated with growth are positively rewarded in the resource sector.

2.5.4.3 A South African Risk Model

BARRA, a leading risk forecasting and investment-consulting firm, has also carried out research in the field of microeconomic multifactor risk models using 13 characteristic-based factors. In 1995 the organisation embarked upon and completed a project to build a model to predict and explain the risk of investing in South African equities. The multifactor model consists of a number of style and industry factors common to all stocks that explain the risk of individual assets and portfolios (Cauldwell, 1995). They claim that industry-specific risk is the least important contributor to risk while style-based risk is the highest. Of the style-based risks, the following are the most important:

- Size
- Foreign exposure
- Value
- Dividend yield
- Market sensitivity
- Historical volatility
- Labour intensity.

Size and value are directly related to two of the four risk factors in the Fama and French four-factor model, namely SMB and HML respectively (Section 2.5.3.1), indicating the potential of the four-factor model in South Africa.

2.6 Summary o

In conclusion, the available literature shows that the debate on corporate hedging has not been finalised and that there is no overwhelming theoretical or empirical evidence to support a company hedging their market risk by means of derivative instruments. Even though businesses are exposed to a multitude of risks, the available literature cannot assist a decision-maker in making better decisions about corporate hedging or assist in providing guidance as to whether corporate hedging is a value-adding or value-destroying strategy. In addition, there has been no South African specific research in the field of corporate hedging or derivative usage. There is no South African literature that quantifies the extent of derivative usage or that empirically researches the impact of derivative usage on company performance.

However, a recent article by Nelson *et al* (2005) has extended the available knowledge on the subject as they undertook a study specific to corporate hedging and the impact on the market value of equity. They attempted to correct many of the mistakes made by previous work in the area and to expand the study to a significantly larger and broader sample of companies and derivative types. The work, however, only focussed on the U.S. market and did not attempt in any way to explore other markets. Each market has its own specific nuances. Consequently, there is still a large gap in the literature as there is no research available to assist South African decision-makers. This research attempts to reduce the gap and will provide a resource to guide their decision-making on corporate hedging strategies.

3 RESEARCH

The purpose of the five propositions in this study is first to determine the extent of hedging in South Africa and second to investigate the impact that corporate hedging has on company performance. The following are specific research propositions that are to be investigated:

- Proposition 1: South African companies hedge their market risk by means of financial derivative instruments.
- Proposition 2: Companies that disclose the use of financial derivatives for hedging their market risk show a greater increase in annual stock price performance than the market as a whole.
- Proposition 3: Companies that disclose the use of derivatives for hedging their currency risk experience a greater increase in annual stock price performance than companies that disclose the use of interest rate or commodity derivatives.
- Proposition 4: The greater annual increase in stock price performance over the market for companies using derivative instruments is concentrated in larger companies.
- Proposition 5: There is a positive relationship between the annual increase in stock price performance over the market for companies using derivative instruments and the return to resource-based companies.

The study utilises three specifically developed databases to gather and analyse data on derivative usage in South Africa and uses statistical techniques (primarily multiple regression analysis) to verify whether the findings in other

markets apply to S e results from this South African study should be comparable to the work undertaken by Nelson *et al* (2005) in the U.S. However, it is also expected that the unique structure of the JSE (heavily resource-focussed and with a few large companies dominating) could impact on a direct comparison between the two markets. The forth and fifth propositions have been formulated to understand the impact of these differences.

4 RESEARCH

4.1 Research Method

This study systematically and objectively located, evaluated and synthesised secondary data from JSE-listed companies in order to empirically quantify the extent and value of corporate hedging in South Africa. As such, the study can be classified as a formal study using a documentary research technique (Roberts, 1996). Rather than collecting primary data, secondary data was sourced from existing financial databases and publications and analysed using a quantitative research method based on multiple regression and descriptive statistical techniques.

Creswell (1994, 2) states that a quantitative study "is an inquiry into a social or human problem, based on testing a theory composed of variables, measured with numbers and analysed with statistical procedures, in order to determine whether the predictive generalisations of the theory hold true." It is therefore argued that the quantitative research method is the best technique to address this specific research problem.

In brief, the research method is dominated by statistical analysis on a database of cross-sectional data developed from financial figures and ratios, as well as total share price return data.

4.2 Populations

Albright, Winston and Zappe (2003, 366) define a population as "the set of all members about which the study intends to make inferences, where an inference is a statement about a numerical characteristic of the population." The study refers to one of two different populations dependent on the proposition to be investigated. One population is, however, simply a subset of the other.

The two populations to be discussed were derived from a dataset of all companies listed on the JSE as of 31 December 2005. The dataset of 340 shares was downloaded from Sharedata Online[3] and contained shares listed on all the JSE boards and companies that had recently been suspended. It is important to note that the dataset was never changed through the study and, therefore, shares that may have been active prior to 31 December 2005 but were not active that day, were not included in the study. This has survivor bias implications discussed in Section 4.8.

4.2.1 First Population

Proposition one makes an inference to all non-financial companies on the JSE and the population, therefore, consists of all -

- non-financial companies;
- listed and active, on the main board of the JSE on 31 December 2005.

The population of non-financial companies consisted of 210 shares as of 31 December 2005, and is henceforth termed the "non-financial companies population".

[3] http://www.sharedata.co.za

4.2.2 Second Po

Propositions two through five only make reference to the subset of derivative users in the first population and, therefore, consist of all companies from the non-financial companies population that disclosed the use of derivative instruments to hedge their market risk by means of commodity, interest rate or foreign currency hedging. The derivative population consisted of 133 shares and is henceforth termed the “derivative-usage population”.

4.2.3 Defence of Populations

The populations are specific due to the nature and complexity of derivative usage. The population requirements listed above are justified by means of the following:

- Financial companies have been excluded from the population as financial institutions do not only hedge risk, but also speculate. The population therefore excludes all companies in the following sectors: banks, insurance, financial services and investment instruments. This methodology is consistent with similar research by Graham and Rogers (1999).
- Only companies on the JSE have been selected to be part of the population as listed companies are compelled to disclose the use of derivative instruments in their annual reports (AC 125 and AC 133). Private companies may hedge market risk, but they are not compelled to disclose their derivative usage to the general public and there is, therefore, no easy and consistent manner in which to gather data in a short space of time.

- Only active ıy share suspended on 31 December 2005 was excluded from the population. The reason for this was to negate the need to investigate the reason for suspension and the impact the suspension may have had on the data.
- Only JSE main board shares were considered to ensure that only companies with rigorous listing and reporting requirements were considered.
- To ensure consistency in data collection, only companies that formally disclosed the use of derivative instruments were selected for the population.

4.3 Samples

Welman and Kruger (2001, 46) state that the "size of a population usually makes it impractical and uneconomical to involve all members of the population in a research project and consequently it is necessary to rely on a sample of the population." The intention of this study was to include all members (units of analysis) of the population into the sample to create a census, but unfortunately not all the necessary data could be located.

The population of non-financial companies was drawn from the 340 companies downloaded from Sharedata Online on 31 December 2005. Of the 340 companies, 210 were categorised as non-financial, but information on only 201 could be located and not the full 210 necessary to create a census. The sampling technique would therefore be considered a non-probability

convenience sampl ed the most conveniently available units of analysis (Zikmund, 2000).

The reason for the attempted census sampling technique is that the derivative population is a smaller subset of the non-financial companies population. With no previous research to provide an indication of derivative usage in South Africa, it is argued that the largest possible non-financial companies sample would provide a more statistically meaningful derivative population. In addition, a small derivative population may have provided insufficient companies that hedge at the lower level of commodity, interest rate and currency risk. However, it is argued that this risk is minimal as the sample of non-financial companies includes 96% of the non-financial companies population and the missing data is limited to low market capitalisation companies. In addition, the derivative-usage sample is a census as it is “an investigation of all the individual elements making up the population” (Zikmund, 2000, 339).

In summary, the non-financial companies sample is a convenience sample of the non-financial companies population and the derivative-usage sample is a census of the derivative-usage population.

4.4 Data

The study utilised secondary research data from various sources to develop the databases necessary to run the statistical routines.

Data	Data Source	Period
JSE Population on 31 December 2005	Sharedata Online	As of 31 December 2005
Company Annual Reports	Company web-pages, Sharedata Online, JSE	Annual (2002 to 2006 depending on company year end)
Market Capitalisation	I-Net Bridge	Monthly (June 2001 to June 2005)
Total Returns	MSCI[4] Barra™	Monthly (June 2001 to June 2005)
R153	I-Net Bridge	Monthly (July 2002 to June 2005)
Foreign Currency to Rand Conversion Rates	Reuters	Monthly (Jan 2002 to July 2005)
Balance Sheet Data	McGregor BFA	Annual (2002 to 2006 depending on company year-end)

4.5 Data Collection

The study used secondary data obtained from the various sources in order to construct two separate databases to be discussed in detail in Section 4.6 below. A third database was also constructed to assist with data analysis. As it uses only data derived from the first two databases it will be discussed further in Section 4.6 and not in this section.

The first database details, by individual share in the sample, whether the companies declared the use of financial derivatives; if so, when and what risk the derivative was to manage: currency, commodity or interest rate. The second database is significantly more complex and utilises data from many different sources in order to construct the risk factors used in the Fama and French four-factor regression and other multifactor models.

4.5.1 First Database: Derivative Usage

In order to define the derivative-usage population from the sample of non-financial companies, it was necessary to obtain and examine in full an annual

[4] Morgan Stanley Capital International Inc. and Barra Inc.

report of each non tion. As Section 4.7 will detail, the study focuses on the three-year period from June 2002 to July 2005. However, as companies do not all have the same year-end, it was necessary to obtain each company's annual report relating to the review period. For example, where the company reported in June, it was only necessary to obtain the annual reports for 2003, 2004 and 2005. However, all companies with a year-end prior to June required the 2006 report and those with a year-end post-June required the 2002 annual report. In total, 712 annual reports were required to provide a comprehensive review of derivative usage within the non-financial companies sample.

4.5.1.1 Data Sources

The primary source of the annual reports was Sharedata Online. The company stores Portable Document Format (PDF) files in their database that can be accessed and downloaded for a fee. In addition to reports obtained from Sharedata Online, numerous PDF annual reports were downloaded directly from the respective companies' own Internet pages. As a last resort, hard copies of the annual reports were obtained from the JSE or the companies directly.

4.5.1.2 Data Extraction

In order to extract the derivative usage information from the PDF annual reports and develop the population to be studied, the advanced search functionality of the software package Adobe Reader 6 was used to identify any reference to derivative usage. An extensive list of keywords (identified in Appendix A) was searched for in a folder containing all the electronic annual reports. On

completion of the se arefully examined for any reference to derivative usage and market risk hedging. The annual reports in hard copy format were manually examined with focus on the notes section of the report where the derivative usage information tended to reside.

4.5.1.3 Data Collections: Problems and Concerns

The collection of annual reports to obtain information on derivative usage provided a few problems. First, it was not possible to obtain either an electronic or hard copy of each of the 712 companies in the sample, although just fewer than 700 annual reports were obtained and scrutinised. Where it was not possible to obtain an annual report, one of two processes was followed. The companies were telephoned and a knowledgeable resource questioned, usually the company treasurer or financial director. Alternatively, inferences were made from the proceeding and following year's derivative usage history. For example, if a company declared an open currency hedge position at the end of 2004, it would be correct to assume the company used currency derivatives in 2005, even if only for the first day of the new financial year. Nelson *et al* (2005, 857) used a similar method: "if a firm discloses an outstanding derivative position at the end of financial year *X*, we can classify the firm as a derivative user in year *X* and year *X* + 1".

Second, although AC 125 compelled companies to disclose derivative usage from 1998 and AC 133 required the revaluation of derivative instruments from 2001, it was only in 2003 that companies in South Africa started to fully comply with the disclosure of derivative usage. Therefore, in annual reports for 2002 the references to derivative usage were occasionally vague and sometimes even

contradictory. Where nancials were deemed to be correct as it was often found that auditors simply cut and pasted accounting convention and definition information from other annual reports or accounting textbooks. Where references were vague, again the notes to the financials took precedence and the later annual reports were looked into for guidance.

4.5.2 Second Database: Portfolio Construction

The second database consisted of data collected from various sources and was used to construct the risk factors in the Fama and French four-factor model and the risk factors to be used in additional regression models.

4.5.2.1 Data Sources and Collection

Total Return Data

MSCI Barra™ supplied the total monthly market-return data. The local South African division kindly supplied this data in a flat file that was then manipulated to provide a table containing total return by month and by company. The total return data supplied by MSCI Barra™ was constructed by finding the percentage change in the month-end closing share price added to which was any dividend yield declared for that month. The price was corrected for any capital events such as share splits or buy-backs.

Market Capitilisation

Market capitalisation by month and company was obtained as a direct download into Microsoft Excel from I-Net Bridge.

Balance Sheet Data

Various elements of annual data from each company's balance sheet were required to calculate the book equity of the company. The data required was downloaded from McGregor BFA into a Microsoft Excel spreadsheet. The following data elements were downloaded:

- Ordinary shareholder's interest after adjustments
- Preference shares
- Debentures (if applicable)
- Deferred tax.

Government Bond Yield

The R153 is currently the most accepted proxy for the South African risk free rate (PriceWaterhouseCoopers, 2003) and was downloaded from I-Net Bridge into a Microsoft Excel spreadsheet. The yearly rate was converted into a monthly value as follows:

$$\left(\left(\frac{AnnualRate}{100}+1\right)^{(1/12)}-1\right) \qquad \text{Equation 7}$$

Foreign Currency to Rand Conversion Rates

A minority of companies on the JSE report in a currency other than South African rand and therefore the balance sheet data discussed above had to be converted from the foreign currency to rand. The year-end numbers were converted using the spot rate for the last day of the companies' specific year-end. The data was obtained from Reuters. The following foreign currency data were required:

- Europe (EUR
- Great British Pound (GBP)
- United States Dollar (USD)
- Australian Dollar (AUD)
- Zimbabwian Dollar (ZWD)
- Nigerian Naira (NGN)
- Namibian Dollar (NAB).

4.5.2.2 Data Collection: Problems and Concerns

The data obtained to develop the second database were problematic in that the data sources were not error-free and data cleansing was critical. The majority of data cleansing was carried out on the balance sheet data from McGregor BFA and the market capitalisation data from I-Net Bridge. In order to correct the data, the ratio of book equity to market equity was calculated, as this was necessary for the HML factor in the Fama and French four-factor model. If the ratio of book equity to market equity was extremely small or high in comparison to the average, the market capitalisation and all the balance sheet elements making up the book equity factor were investigated and cross-referenced against other sources. The company's actual annual report was used as a reference for balance sheet data and Reuters and Sharedata Online for the market capitalisation. Reuters was used to confirm the closing share price and the annual report or Sharedata Online was used to confirm the weighted average ordinary shares in issue. The closing share price and number of shares in issue were used to calculate a representative market capitalisation by month. In most cases the market capitalisation was simply wrong by multiples of 1 000 and could be easily corrected. In other cases the solution was not as

straightforward and ituted for the incorrect I-Net Bridge value.

4.6 Database Construction

The following section will detail how the two databases were constructed from the data discussed above. In addition, the third database, only developed from data originating from one of the first two databases, will be discussed. The latter database constructed the dependent variables to be used in the regression models.

4.6.1 First Database: Derivative Usage

The derivative-usage database was constructed using the data discussed in Section 4.5.1. A two-by-two matrix was developed which detailed by company the following information:

- Full company name
- Share code
- Year-end
- Industry sector
- A “yes” or “no” reply to the following:
    - Has the company used any type of derivative at least once since July 2002?
    - Has the company used any type of derivative since July 2002 but specified by financial year?
    - Has the company used commodity derivatives since July 2002 specified by financial year?

- Has tl rivatives since July 2002 specified by financial year?
- Has the company used currency derivatives since July 2002 specified by financial year?
- Has the company used only currency derivatives since July 2002 specified by financial year (i.e. in 2002 company *i* used only currency derivatives and not in conjunction with either interest rate or commodity derivatives)? This study defines a company that uses only currency derivatives as a "pure derivative user".

- Size quartile, where size was calculated by averaging the year-end market capitalisation of each company from 2003 to 2005.

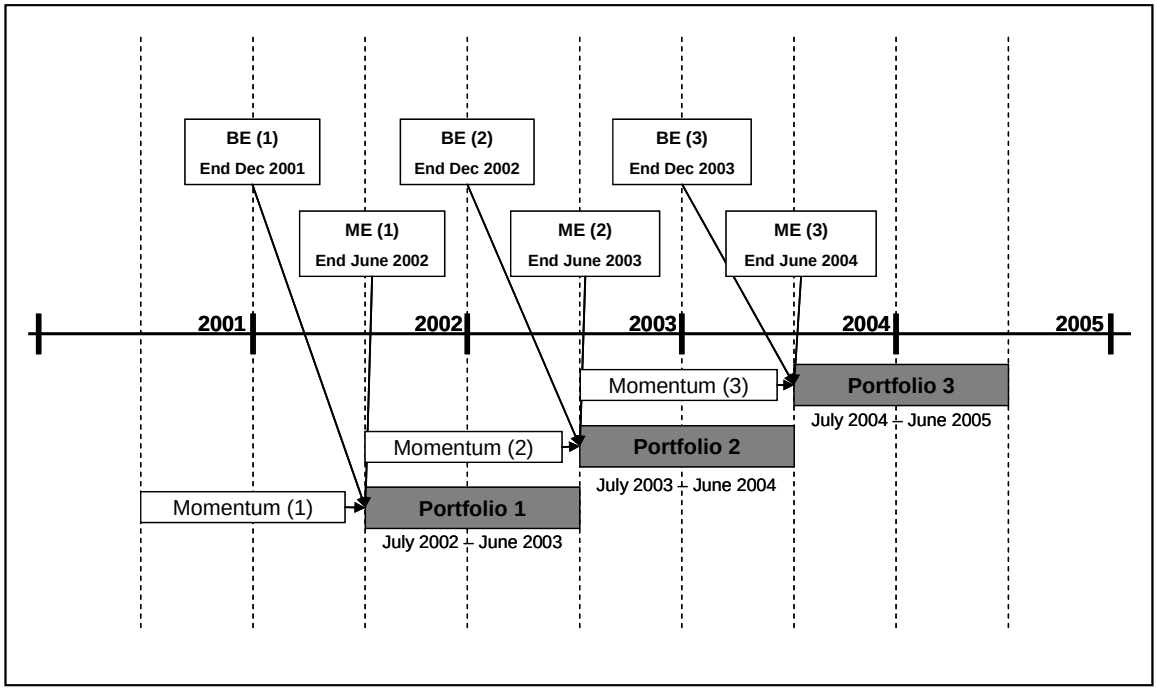
The database was constructed to take account of the staggered company year-ends as discussed in Section 4.5.1. For instance, a company with a September year-end that disclosed the use of derivatives was considered to have used derivatives from October of the previous year to the September year-end. As the portfolios run from July to June, only companies with a June year-end required three annual reports, June 2003, 2004 and 2005. All other years required additional annual reports for either 2002 or 2006, depending on whether the year-end was before or after June as discussed in Section 4.5.1.

4.6.2 Second Database: Portfolio Construction

The second database is significantly more complex and was used to construct the factors to be used as the independent variables (risk factors) in the standard Fama and French four-factor model, as well as other regression models. The

diagram below prov ios to assist in explaining the detailed process used to construct the regression factors.

Figure 2: Schematic representation of portfolio construction



4.6.2.1 Fama and French Risk Factors

The Fama and French risk factors were constructed in keeping with Fama and French (1993) where possible. It was necessary to adapt some of the methods used by Fama and French as the JSE is limited in terms of active shares as compared to exchanges in the developed world and because of the fact that the exchange is heavily weighted against a small number of large companies. The Fama and French four-factor model discussed in Section 2.5.3.1 (Equation 6) is:

$$(R_{it} - R_{ft}) = \alpha_i + \beta_{i1}\,(R_{mt} - R_{ft}) + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}UMD_t$$

The four-factor mo n of a share (R_{it}–R_{ft}) is explained by the return of the market portfolio over the risk free rate (R_{mt}–R_{ft}) and three factors designed to mimic market risk related to size, book-to-market and momentum, namely SMB, HML and UMD respectively. Each of the three risk factors is made up of a portfolio of shares created at the beginning of July and held through to the end of June the following year. No shares can move into or out of the portfolio during the year and the portfolios are reconstructed again the next July. The period covered by this study was from July 2002 until June 2005, and therefore all the portfolios had to be recreated three times as shown in the diagram above. Portfolio 1, Portfolio 2 and Portfolio 3 were constructed in chronological order.

At the end of June 2002 all shares on the JSE, financial and non-financial, were ranked, based on their market capitalisation from biggest to smallest. A 50% breakpoint was established and all shares in the top 50% were designated big (B) and the remaining 50% small (S). The same exercise was carried out at the end of June 2003 and June 2004 and is consistent with methods followed by L'Her *et al* (2004) and Nelson *et al (*2005).

In order to rank the same shares by book-to-market value, the balance sheet data discussed in Section 4.5.2 (ordinary shareholder's interest after adjustments, preference shares, debentures and deferred tax) was used to construct a book equity value. As per L'Her *et al* (2004) and Nelson *et al* (2005), the book equity was computed as the book value of stockholder's equity, plus balance sheet deferred taxes, minus the book value of preference shares. The debentures value was added to the ordinary shareholder's interest of financial

real estate compan value from shareholder's interest. All shares with negative book equity were excluded from the sample. The balance sheet data of each company that reported in a foreign currency was converted to rand using the prevailing spot rate as of the companies' year-ends. This ensured that all book-to-market calculations were calculated using only rand values.

The book equity was constructed using the balance sheet data available to the public at the end of December. The reason for the 6-month delay was to ensure that each company had released their annual report to the general public. The book-to-market value was created by dividing the book equity as of the end of December with the market equity as of the end of June, 6 months later. Unlike the 50%-breakpoint used to designate company size as small and big, the book-to-market value had breakpoints at 30% and 70% once ranked. The shares above the 70%-breakpoint were designated high (H), the middle 40% were designated neutral (N) and the shares below 30% were designated low (L). The procedure of differing breakpoints for SMB (50:50) and HML (30:40:30) is consistent with the literature used as the basis for this study (L'Her *et al* (2004) and Nelson *et al (*2005)), but various breakpoint percentages have been utilised in the literature depending on the nuances of the market under review and the researcher's preference. The UMD factor discussed below has been adjusted from the standard 30:40:30 breakpoint split to 50:50 for just this reason.

A value for momentum was constructed at the end of June in a similar manner as that of the size and consistent with L'Her *et al* (2004). A 50%-breakpoint was

identified once all th ghted average total return in the 10-month period from June to March, prior to the portfolio construction at the end of the following June. The shares were categorised as either “up” (U) if they were in the top 50%, or “down” (D) if they were in the bottom 50%. This method is similar to the one used by L’Her *et al* (2004), except that they selected two breakpoints similar to ranking book-to-market value. This method could not be used for the JSE because the large market capitlaisation shares in South Africa dominate the market and therefore, when weighting the returns by market capitalisation to create a weighted average return, the majority of B shares were U and the majority of S shares were D. The resultant analysis, with two as opposed to one breakpoint, was not meaningful, and therefore, the decision was taken to use the one breakpoint at 50%.

On completion of ranking by size, book-to-market value and momentum, each share was categorised by three letters that included either “S” or “B”; “H”, “N” or “L”; and “U” or “D”. These letters were allocated to every share on the JSE at the beginning of July in each of the three years under review. The table below shows an extract from the database for explanatory purposes:

Table 3: Extract from database to show categorisation

COMPANY	BE/ME	ME	Mom	SMB	HML	UMD
Absa Group Ltd	N	B	M	BN	BN	BM
Absolute Holdings Ltd	L	S	D	SL	SL	SD
Acucap Properties Ltd	H	S	M	SH	SH	SM
Adcorp Holdings Ltd	L	S	U	SL	SL	SU
ADvTECH Ltd	N	S	U	SN	SN	SU
AECI Ltd	N	B	M	BN	BN	BM
Winhold Ltd	H	S	U	SH	SH	SU
Wooltru Ltd	H	S	D	SH	SH	SD
Woolworths Holdings Ltd	L	B	M	BL	BL	BM
Zambia Copper Investments Ltd	H	S	U	SH	SH	SU
Zaptronix Ltd	L	S	U	SL	SL	SU

The next step in the to categorise the shares into one of six portfolios to calculate the SMB and HML factor, and then into one of four portfolios to calculate the UMD factor. First, to assist in the calculation of SMB and HML, the six portfolios were created by concatenating the letter allocated from the size ranking and the book-to-market ranking, i.e. a big size share with low book-to-market value would be BL, and a small size share with a neutral book-to-market value would be SN. Each share was therefore allocated to one of six portfolios, namely SL, SN, SH, BL, BN or BH. Second, to assist in the calculation of the UMD factor, a further four portfolios were created in a similar way, namely SU, SD, BU and BD, where SU is a small share with positive momentum and BD a big share with negative momentum. Note that in all cases the number of shares in each of the ten portfolios varies. The table below provides an extract from the database to indicate the portfolio allocation.

Table 4: Extract from database to show categorisation of portfolios

COMPANY	BE/ME	ME	Mom	SMB	HML	UMD	2005-Jan	2005-Feb	2005-Mar	2005-Apr	2005-May
Absa Group Ltd	N	B	M	BN	BN	BM	0.53%	4.06%	-5.15%	3.18%	5.96%
Absolute Holdings Ltd	L	S	D	SL	SL	SD	25.00%	-10.00%	0.00%	-11.11%	-25.00%
Acucap Properties Ltd	H	S	M	SH	SH	SM	-1.81%	5.33%	1.20%	1.19%	9.41%
Adcorp Holdings Ltd	L	S	U	SL	SL	SU	14.50%	2.33%	-5.30%	0.27%	-6.91%
ADvTECH Ltd	N	S	U	SN	SN	SU	5.83%	0.79%	5.47%	3.70%	1.74%
AECI Ltd	N	B	M	BN	BN	BM	5.13%	4.88%	-1.16%	-0.26%	2.82%
Winhold Ltd	H	S	U	SH	SH	SU	-4.11%	4.52%	3.24%	-0.52%	-26.32%
Wooltru Ltd	H	S	D	SH	SH	SD	10.71%	-3.23%	10.00%	-9.09%	13.33%
Woolworths Holdings Ltd	L	B	M	BL	BL	BM	-3.07%	-5.53%	-2.89%	-3.02%	7.88%
Zambia Copper Investments Ltd	H	S	U	SH	SH	SU	-2.38%	2.68%	12.83%	2.11%	0.00%
Zaptronix Ltd	L	S	U	SL	SL	SU	0.00%	75.00%	85.71%	0.00%	46.15%
							3.11%	**2.96%**	**1.27%**	**0.27%**	**7.94%**

Once each share had been allocated to its respective portfolios and the share's weighted total return data by month constructed (by multiplying its contribution to the total market capitalisation by its total return as supplied by BARRA MSCI™), Microsoft Excel's pivot table functionality could be used to calculate the weighted average return of each of the ten portfolios used to construct SMB, HML and UMD. The three factors were calculated for each month of the 36-

month review perio d an extract of the pivot tables below illustrates the method.

Table 5: Extract of the pivot tables

SMB

Sum of Jul-04		
SMB	Total	
BH	0.25%	0.25%
BL	0.36%	0.36%
BN	1.47%	1.47%
SH	0.01%	0.01%
SL	0.02%	0.02%
SN	0.02%	0.02%
Grand Total	2.13%	**-0.68%**

HML

Sum of Jul-04		
SMB	Total	
BH	0.25%	0.25%
BL	0.36%	0.36%
BN	1.47%	1.47%
SH	0.01%	0.01%
SL	0.02%	0.02%
SN	0.02%	0.02%
Grand Total	2.13%	**-0.06%**

UMD

Sum of Jul-04		
UMD	Total	
BD	-0.05%	-0.05%
BU	2.13%	2.13%
SD	0.02%	0.02%
SU	0.03%	0.03%
Grand Total	2.13%	**1.09%**

The blocks highlighted in grey are the results of the equations used to calculate the equally-weighted average returns on the portfolios. These equations are as follows:

1. SMB is the equally-weighted average return on the small share portfolios minus the returns on the big share portfolios:

$$SMB = \frac{(SL - BL) + (SN - BN) + (SH - BH)}{3}$$

2. HML is the equally-weighted average return of the high book-to-market value share portfolios minus the return of the low book-to-market value share portfolios:

$$HML = \frac{(SH - SL) + (BH - BL)}{2}$$

3. UMD is the equally-weighted average return of the returns on the winner share portfolios minus the returns on the loser stock portfolios:

$UMD = \frac{1}{2}$

In addition to determining the Fama and French risk factors above, the market risk premium (R_m–R_f), which is the market capitalisation weighted return of all the shares in excess of the realised monthly return on the R153 South African government bond, was calculated. The same data used to construct the pivot tables were used to calculate the market risk premium and are illustrated in the last row of Table 6 below.

Table 6: Extract from database showing calculation of the market risk premium

COMPANY	BE/ME	ME	Mom	SMB	HML	UMD	2005-Jan	2005-Feb	2005-Mar	2005-Apr	2005-May
Absa Group Ltd	N	B	M	BN	BN	BM	0.53%	4.06%	-5.15%	3.18%	5.96%
Absolute Holdings Ltd	L	S	D	SL	SL	SD	25.00%	-10.00%	0.00%	-11.11%	-25.00%
Acucap Properties Ltd	H	S	M	SH	SH	SM	-1.81%	5.33%	1.20%	1.19%	9.41%
Adcorp Holdings Ltd	L	S	U	SL	SL	SU	14.50%	2.33%	-5.30%	0.27%	-6.91%
ADvTECH Ltd	N	S	U	SN	SN	SU	5.83%	0.79%	5.47%	3.70%	1.74%
AECI Ltd	N	B	M	BN	BN	BM	5.13%	4.88%	-1.16%	-0.26%	2.82%
Winhold Ltd	H	S	U	SH	SH	SU	-4.11%	4.52%	3.24%	-0.52%	-26.32%
Wooltru Ltd	H	S	D	SH	SH	SD	10.71%	-3.23%	10.00%	-9.09%	13.33%
Woolworths Holdings Ltd	L	B	M	BL	BL	BM	-3.07%	-5.53%	-2.89%	-3.02%	7.88%
Zambia Copper Investments Ltd	H	S	U	SH	SH	SU	-2.38%	2.68%	12.83%	2.11%	0.00%
Zaptronix Ltd	L	S	U	SL	SL	SU	0.00%	75.00%	85.71%	0.00%	46.15%
							3.11%	**2.96%**	**1.27%**	**0.27%**	**7.94%**

Table 7 below summarises the Fama and French factors. These numbers are used as the independent variables for the regression model described in Section 4.7.

Table 7: Sumr s to be used in the statistical analysis

Month	SMB	HML	UMD	MRP
Jul-02	4.095%	2.062%	-4.089%	-13.165%
Aug-02	-1.978%	-1.859%	3.013%	5.073%
Sep-02	0.118%	-1.524%	0.540%	-1.261%
Oct-02	-0.111%	0.670%	-1.590%	-0.464%
Nov-02	-0.733%	-0.890%	0.402%	1.500%
Dec-02	0.657%	-0.890%	0.000%	-2.779%
Jan-03	1.282%	0.291%	-1.583%	-4.680%
Feb-03	1.455%	1.207%	-1.127%	-5.143%
Mar-03	2.571%	1.536%	-2.380%	-8.535%
Apr-03	0.443%	0.923%	-2.765%	-2.108%
May-03	-4.909%	-2.461%	5.741%	14.125%
Jun-03	0.621%	0.485%	-1.846%	-2.533%
Jul-03	-1.824%	-0.158%	0.962%	4.836%
Aug-03	-1.949%	-1.548%	-2.158%	5.251%
Sep-03	0.850%	0.274%	1.363%	-3.181%
Oct-03	-3.327%	-1.173%	-3.516%	9.523%
Nov-03	-0.309%	-0.383%	0.151%	0.332%
Dec-03	-2.354%	-0.611%	-2.619%	6.527%
Jan-04	-1.636%	-0.095%	-2.289%	4.400%
Feb-04	-0.149%	0.494%	-0.006%	-0.168%
Mar-04	0.210%	-0.158%	0.962%	-1.284%
Apr-04	0.844%	1.151%	0.913%	-3.197%
May-04	-0.203%	-0.322%	-0.088%	-0.213%
Jun-04	0.700%	0.614%	1.439%	-2.790%
Jul-04	-0.676%	-0.063%	1.092%	1.360%
Aug-04	-3.064%	-1.033%	4.317%	8.622%
Sep-04	-1.768%	-0.123%	2.464%	5.081%
Oct-04	-0.052%	-0.123%	2.464%	-0.104%
Nov-04	-2.487%	-1.213%	3.794%	7.080%
Dec-04	-0.456%	0.092%	0.762%	1.059%
Jan-05	-0.515%	-0.266%	0.931%	1.123%
Feb-05	-1.928%	-0.277%	2.590%	5.331%
Mar-05	0.210%	0.279%	-0.191%	-1.245%
Apr-05	1.525%	0.228%	-1.967%	-5.113%
May-05	-3.344%	-1.155%	4.675%	9.563%
Jun-05	-0.919%	-0.410%	1.079%	2.266%

4.6.2.2 Additional Regression Factors

The last regression factor calculated from the data was the monthly weighted-average return of all resource-based firms over the risk free rate (R153). The return was calculated using a method similar to the one used to calculate the market risk premium, but only shares in the resource sector were selected. The shares selected to be part of the resource index were from the following industry sectors:

- Chemicals
- Forestry and paper
- Industrial metals
- Mining
- Oil and gas.

The table below sur factors to be used in the modified Fama and French four-factor model.

Table 8: Summary of the resource regression factors to be used in the statistical analysis

Month	Resources
Jul-02	-17.23%
Aug-02	8.90%
Sep-02	2.53%
Oct-02	-4.23%
Nov-02	-3.56%
Dec-02	0.57%
Jan-03	-4.90%
Feb-03	-4.99%
Mar-03	-8.97%
Apr-03	-9.02%
May-03	19.40%
Jun-03	-6.70%
Jul-03	5.03%
Aug-03	10.09%
Sep-03	-5.06%
Oct-03	9.67%
Nov-03	-4.44%
Dec-03	8.12%
Jan-04	4.95%
Feb-04	-0.16%
Mar-04	-5.27%
Apr-04	-7.60%
May-04	-0.89%
Jun-04	-6.46%
Jul-04	3.09%
Aug-04	13.32%
Sep-04	3.00%
Oct-04	-7.66%
Nov-04	1.28%
Dec-04	-4.09%
Jan-05	3.21%
Feb-05	10.45%
Mar-05	0.64%
Apr-05	-8.71%
May-05	15.35%
Jun-05	1.68%

4.6.3 Third Database: Construction of Dependent Variable

Although only two databases are discussed under data collection in Section 4.5, a third database was constructed from results generated by the derivative usage database and the portfolio construction database, so no new data was required. The third database was used to construct the dependent variables used in the regression analysis, (R_{it}–R_{ft}) in the Fama and French four-factor model. The following five portfolios relating to derivative usage were

constructed to prod the study and to provide insight into the five propositions:

1. “All Types” which aggregates all companies that disclosed any derivative usage.
2. “Currency” which aggregates any company that disclosed the use of currency derivatives.
3. “Commodity” which aggregates any company that disclosed the use of currency derivatives.
4. “Interest Rate” which aggregates any company that disclosed the use of currency derivatives.
5. A second “Currency” portfolio which aggregates only pure users of currency derivatives during the period under review.

In order to construct the above portfolios, the sample of companies that made use of derivatives at any point during the review period was extracted from the derivative usage database. Then, referring to the derivative usage database again, all shares that did not use derivatives in a month as dictated by the five derivative portfolios above, were excluded from the population. For example, for portfolio three, only companies that used commodity derivatives in an individual month were included, while all other shares were excluded from the sample. Microsoft Excel functionality was then used to extract from the portfolio database each company’s total return data and market capitalisation to calculate a weighted total monthly return by individual share. An extract of the weighted returns by share for users of commodity derivatives can be seen in Table 9 below.

Table 9: Extract f commodity derivative and associated weighted returns (non-commodity derivatives have not been excluded for display purposes)

Company	YE	Jul-02	Aug-02	Sep-02	Oct-02	Nov-02	Dec-02
ADVTECH	December						
AECI	December						
AF & OVR	June						
AFGRI	February	-0.01%	0.02%	-0.01%	0.03%	0.00%	0.02%
AFROX	September						
AGI	June						
ALTECH	February						
ALTRON	February						
AMAPS	June						
ANGGOLD	December	-1.50%	1.69%	2.23%	-1.03%	-0.81%	2.86%
ANGLO	December	-7.71%	2.20%	0.67%	-0.76%	-0.49%	-0.99%
ANGLOPLAT	December	-2.40%	2.75%	-0.04%	0.30%	-1.23%	-0.79%
WINHOLD	September						
WOOLIES	June						
		-15.58%	**11.90%**	**3.25%**	**-4.14%**	**-2.90%**	**-0.94%**

Similar to the weighted average total return calculation for the market risk premium as shown in Table 6, the weighted average total return for each month of the selected portfolio was calculated by adding the columns. Once complete, the weighted average total return for all 36 months from July 2002 to June 2005, for each of the five portfolios, was available. In keeping with the Fama and French four-factor model, the risk free rate (R153) was subtracted from the weighted average total return of the portfolio to generate an excess return value per month. Table 10 summarises the excess returns of the five portfolios by month. These figures are used as the dependent variables for the regression models described in Section 4.7.

Table 10: Summar e used in the statistical analysis

	Port 1	Port 2	Port 3	Port 4	Port 5
Jul-02	-14.43%	-14.42%	-16.48%	-14.97%	-4.97%
Aug-02	5.91%	5.76%	10.98%	4.51%	-1.50%
Sep-02	-0.72%	-0.90%	2.31%	-2.72%	-1.69%
Oct-02	-1.88%	-1.72%	-5.06%	-2.14%	9.08%
Nov-02	-0.35%	-0.09%	-3.76%	0.43%	9.91%
Dec-02	-1.13%	-1.21%	-1.80%	-3.99%	-3.27%
Jan-03	-5.78%	-5.78%	-9.32%	-7.28%	-0.62%
Feb-03	-5.00%	-4.93%	-5.86%	-3.99%	-3.25%
Mar-03	-8.40%	-8.17%	-9.85%	-7.57%	-5.71%
Apr-03	-4.73%	-4.67%	-10.76%	-4.63%	1.76%
May-03	15.79%	15.45%	26.53%	15.09%	8.43%
Jun-03	-3.27%	-3.20%	-9.69%	-4.38%	6.78%
Jul-03	5.70%	5.70%	8.75%	6.31%	5.26%
Aug-03	7.34%	7.38%	13.16%	6.91%	5.07%
Sep-03	-3.45%	-3.57%	-8.34%	-3.96%	1.15%
Oct-03	9.88%	9.95%	15.99%	9.51%	12.26%
Nov-03	-0.02%	-0.15%	-3.28%	-0.08%	3.97%
Dec-03	7.32%	7.35%	12.71%	7.31%	8.52%
Jan-04	5.03%	4.92%	8.48%	4.88%	2.26%
Feb-04	-0.35%	-0.34%	1.74%	0.21%	0.57%
Mar-04	-1.90%	-1.79%	-6.71%	-2.86%	4.40%
Apr-04	-4.47%	-3.99%	-8.91%	-3.98%	-1.43%
May-04	-1.19%	-0.67%	-0.39%	-0.62%	-1.84%
Jun-04	-4.38%	-4.12%	-7.97%	-4.84%	-0.09%
Jul-04	1.83%	1.84%	5.66%	2.36%	-0.65%
Aug-04	10.35%	9.91%	20.55%	9.45%	7.60%
Sep-04	3.85%	3.75%	5.90%	4.11%	5.40%
Oct-04	-1.47%	-1.14%	-9.85%	-2.33%	7.85%
Nov-04	5.85%	6.30%	5.27%	4.99%	14.09%
Dec-04	-0.15%	-0.10%	-5.81%	-1.48%	6.47%
Jan-05	2.34%	1.80%	4.44%	2.13%	0.50%
Feb-05	6.77%	6.63%	16.89%	7.27%	3.11%
Mar-05	-1.42%	-1.25%	1.35%	-0.04%	-6.65%
Apr-05	-6.38%	-6.63%	-14.41%	-7.71%	-1.33%
May-05	11.39%	11.55%	25.92%	12.97%	5.10%
Jun-05	2.70%	2.58%	2.90%	2.77%	1.05%

4.6.4 Conclusion: Database Construction

The result of the database construction is ten columns of data for subsequent statistical analysis, five columns of independent variables and five columns of dependent variables. These are summarised in Table 11.

Table 11: Summa the statistical analysis

	Independent Variables					Dependent Variables				
	SMB	HML	UMD	Rp - Rf	Resources	Port 1	Port 2	Port 3	Port 4	Port 5
Jul-02	4.09%	2.06%	-4.09%	-13.16%	-16.34%	-14.43%	-14.42%	-16.48%	-14.97%	-4.97%
Aug-02	-1.98%	-1.86%	3.01%	5.07%	9.81%	5.91%	5.76%	10.98%	4.51%	-1.50%
Sep-02	0.12%	-1.52%	0.54%	-1.26%	3.47%	-0.72%	-0.90%	2.31%	-2.72%	-1.69%
Oct-02	-0.11%	0.67%	-1.59%	-0.46%	-3.31%	-1.88%	-1.72%	-5.06%	-2.14%	9.08%
Nov-02	-0.73%	-0.89%	0.40%	1.50%	-2.71%	-0.35%	-0.09%	-3.76%	0.43%	9.91%
Dec-02	0.66%	-0.89%	0.00%	-2.78%	1.43%	-1.13%	-1.21%	-1.80%	-3.99%	-3.27%
Jan-03	1.28%	0.29%	-1.58%	-4.68%	-4.08%	-5.78%	-5.78%	-9.32%	-7.28%	-0.62%
Feb-03	1.46%	1.21%	-1.13%	-5.14%	-4.17%	-5.00%	-4.93%	-5.86%	-3.99%	-3.25%
Mar-03	2.57%	1.54%	-2.38%	-8.53%	-8.16%	-8.40%	-8.17%	-9.85%	-7.57%	-5.71%
Apr-03	0.44%	0.92%	-2.77%	-2.11%	-8.23%	-4.73%	-4.67%	-10.76%	-4.63%	1.76%
May-03	-4.91%	-2.46%	5.74%	14.12%	20.16%	15.79%	15.45%	26.53%	15.09%	8.43%
Jun-03	0.62%	0.48%	-1.85%	-2.53%	-5.98%	-3.27%	-3.20%	-9.69%	-4.38%	6.78%
Jul-03	-1.82%	-0.16%	0.96%	4.84%	5.78%	5.70%	5.70%	8.75%	6.31%	5.26%
Aug-03	-1.95%	-1.55%	-2.16%	5.25%	10.86%	7.34%	7.38%	13.16%	6.91%	5.07%
Sep-03	0.85%	0.27%	1.36%	-3.18%	-4.32%	-3.45%	-3.57%	-8.34%	-3.96%	1.15%
Oct-03	-3.33%	-1.17%	-3.52%	9.52%	10.38%	9.88%	9.95%	15.99%	9.51%	12.26%
Nov-03	-0.31%	-0.38%	0.15%	0.33%	-3.73%	-0.02%	-0.15%	-3.28%	-0.08%	3.97%
Dec-03	-2.35%	-0.61%	-2.62%	6.53%	8.84%	7.32%	7.35%	12.71%	7.31%	8.52%
Jan-04	-1.64%	-0.09%	-2.29%	4.40%	5.70%	5.03%	4.92%	8.48%	4.88%	2.26%
Feb-04	-0.15%	0.49%	-0.01%	-0.17%	0.59%	-0.35%	-0.34%	1.74%	0.21%	0.57%
Mar-04	0.21%	-0.16%	0.96%	-1.28%	-4.51%	-1.90%	-1.79%	-6.71%	-2.86%	4.40%
Apr-04	0.84%	1.15%	0.91%	-3.20%	-6.81%	-4.47%	-3.99%	-8.91%	-3.98%	-1.43%
May-04	-0.20%	-0.32%	-0.09%	-0.21%	-0.10%	-1.19%	-0.67%	-0.39%	-0.62%	-1.84%
Jun-04	0.70%	0.61%	1.44%	-2.79%	-5.67%	-4.38%	-4.12%	-7.97%	-4.84%	-0.09%
Jul-04	-0.68%	-0.06%	1.09%	1.36%	3.86%	1.83%	1.84%	5.66%	2.36%	-0.65%
Aug-04	-3.06%	-1.03%	4.32%	8.62%	14.03%	10.35%	9.91%	20.55%	9.45%	7.60%
Sep-04	-1.77%	-0.12%	2.46%	5.08%	3.71%	3.85%	3.75%	5.90%	4.11%	5.40%
Oct-04	-0.05%	-0.12%	2.46%	-0.10%	-6.98%	-1.47%	-1.14%	-9.85%	-2.33%	7.85%
Nov-04	-2.49%	-1.21%	3.79%	7.08%	1.94%	5.85%	6.30%	5.27%	4.99%	14.09%
Dec-04	-0.46%	0.09%	0.76%	1.06%	-3.46%	-0.15%	-0.10%	-5.81%	-1.48%	6.47%
Jan-05	-0.52%	-0.27%	0.93%	1.12%	3.83%	2.34%	1.80%	4.44%	2.13%	0.50%
Feb-05	-1.93%	-0.28%	2.59%	5.33%	11.04%	6.77%	6.63%	16.89%	7.27%	3.11%
Mar-05	0.21%	0.28%	-0.19%	-1.24%	1.30%	-1.42%	-1.25%	1.35%	-0.04%	-6.65%
Apr-05	1.53%	0.23%	-1.97%	-5.11%	-8.08%	-6.38%	-6.63%	-14.41%	-7.71%	-1.33%
May-05	-3.34%	-1.15%	4.67%	9.56%	16.00%	11.39%	11.55%	25.92%	12.97%	5.10%
Jun-05	-0.92%	-0.41%	1.08%	2.27%	2.29%	2.70%	2.58%	2.90%	2.77%	1.05%

4.7 Data Analysis

Microsoft Excel pivot table analysis, basic descriptive statistics and multiple regression were used to analyse the data displayed in Table 11 and the data in the derivative-usage database. Each technique will be discussed in detail in relation to the proposition being investigated.

4.7.1 Pivot Tables

The aggregated data in the derivative-usage database, as described in Section 4.6.1, are perfectly suited to pivot table analysis, as a pivot table is “a data mining feature that enables one to summarise and analyse large amounts of data in lists and tables. Pivot tables can quickly be rearranged by dragging and

dropping columns t ary positions."[5] The pivot table analysis was used to provide answers to the first research proposition by rearranging the large amount of data into simple tables displaying derivative usage by means of multiple descriptors, such as sector, financial year and size.

4.7.2 Descriptive Statistics

Descriptive statistics were used to provide a simple analysis of the five portfolios under review in propositions two through five. The descriptive statistics functionality of the statistical software package NCSS was used to analyse the portfolios for central tendency, dispersion and shape.

4.7.3 Multiple Regression

The primary statistical analysis techniques used to analyse the data were simple and multiple regression. Multiple regression was perfectly suited to analysing the data as it allowed "for the simultaneous investigation of two or more independent variables on a single interval-scaled dependent variable" (Zikmund, 2000, 535). As with the descriptive statistics, the NCSS statistical analysis package was used in the regression analysis.

4.7.3.1 Regression Models

Propositions two through five all required the use of regression analysis. Numerous combinations of the five independent variables were used in conjunction with one another and with each combination the regression was run five times, once for each of the five different derivative portfolios. The primary

[5] www.orafaq.org/glossary/faqglosp.htm

combination of the multiple regression was the one defined by Fama and French's four-factor model in Section 2.5.3.1:

$$(R_{it} - R_{ft}) = \alpha_i + \beta_{i1} (R_{mt} - R_{ft}) + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}UMD_t + e_{it}$$

The Fama and French four-factor model was used as the basis for the multiple regression and five columns of data were simply copied out of the Excel database and pasted into NCSS: Four columns containing the 36 months' worth of data for SMB, MRP [or (R_{mt}–R_{ft})], HML and UMD, and one column for the 36 months' worth of data for the derivative portfolio to be analysed. As mentioned before, with the independent variables constant the same regression would be run five times, once for each of the different dependent variables.

As discussed in Section 2.5.3, multifactor models are developed with little theoretical guidance as to the true nature of the risk-return relationship. In this sense, developing a useful factor model is as much a form of art as it is science and a wide variety of empirical factor specifications have been employed in practice. A hallmark of a good model is that it attempts to identify a set of factors that is simultaneously broad enough to capture the major nuances of the market, but small enough to provide a workable solution. This said, the selection of factors is fairly arbitrary and research shows (Section 2.5.3.1) that the number and nature of the factors, even in well-respected multifactor models, are open to interpretation and 'augmentation' where deemed necessary by the researcher. This process of augmenting the multifactor models has been carried through in this study, and although the well-respected Fama and French four-factor model is used as the basis for the data analysis, it has been augmented

where deemed nece asised that the purpose of augmentation was not to ensure a preconceived result, but to ensure that statistical results were meaningful or to achieve additional insight from the data.

4.7.3.2 Regression Analysis Checklist

A rigorous and systematic checklist was followed in analysing the NCSS output data to ensure valid interpretation of the data and to determine whether the results were statistically sound or not (Hintze, 2001).

4.7.3.3 Regression Result Interpretation

The required data was extracted from the NCSS output and summarised for further analysis only after a systematic check for statistical soundness. Although the *αs* and *β*s of the regression expression are collectively known as the regression coefficients, the remainder of this study will describe the *β*s as the regression coefficients and *α*s as the intercept terms (Albright *et al*, 2003). The regression coefficients and the intercept terms, to be discussed in more detail below, were all documented in the NCSS output, together with the relevant test of statistical significance. Although the *t*-value was provided for the individual regression coefficients and the intercept terms, only the *p*-value was focussed on as it provided a reliable measure of significance. Conventional levels of statistical acceptance were used, i.e. 0.1, 0.05 and 0.01.

The key values form the NCSS output were as follows:

1. The important intercept term (*α)* was documented as it provided an estimate of the abnormal return accruing to the derivative portfolio being examined at the time (Nelson *et al*, 2005). The term could be negative or

positive and oy month. An annualised return was calculated by compounding the monthly returns by 12 months.

2. The regression coefficients (β) calculated by NCSS and the corresponding *p*-value were documented as they provided an indication as to whether a particular independent variable had statistical significant predicative capability in the presence of the other variables or not. In the regression tests that were run, the magnitude of the coefficient for each independent variable provided the size of the effect that the variable had on the dependent variable. The sign of the coefficient provided the direction of the effect. Therefore, the regression coefficients were used to indicate whether the derivative population under review was skewed, for example to smaller or larger companies; high book-to-market or low book-to-market companies.
3. The adjusted R^2 value provided by NCSS indicated the fit of the data to the estimated regression model.

4.8 Research Limitations

Empirical research into derivative usage and company performance is in its initial stages in South Africa and this research therefore had the following limitations:

- The time period of three years, 2003 to 2005, only provided 36 data points for inclusion in the regression analysis. Any future research should extend the study to include more years of data.
- Although AC 125 and AC 133 dictate that all hedging activity be documented in the financial statements, companies avoid the need to

declare their neet". In this situation the financial institution that takes out the hedge holds the position. This negates the need for the actual hedge owner to mark-to-market. This study therefore only considered companies that declare the use of derivative instruments.

- The study focused on JSE-listed companies only but many other South African companies make use of derivative instruments. As data for unlisted companies would be extremely difficult to locate and analyse, only listed companies were considered in this study.
- The populations showed heavy survivor bias. Only shares active on 31 December 2005 were included and no attempt was made to include shares active in the preceding three years but delisted prior to the 31 December cut-off. This was due to the fact that historical data were difficult to locate and that finding annual reports of a company delisted for up to three years was extremely difficult.
- The factors used in the Fama and French four-factor regression model have not yet been specifically proven in South Africa, although asset-pricing research indicates that similar factors are applicable.
- The study did not include the magnitude of the hedging activity per company. The hedging variable was simply "yes" or "no". Even if one future was purchased per year, the company was considered a derivative user.

However, despite the limitations listed above, this study provides an important contribution to the issue of derivative usage in South Africa and paves the way

for further research limitations, the results are discussed in Chapter Five.

5 RESULTS

This section of the study documents the quantitative findings of the research in Section 4, and is structured around the five research propositions. The first proposition is structured as to provide an overall view of hedging within non-financial companies in South Africa, while propositions two through five make inferences about the stock price performance of non-financial companies that declare the use of derivative instruments.

Two well-defined samples of JSE companies are used to answer the five propositions, namely the non-financial companies sample and derivative-usage sample. The sample of non-financial companies is a convenience sample of all the non-financial companies listed on the JSE on 31 December 2005. The sample does, however, consist of 96% of the population and is close to a census as the excluded companies (4%) are small companies that would not significantly affect the final results due to the market capitalisation weighting when calculating averages. The sample of companies that use derivatives is a census as it includes all the sampling units (companies) from the initial non-financial companies sample.

5.1 Proposition

The first proposition intends to determine the extent of market risk hedging in South African non-financial companies by examining the disclosure of financial derivative usage in each company's annual report. The results are provided according to derivative type and categorised as market sector, size and, where appropriate, year.

5.1.1 Derivative Usage by Market Sector

Table 12 indicates that more than two thirds of JSE-listed non-financial companies declare the use of financial derivative instruments. The use of currency derivatives is the most prevalent and nearly all companies that disclose the use of derivatives (67.16%), also utilise currency derivatives (64.68%). In addition, the data shows that 24.38% of companies use derivatives to hedge interest rate risk and only 13.43% of companies make use of commodity derivatives.

The data also shows that all market sectors declare the use of financial derivative instruments, although commodity derivative usage is not prevalent through all sectors as is the use of interest rate and currency derivatives. Consumer services, oil and gas, and telecommunications sectors have the highest percentage of derivative usage, although the latter two sectors have a small sample size of only one and three respectively.

Table 12: Perce t disclose the use of financial derivative instruments by market sector

Sector	Sample Size	All Derivatives (%)	Commodity Derivatives (%)	Interest Rate Derivatives (%)	Currency Derivatives (%)
Basic Materials	43	58.14	32.56	32.56	53.49
Consumer Goods	17	82.35	52.94	35.29	76.47
Consumer Services	50	80.00	-	20.00	78.00
Healthcare	3	66.67	-	66.67	33.33
Industrials	62	62.90	4.84	20.97	62.90
Oil and Gas	1	100.00	100.00	100.00	100.00
Technology	22	50.00	-	9.09	50.00
Telecommunications	3	100.00	-	33.33	100.00
Total	**201**	**67.16**	**13.43**	**24.38**	**64.68**

5.1.2 Derivative Usage by Company Size

The size quartiles displayed in Table 13 aggregate companies by market capitalisation, with the first quartile consisting of the largest non-financial companies on the JSE and the fourth quartile the smallest companies. The data shows that derivative usage increases by size quartile across all derivatives and only interest rate derivative usage is not represented in all size quartiles.

Table 13: Percentage of sample companies that disclose the use of financial derivative instruments by company size

Size Quartile	All Derivatives (%)	Commodity Derivatives (%)	Interest Rate Derivatives (%)	Currency Derivatives (%)
First	96.00	34.00	64.00	90.00
Second	80.39	13.73	27.45	78.43
Third	64.00	4.00	6.00	64.00
Fourth	28.00	2.00	-	26.00
Total	**67.16**	**13.43**	**24.38**	**64.68**

5.1.3 Derivative U /ear

The data in Table 14 below show the extent of derivative usage by financial year. Derivative usage remained fairly constant over the three financial years and only interest rate derivative usage shows an increasing trend from 19.8% in 2003 to 23.9% in 2005. Currency derivative usage shows a small increase from 62.4% to 64.2%.

Table 14: Percentage of sample companies that disclose the use of financial derivative instruments by financial year

Financial Year	Sample Size	All Derivatives (%)	Commodity Derivatives (%)	Interest Rate Derivatives (%)	Currency Derivatives (%)
2003	197	65.48	11.68	19.80	62.44
2004	201	65.17	10.95	20.40	62.69
2005	201	66.17	11.44	23.88	64.18

5.1.4 Derivative Usage by Company Financial Year and Market Sector

The data summarised in Table 15 combine the data analysis from Section 5.1.1 and Section 5.1.3 to provide more detail of derivative usage by market sector over time. Similar to the previous section, the data shows little visual evidence of either an increasing or decreasing trend over time by sector. The only three areas that are meaningful are Consumer Services and Industrials for interest rate derivative usage and Industrials for currency derivative usage.

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Table 15: Perce t disclose the use of financial derivative instruments by financial year and market sector

Sector	All Derivatives (%)			Commodity Derivatives (%)			Interest Rate Derivatives (%)			Currency Derivatives (%)		
	2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005
Basic Materials	59.52	58.14	58.14	30.95	25.58	25.58	28.57	30.23	32.56	52.38	53.49	53.49
Consumer Goods	82.35	82.35	76.47	47.06	52.94	52.94	29.41	29.41	29.41	76.47	76.47	76.47
Consumer Services	77.55	76.00	78.00	-	-	-	12.24	14.00	20.00	75.51	74.00	78.00
Healthcare	66.67	66.67	66.67	-	-	-	66.67	66.67	66.67	33.33	33.33	33.33
Industrials	59.02	59.68	62.90	1.64	1.61	3.23	16.39	16.13	20.97	59.02	59.68	62.90
Oil and Gas	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Technology	47.62	50.00	50.00	-	-	-	9.52	9.09	9.09	47.62	50.00	50.00
Telecommunications	100.00	100.00	100.00	-	-	-	33.33	33.33	33.33	100.00	100.00	100.00
Total	**65.48**	**65.17**	**66.17**	**11.68**	**10.95**	**11.44**	**19.80**	**20.40**	**23.88**	**62.44**	**62.69**	**64.18**

5.1.5 Pure Deriva

Pure derivative users are defined as companies that only use derivatives in one area, i.e. commodity, interest rate or currency. Table 16 shows the extent of pure derivative usage by market sector. Over 40% of non-financial companies are pure derivative users as opposed to the 67.2% of companies that use any derivatives, as illustrated in Table 12. Few companies are pure users of either commodity or interest rates derivatives, but pure users of currency derivatives dominate the usage of pure derivatives at nearly 40%.

The data also shows that, for the full sample of companies that declare the use of derivative instruments, the basic materials sector has the least exposure to pure currency derivatives (16.3%), while consumer services and telecommunications have the largest exposure to derivative instruments (60% and 66.7% respectively). Oil and gas and healthcare show no usage of pure currency derivatives.

Table 16: Percentage of sample companies that disclose the use of pure financial derivative instruments by market sector

Sector	Sample Size	All Derivatives (%)	Commodity Derivatives (%)	Interest Rate Derivatives (%)	Currency Derivatives (%)
Basic Materials	43	18.60	-	2.33	16.28
Consumer Goods	17	29.41	5.88	-	23.53
Consumer Services	50	62.00	-	2.00	60.00
Healthcare	3	33.33	-	33.33	-
Industrials	62	41.94	-	-	41.94
Oil and Gas	1	-	-	-	-
Technology	22	40.91	-	-	40.91
Telecommunications	3	66.67	-	-	66.67
Total	**201**	**40.80**	**0.50**	**1.49**	**38.81**

5.1.6 Pure Deriva

Whereas Table 13 showed the use of all derivatives types by size quartile, Table 17 shows the same results, but defined by pure derivative usage. Most pure users use currency derivatives while there are only a few pure users of commodity and interest rate derivatives. For all pure derivative and pure currency derivative users the highest percentage is within the third size quartile (54%) followed by the second size quartile (52.94% and 50.98% respectively). As a large proportion of the JSE market capitalisation is concentrated in only a few large companies (68% in the top 20 companies as at 31 December 2005), companies in the second and third size quartiles are in fact significantly smaller on a relative basis.

Table 17: Percentage of sample companies that disclose the use of pure financial derivative instruments by size

Size Quartile	All Derivatives (%)	Commodity Derivatives (%)	Interest Rate Derivatives (%)	Currency Derivatives (%)
First	28.00	-	4.00	24.00
Second	52.94	-	1.96	50.98
Third	54.00	-	-	54.00
Forth	28.00	2.00	-	26.00
Total	**40.80**	**0.50**	**1.49**	**38.81**

5.2 Propositions Two, Three and Four

The following section provides the results of the research for propositions two, three and four. Whereas the first proposition provided a high-level view of derivative usage in South Africa, the following three propositions aim to investigate the stock price performance of non-financial companies making use of derivatives.

The Fama and Fre as the base model with which to statistically analyse the abnormal returns accruing to portfolios of non-financial companies that disclose the use of derivatives in their annual reports. In all cases the results are specific to the 36-month period between July 2002 and June 2005. However, the first section of the results provides a detailed review of the descriptive statistics for the five derivative portfolios (Section 4.6.3) under review without reference to Fama and French or any other regression model.

5.2.1 Descriptive Statistics

Table 18 summarises the descriptive statistics of the five derivative portfolios under review. The mean percentage monthly return (in the third column) was calculated by taking the simple mean of the 36 monthly weighted average total returns. The weighted average was calculated using the market capitalisation and each monthly weighted average return was nett of the risk free rate. As the sample size used to calculate the weighted average portfolio total return is nearly 100% of the population, the statistics provide a meaningful insight into the population.

The mean return for the pure currency derivative users is the greatest at 2.7% per month. This portfolio also has the lowest standard deviation and smallest range. The commodity portfolio mean return is more than 1.4% per month but the standard deviation and range are large if compared to the other four portfolios. All five portfolios have a positive mean monthly return.

Table 18: Results o on-financial companies using derivatives

Portfolio	Count	Mean % (Monthly)	Std Deviation %	Std Error %	Minumum %	Maximum %	Range %	Normality
Panel A - All Types of Derivatives								
All Types	36	0.8661	6.198	1.033	-14.43	15.79	30.22	Accept
Panel B - Specific Type of Derivative								
Currency	36	0.8897	6.132	1.022	-14.42	15.45	29.87	Accept
Commodity	36	1.424	11.15	1.858	-16.48	26.53	43.01	Accept
Interest Rate	36	0.6011	6.347	1.058	-14.97	15.09	30.06	Accept
Panel C - Specific "Pure" Type of Derivative								
Currency	36	2.710	5.116	0.8528	-6.65	14.09	20.74	Accept

5.2.2 Fama and French Four-Factor Model

The results of the Fama and French four-factor model are summarised in Table 19. The model is used as the basis for multiple regression with the dependent variable being the derivative portfolio and the four independent variables being the risk factors of the Fama and French model, namely R_m-R_f, (or MRP) SMB, HML and UMD. The intercept term provides an estimate of the abnormal return accruing to the market capitalisation weighted portfolio, comprised of all companies that disclosed the use of derivatives during the period July 2002 to June 2005. The value of the regression coefficient is the non-bracketed figure in the Table, while the bracketed figure is the *p*-value displaying the statistical significance of the regression coefficient. Panel A provides the results for the combined sample of all companies that disclosed the use of derivatives. Panel B categorises the sample according to the type of derivative used and Panel C displays pure currency derivative users only.

Table 19: Results and French four-factor model

Hedging Activity	Intercept	Rm - Rf	SMB	HML	UMD	Adj R^2
Panel A - All Types of Derivatives						
All Types	-0.0111	-0.2993	-4.1605	-0.3680	-0.0060	0.9718
	(0.1875)	(0.8118)	(0.2874)	(0.2915)	(0.9493)	
Panel B - Specific Type of Derivative						
Currency	-0.0114	-0.3927	-4.4539	-0.2758	-0.0027	0.9759
	(0.1412)	(0.7324)	(0.2139)	(0.3854)	(0.9750)	
Commodity	-0.0916	-11.7303	-41.7157	0.9729	0.1587	0.8341
	(0.0163)	(0.0387)	(0.0184)	(0.5200)	(0.6978)	
Interest Rate	-0.0207	-1.2390	-7.5582	0.8085	0.0358	0.9541
	(0.0644)	(0.4522)	(0.1422)	(0.0807)	(0.7700)	
Panel C - Specific "Pure" Type of Derivative						
Currency	0.0741	8.9353	24.9857	0.0252	-0.4357	0.4790
	(0.0168)	(0.0518)	(0.0763)	(0.9836)	(0.1955)	

The results of the regression displayed in Table 19 all show severe multicollinearity and the regression results can therefore not be used to interpret the data meaningfully. Multicollinearity is known to create inaccurate estimates of the regression coefficients (in this case the intercept, R_m-R_f, SMB, HML and UMD), inflate the standard errors of the coefficients, give false non-significant *p*-values and degrade the predictability of the model.

A detailed study of the regression outputs identified the source of multicollinearity as a near-linear relationship between two independent variables in the study. In all cases the multicollinearity was due to a 0.9996 correlation between R_m-R_f and SMB, resulting in Eigenvalues of centred and uncentred correlations well in excess of 1 000.

In order to still util ctor model, each of the correlated factors were dropped individually and the regression rerun. The regression results that discarded the R_m-R_f factor and included the SMB factor showed more promising statistical results due to a higher R^2 and more significant regression coefficients (this will be discussed further below). The regression results that discarded the SMB factor and included the R_m-R_f factor have been included in Appendix B for the sake of completeness and transparency.

5.2.2.1 Fama and French Four-Factor Model, Excluding R_m-R_f

Table 20 below summarises the results of the Fama and French four-factor model, modified to three factors by excluding the R_m-R_f risk factor. In all cases the regression outputs were statistically sound, showing no evidence of multicollinearity, and they could be used for meaningful interpretation. The intercept terms are significant at the 0.1 level and in all but commodity derivatives, significant at the 0.05 level. Only the pure currency derivative portfolio, however, produces a positive intercept term. In addition to providing intercept terms significant at conventional levels, the regression also indicates that the SMB factor is significant. None of the remaining coefficients, neither HML nor UMD, are significant at conventional levels.

Table 20: Results o or model, including the SMB risk factor

Hedging Activity	Intercept	SMB	HML	UMD	Adj R^2
Panel A - All Types of Derivatives					
All Types	-0.0092	-3.2384	-0.3983	-0.0103	0.9726
	(0.0000)	(0.0000)	(0.2140)	(0.9094)	
Panel B - Specific Type of Derivative					
Currency	-0.0089	-3.2440	-0.3155	-0.0084	0.9766
	(0.0000)	(0.0000)	(0.2800)	(0.9194)	
Commodity	-0.0157	-5.5733	-0.2154	-0.0112	0.8151
	(0.0705)	(0.0000)	(0.8843)	(0.9788)	
Interest Rate	-0.0127	-3.7409	-0.6829	0.0178	0.9547
	(0.0000)	(0.0000)	(0.1085)	(0.8810)	
Panel C - Specific "Pure" Type of Derivative					
Currency	0.0162	-2.5451	0.9304	-0.3063	0.4487
	(0.0223)	(0.0004)	(0.4377)	(0.3721)	

5.2.3 Simple Regression

Where the Fama and French model was adapted by taking out the R_m-R_f and SMB factors (Appendix B and Section 5.2.2.1 respectively), neither the HML nor the UMD factor was significant at any conventional levels and therefore neither added value to the regression model. In order to evaluate the data using the statistical concept of parsimony, i.e. explaining the most with the least, both of these regressions were rerun with the HML and UMD factors excluded. As discussed in Section 5.2.2, the simple regression with the R_m–R_f factor has been included in Appendix B and the simple regression with the SMB factor included in the main section of the document.

5.2.3.1 Simple Reg

Table 21 summarises the results of the regression with only SMB as a regression factor. Only the pure currency derivative portfolio shows a poor R^2. However, this data is not statistically sound due to the presence of non-normality within the regression residuals. The intercept term and the SMB coefficient for the remaining four portfolios are all significant at conventional levels, with only the intercept term for commodity derivatives significant at the 0.1 level and not at the 0.05 level. The intercept term is negative in all four cases.

Table 21: Results of the simple regression with the SMB factor

Hedging Activity	Intercept	SMB	R^2
Panel A - All Types of Derivatives			
All Types	-0.0094	-3.4059	0.9729
	(0.0000)	(0.0000)	
Panel B - Specific Type of Derivative			
Currency	-0.0090	-3.3765	0.9771
	(0.0000)	(0.0000)	
Commodity	-0.0158	-5.6597	0.8258
	(0.0593)	(0.0000)	
Interest Rate	-0.0123	-3.4538	0.9537
	(0.0000)	(0.0000)	
Panel C - Specific "Pure" Type of Derivative			
Currency	0.0170	-1.9102	0.4333
	(0.0161)	(0.0000)	

5.3 Proposition

The fifth proposition attempts to show the significance of resource-related companies in examining the abnormal return accruing to companies that use derivative instruments. A modified Fama and French four-factor model is again used as the basis for regression analysis of the data. For this proposition the R_m-R_f and SMB risk factors were alternatively replaced by a resource company risk factor which was constructed for each of the study's 36 months by determining the return accruing to resource companies less the monthly risk-free rate. The results for the regression that include the R_m-R_f risk factor are displayed in Appendix B and not in the main body of the document.

5.3.1 Modified Fama and French Four-Factor Model with the Resource Risk Factor Substituting for R_m-R_f

The data in Table 22 below summarise the results of the regression with the resource risk factor substituting for the R_m-R_f factor. In all cases the resource and SMB coefficients are statistically significant at the 0.01 level. However, whereas the SMB coefficient is consistently negative, the resource coefficient is positive in all cases of hedging activity with the exception of pure currency hedgers. The Table also shows that the HML coefficient is significant for the commodity and interest rate portfolios, although the commodity regression indicates normality concerns. In addition, the Table shows that the intercept terms are statistically significant at the 0.05 level, with the exception of pure currency hedgers.

Table 22: Results ı four-factor model with the resource risk factor substituting for R_m-R_f

Hedging Activity	Intercept	Resources	SMB	HML	UMD	Adj R^2
Panel A - All Types of Derivatives						
All Types	-0.0046	0.2606	-2.3525	-0.0086	-0.0011	0.9914
	(0.0003)	(0.0000)	(0.0000)	(0.9626)	(0.9833)	
Panel B - Specific Type of Derivative						
Currency	-0.0048	0.2306	-2.4601	0.0445	-0.0002	0.9916
	(0.0002)	(0.0000)	(0.0000)	(0.8043)	(0.9969)	
Commodity	0.0082	1.3582	-0.9553	1.9058	0.0369	0.9748
	(0.0267)	(0.0000)	(0.0374)	(0.0019)	(0.8130)	
Interest Rate	-0.0071	0.3159	-2.6668	1.1763	0.0290	0.9809
	(0.0003)	(0.0000)	(0.0000)	(0.0002)	(0.7080)	
Panel C - Specific "Pure" Type of Derivative						
Currency	0.0004	-0.9028	-5.6146	-0.4795	-0.3383	0.7580
	(0.9818)	(0.0000)	(0.0000)	(0.5527)	(0.1347)	

6 DISCUSSIC

The results section of this study documented the statistical findings of the five research propositions intended to broadly examine the extent of corporate hedging in South Africa and the impact of corporate hedging on company performance. The results of the systematic series of statistical analyses show that corporate hedging in South Africa is widespread and that there is a statistical significant relationship between corporate hedging and company performance. However, the results show that company performance does not necessarily positively relate to corporate hedging, as was displayed by the work of Nelson *et al* (2005) carried out in the U.S. In fact, the South African results show a negative relationship between company performance and the use of derivative instruments for corporate hedging. The following section will discuss the results in detail by providing insight in relation to the literature and in terms of the research question.

6.1 Proposition One

Proposition 1: South African companies hedge their market risk by means of financial derivative instruments.

If capital markets are absent of market imperfections, and financial policy and capital structure cannot affect the value of a firm (Modigliani and Miller, 1958) hedging with derivative financial instruments should not add to firm value and firms should not hedge. Yet, international research (Géczy *et al* (1997), Hentschel and Kothari (2001) and Nelson *et al* (2005)) shows that derivative usage is prevalent, creating an argument for the fact that costly market

imperfections must ough corporate hedging activity.

If market imperfections exist in international markets, resulting in the need for companies to hedge, surely similar imperfections exist in South Africa and derivative usage should also be prevalent in the local market? It is known that South African companies make use of derivative instruments as publicly available annual reports make reference to such financial instruments. There is, however, no research that quantifies the extent of corporate hedging in South Africa. The first proposition in this study intends to determine whether non-financial South African companies hedge market risk through the use of financial derivative instruments or not, but more importantly the proposition aims to quantify the extent of market risk hedging in South Africa.

In general, the results discussed in Section 5.1 show that derivative usage in South Africa is prevalent, but varies dramatically in terms of market sector, company size and company financial year. The following sections will discuss derivative usage in terms of these three categories, as well as provide a high-level view of derivative usage.

6.1.1 Extent of Derivative Usage in South Africa

Consistent with the U.S. studies by Bodnar, Hayt and Marston (1995) and Milan (1996), the data shows that South African companies actively hedge their risk by means of derivative usage, whether it be currency, interest rate or commodity derivatives. In fact, the data in Table 12 shows that derivative usage in South Africa is even more prevalent with 67.2% of South African companies

using derivatives a y Hentschel and Kothari (2001) and 21.6% found by Nelson *et al* (2005). The latter study was more comprehensive and more recent and, as this research was modelled on the study by Nelson *et al* (2005), it is more comparable. As a result, it can be concluded that the use of derivative instruments to hedge market risk is significantly more prevalent in South Africa than in the U.S.

Consistent with the findings by Géczy *et al* (1997), Hentschel and Kothari (2001), and Nelson *et al* (2005) the results of this study confirm the order of derivative usage; with currency derivatives being the most popular, followed by interest rate derivatives and lastly commodity derivatives. The absolute percentages are, however, not consistent with the U.S. studies by Hentschel and Kothari (2001), and Nelson *et al* (2005), as they found currency and interest rate derivative usage to be approximately equal, with commodity derivatives a distant third. The results of this study further show that currency derivative usage is significantly more popular than interest rate or commodity derivative usage. In South Africa, currency derivative usage is more than 2.5 times greater than interest rate derivative usage and nearly five times greater than commodity derivative usage.

The results show that the magnitude of derivative usage in South Africa, in comparison to the U.S., is primarily driven by the magnitude of currency derivative users. The reasons for this are twofold: First, the large exposure of the JSE to mining companies that need to hedge their exposure to fluctuations in exchange rates and the resulting price of their commodities; and second,

South African comp ted raw materials, capital equipment, imported electronics and cheap consumer goods.

6.1.2 Derivative Usage by Market Sector

Nelson *et al* (2005) are the only researchers to have looked at derivative usage by market sector and as such their work is the only cross-reference for the findings of this study. They found that derivative usage was most widespread in the mining, oil and chemical industries (i.e. resource companies) and least prevalent in the retail and service-related industries. The data of this study (Table 12) cannot be interpreted as easily because the sample size varies vastly from one to 62 companies. For example, the data shows that oil and gas companies are also significant derivative users in South Africa, but there is only one company in the sample. The South African data is definitely inconsistent with the U.S. data with regard to the basic materials sector in South Africa (which includes mining). This sector does not show the most widespread use of derivatives whereas the consumer goods (including retail) and consumer services sectors show widespread use of derivatives.

6.1.2.1 Derivative Usage by Market Sector: Commodity Derivatives

At the lower level of derivative usage by market risk type, the data in Table 12 shows a large range of usage by sector. Hedging of commodity risk by means of derivative usage is only found in respect of basic materials, consumer goods, industrials and oil and gas. The basic materials sector, which includes mining, typically hedges the risk of metal price movement such as gold and platinum. However, given that mining companies make up two thirds of the sector, a derivative usage of 33% is low in comparison to the 53% of consumer goods

companies that typi ement in their agricultural raw materials, such as maize and wheat. A closer examination of the mining companies showed three clear groups:

1. Small to medium mining companies that did not even consider derivative usage.
2. Large mining companies that consider hedging price risk fundamental to their strategy of locking in commodity prices.
3. Large mining companies that specifically do not hedge any risk so as to allow their share price to track changes in the end price of the commodity they mine.

The industrials sector is a limited user of derivatives with only three companies in the sample using derivative instruments, only one of which consistently used derivatives in the three-year period examined by the study.

6.1.2.2 Derivative Usage by Market Sector: Interest Rate Derivatives

Interest rate derivatives are used by all market sectors. The data for sectors with a sample size of more than ten companies shows that interest rate derivative usage is most widespread in the consumer goods sector and least widespread in technology companies. A closer examination of the data revealed that the specific hedging tools used for interest rate hedging is almost exclusively interest rate swaps used in relation to debt financing.

6.1.2.3 Derivative Usage by Market Sector: Currency Derivatives

Currency derivative usage is widespread across all market sectors. As with interest rate derivative usage (for sectors with more than ten companies), derivative usage is least widespread in technology companies, but most

widespread in cons gh only marginally so as derivative usage in the consumer goods sector is approximately the same. A closer visual inspection of the data shows that currency hedging for imports versus exports can be distinguished according to sector. Typically, the basic materials sector hedges risk associated with the export of their products/services, while consumer goods, consumer services and technology companies typically hedge risk associated with the importation of raw materials for later transformation in manufacturing processes.

6.1.3 Derivative Usage by Company Size

The results in Table 13 show that derivative usage is more heavily concentrated in larger firms. Whereas Hentschel and Kothari (2001) found that 62% of the Standard and Poor's (S&P) 500 sample used derivatives and Nelson *et al* (2005) observed that 48.5% of the top quartile used derivatives, this study shows that 96% of the top quartile use derivatives. In addition, more than 80% of companies in the second quartile use derivatives and 64% in the third quartile. An examination of the data at the lower level of market risk type (commodity, currency and interest rate) confirms this through the consistently decreasing usage of derivatives from the first to the forth quartile.

The data, therefore, indicates that the potential benefits of hedging are concentrated in larger firms. If hedging adds value predominantly in larger firms, this would support the economies of scale hypothesis in transaction costs and the theory that increased management sophistication is required to effectively use derivative instruments (Nance, Smith and Smithson, 1993 and Dolde, 1993). In addition, the results support the conclusion of Graham and Rogers

(1999) that, even th re than large firms due to small firms facing substantial informational asymmetry, the large fixed cost component of implementing a hedging programme negates any cost benefits.

6.1.4 Derivative Usage by Company Financial Year

The data in Table 14 shows that, even though the process of hedging market risk through the use of derivative financial instruments is receiving increased attention in companies around the world and in South Africa (Vorster *et al*, 2004), the use of derivatives is not increasing. The use of derivatives as a whole has remained constant since 2003 and only the use of interest rate derivatives has seen an increase greater than 2% from 2003 to 2005.

As companies become more sophisticated and derivative products easier to understand and purchase, it may be argued that the extent of derivative usage should increase. Why this is not happening, is most likely due to the very reason why it is now possible to quantify derivate usage: AC 125 and AC 133 as discussed by Vorster *et al* (2004). The new accounting rules that require a company to report on derivative usage also require companies to implement onerous administrative processes and mark-to-market their gains or losses. In addition, stakeholders, shareholders and analysts now have a view of the derivative positions a company may engage in and have started to query the need to hold expensive and possibly risky financial instruments. To escape these potential disclosure issues, firms have started to hold off-balance-sheet derivative positions that are not declared or firms simply do not use derivative instruments to manage their risk anymore.

6.1.5 Pure Deriva

An examination of the data in Table 16 on pure derivative usage shows a trend similar to the derivative usage illustrated in Table 12. In both cases currency derivative users make up the bulk of all derivative users and few companies use only commodity or interest rate derivatives. A noticeable inconsistency between the two sets of results, however, is the large change in the percentages for basic materials and consumer goods. Both these sectors show a large decrease in percentage usage from Table 12 to Table 16. Although the consumer services and industrial sectors also show a decrease in the percentage of usage, it is not as pronounced as that of basic materials and consumer goods. The results, therefore, show that a large proportion of consumer service and industrial companies are pure derivative users as opposed to basic materials and consumer goods companies that typically use a combination of the various derivatives.

When comparing the impact of company size and the extent of derivative usage, the results for pure derivative usage in Table 17 are inconsistent with the results for derivative usage in Table 13. Whereas Table 13 shows that derivative usage in general increases with company size, Table 17 (pure derivatives) shows that small to medium companies are larger users of derivatives, especially currency derivatives. A possible explanation for this is that commodity and interest rate derivatives are typically more complex and expensive than currency derivatives. Therefore, small to medium companies will make use of derivatives to hedge currency risk, but will not make use of interest rate or commodity derivatives. Larger and typically more sophisticated

companies, howeve nt types of derivatives in combination with one another.

6.1.6 Conclusion: Proposition One

The first proposition: “South African companies hedge their market risk by means of financial derivative instruments”, is supported by the results. Non-financial South African companies make extensive use of derivative instruments to hedge their market risk. At a more detailed level of derivative usage the key findings are as follows:

- More than 67% of non-financial JSE-listed companies make use of financial derivative instruments to hedge their market risk.
- Currency hedging is significantly more popular than interest rate or commodity hedging.
- More consumer goods and services companies use derivative instruments than companies in the basic materials and industrials sector.
- Only four of the eight JSE sectors use commodity derivatives.
- Derivative usage is more prevalent in larger than in smaller companies. The use of pure derivatives, however, is more prevalent in small to medium companies.
- Derivative usage is not increasing.
- Consumer services and industrial companies are large users of pure derivatives, whereas basic materials and consumer goods companies are large users of a combination of derivative types.

This section focuse and nature of derivative usage. The next section, propositions two and three, focuses on the impact of derivative usage on company performance as measured by the increase in annual stock price performance.

6.2 Propositions Two and Three

Proposition 2: Companies that disclose the use of financial derivatives for hedging their market risk show a greater increase in annual stock price performance than the market as a whole.

Proposition 3: Companies that disclose the use of derivatives for hedging their currency risk experience a greater increase in annual stock price performance than companies that disclose the use of interest rate or commodity derivatives.

Finance theory has been unable to conclude whether hedging is a value-adding strategy or not and three broad schools of thought have emerged to categorise the theories. Section 2.3 details the three schools of thought on hedging as a zero NPV decision, a negative NPV decision and a positive NPV decision. With no overwhelming academic support for any of the three schools, researchers have undertaken empirical studies to understand the practical impact of hedging on firm value and where possible, quantify this impact, whether it be positive or negative [Graham and Rogers (1999), Allayannis and Weston (2001), Carter *et al* (2003) and Nelson *et al* (2005)].

The majority of research on the issue of corporate hedging and firm value has been done using U.S. data, with a few studies using data from the United

Kingdom (U.K.) and sition of this study aims to determine the impact of corporate hedging and derivative usage in South Africa, specifically on non-financial public companies.

The following section starts with a general discussion on the statistical results and the use of the Fama and French four-factor model in order to put the results into context. The results of the analysis for the second and third proposition are subsequently discussed and compared with the previous work carried out by Nelson *et al* (2005). The two propositions will be addressed using the same results discussed in Section 5.2.

6.2.1 Statistical Analysis

The statistical analysis used to address the second and third propositions was extracted from the tables in Section 5.2. Although the Fama and French four-factor model was to be used as the basis for the statistical regression analysis, Table 19 and the discussion in Section 5.2.2 shows that structural issues in the South African equities market result in poor statistical results that cannot be interpreted meaningfully due to strong evidence of multicollinearity between the market risk premium (R_m–R_f) and size factors (SMB) in the model.

The Fama and French four-factor model, however, is a multifactor model (Section 2.5.3) in which Fama and French have specified the number and nature of the regression terms. Although the number and nature of the terms have been defined based on their experience and tested using empirical data analysis, they are arbitrarily defined and can be questioned or augmented where necessary. For example, the original Fama and French (1993) model

only had three risk ith the forth (momentum) added later by Carhart (1997) and Brav *et al* (2000).

The multifactor models used in the regression analyses of this study have been augmented where necessary to provide a deeper and more statistically meaningful insight into the data. In the extreme case the Fama and French multifactor model has been stripped of three factors, resulting in a simple regression equation similar to CAPM. The results displayed in Panel A of the tables in Section 5.2 will be used for the second proposition and the results in Panel B and C for the third proposition.

6.2.2 Discussion: Proposition Two

The aim of the second proposition is to establish whether companies that disclose the use of derivative instruments to hedge their market risk experience a greater increase in annual stock price performance than companies that do not use derivatives. The descriptive statistics suggest that the proposition holds true as the mean monthly percentage return discussed in Section 5.2.1 is positive with a 0.6% to 2.7% monthly return, depending on the portfolio. A concern with regard to the results, however, is that the standard deviation and standard error terms, as well as the ranges, are large. The descriptive statistics, although statistically valid, are too broad to be meaningful and the greater rigour of statistical regression models is required.

The results obtained from the regression models are shown in Table 20 and Table 21. The results in Table 20, which show the results of regressing the SMB, HML and UMD risk factors against the dependent variable, are similar to

the results in Table :tor, SMB. The reason for this is that HML and UMD risk factors consistently do not assist in explaining the fit of the regression line and often result in a slightly lower adjusted R^2 value (Section 4.7.3.3).

For each month the dependent variable is calculated as the market capitalisation-weighted average return on each stock that disclosed the use of derivatives at any time during the review period. A statistically significant intercept term, therefore, provides an estimate of the abnormal return accruing to a weighted portfolio comprised of all the companies that used derivatives for the purpose of hedging their market risk during the review period. A positive intercept term indicates that corporate hedging is a value-adding strategy, whereas a negative term indicates that corporate hedging is a value-destroying strategy.

The results in Panel A of Table 20 and Table 21 show that the monthly abnormal return accruing to the portfolio of companies that use all derivative types is a negative 0.92% to 0.94%, which compounds to a negative ten to eleven percent annually. This result is significantly different to the positive 4.31% annual return found in the study by Nelson *et al* (2005). The result for all derivative types provides evidence that the use of derivatives can have a substantial negative impact on the stock price performance of a company and supports the academic theory that corporate hedging is a negative NPV decision.

6.2.3 Discussion

The results in Panel B of Table 20 and Table 21 show the monthly abnormal return accruing to a portfolio of companies that use currency derivatives compared to commodity or interest rate derivatives. These results show consistent evidence that the use of derivatives to hedge specific market risk is again not a value-adding strategy. Compared to the negative monthly return of 1.6% for commodity derivative users and the negative 1.2% to 1.3% for users of interest rate derivatives, currency derivative users only experience a negative 0.9% monthly abnormal return, compounding to a negative 11.4% per annum. This compares poorly with the research results of Nelson *et al* (2005) that found a positive 5.1% annual abnormal return to currency derivative users.

The subset of pure currency derivative users provides the strongest evidence of the potential benefit of using derivative products for the average firm. Panel C of Table 20 (the data in Panel C of Table 21 was not statistically sound) shows the results of companies that are pure users of currency derivatives. Even though the adjusted R^2 is poor, the intercept term is statistically significant and the positive monthly abnormal return of 1.62% therefore provides an indication of the abnormal return to the portfolio of companies that use only currency derivatives. The 1.62% per month compounds to a significant 21.3% per annum and is the only type of hedging activity thus far in the study to provide a positive return. The 21.3% is double the result found by Nelson *et al* (2005) for pure currency derivate usage. A closer visual inspection of the third database (Dependent Variable Construction) discussed in Section 4.6.3 reveals that the companies driving the high return to pure currency derivative users are only a few large market capitalisation companies. The companies are from a mix of

sectors, but not resc scussed further in Section 6.5.

The third proposition aims to provide an indication as to whether users of currency derivative experience a significantly greater increase in annual stock performance than companies that use either commodity or interest rate derivatives. The proposition cannot be confirmed in the strictest sense as none of the three specific derivative types provide a positive abnormal return. The use of specific currency derivatives does, however, show a smaller negative abnormal return. Although there is no comparison for pure derivative users, as only pure currency derivatives have been included in the study due to the lack of pure commodity or interest rate derivative users, the results are positive. The weighted average return to the portfolio of companies that are pure currency derivative users is significantly higher than that of the subset of specific currency, interest rate or commodity derivative users.

6.2.4 Conclusion: Propositions Two and Three

In all but the case of pure currency derivative users, there is little support for the use of derivatives in corporate hedging programmes. The weighted average annual market return is 10% to 17% higher than the return to the portfolio of companies that use either all derivatives or specific derivative types as discussed above. Therefore, the results provide evidence that corporate hedging through the use of derivative instruments is only a value-adding strategy for firms that exclusively use currency derivatives. The use of commodity or interest rate derivatives is not a value-adding strategy, nor is the

use of currency de nmodity or interest rate derivatives.

Smith and Stulz's (1985) argument that hedging destroys firm value due to the fact that hedges are costly to implement (Section 2.3.2) cannot be confirmed as the reason for the negative performance of non-financial South African companies that use derivatives. The purpose of this proposition and study is not to confirm or refute the academic theory, but simply to understand the impact of corporate hedging from an empirical perspective and to compare this against international benchmarks. Further research will be required to fully understand the reason why corporate hedging in South Africa yields such poor results and why only pure currency derivative users yield a positive abnormal return.

6.3 Proposition Four

Proposition 4: The greater annual increase in stock price performance over the market for companies using derivative instruments is concentrated in larger companies.

Section 6.1.3 shows that the extent of corporate hedging increases significantly with company size, but the results provide no indication as to whether company size is a factor in the benefit obtained from corporate hedging programmes. Theory suggests that hedging adds value only in larger firms due to the economies of scale in hedging transaction costs and that increased management sophistication is required to effectively use derivative instruments (Nance *et al*, 1993 and Dolde, 1993). Nelson *et al* (2005), who found derivative usage to be a value-adding strategy, suggest that the potential benefits of

hedging are concer ger firms using currency derivatives primarily drive the valuation impact for currency hedgers.

Unlike the inconsistencies between the South African and U.S. results in propositions one through three, proposition four is consistent with the above theory and empirical evidence. The results in Table 20 and Table 21 show that the SMB regression coefficient is statistically significant at low levels (0.01) for all five types of derivative usage. The statistically significant coefficient indicates that the SMB factor plays an important role in the model and that company size is an important factor when explaining the weighted average total return accruing to companies that use derivative instruments. The consistent negative sign for the SMB coefficient indicates that there is a negative relationship between SMB and return. However, due to the method of constructing the SMB coefficient (Section 2.5.3.1), the coefficient is negative when the return of large companies dominates over the return of small companies. Therefore, the results suggest a positive linear relationship between company size and the weighted average total return accruing to companies using derivative instruments. The results, therefore, support the proposition that the increased stock price performance of companies using derivative instruments for corporate hedging is concentrated in larger firms.

The manner in which the South African results are similar to the U.S. results may suggest that the reasons for the concentration of increased return in larger firms would also be similar. Therefore, there is no reason to assume that the results found in this study cannot also be attributed to the economies of scale in hedging transaction costs and that increased management sophistication is

required to effective ance *et al* (1993), Dolde (1993)and Nelson *et al* (2005)). It may also be argued that, similar to the recent findings by Allayanis *et al* (2003) governance issues perhaps lead larger firms to make correct decisions regarding derivative usage as opposed to smaller firms making poor decisions based on weaker governance.

6.3.1 Additional Observations

Although not relevant to company size, neither of the remaining coefficients are significant at conventional levels, suggesting that the sample does not have a book-to-market (HML) or momentum (UMD) bias. These results, therefore, show no statistical evidence that indicates a relationship between growth or value firms and the total return accruing to companies that use derivative instruments, or between past company performance and total return. These results are consistent with those found by Nelson *et al* (2005) in the U.S.

6.4 Proposition Five

Proposition 5: There is a positive relationship between the annual increase in stock price performance over the market for companies using derivative instruments and the return to resource-based companies.

As the JSE is heavily weighted with resource stocks due to South Africa's resource-based economy, and the fact that these stocks are significantly exposed to market risks, it is important to understand the relationship between corporate hedging and the resource sector (Achour *et al*, 1998). To understand this impact the Fama and French four-factor model has again been augmented

to create a new mul $_f$. with the resource factor calculated in Section 4.6.2.2.

Table 22 confirms the results from the previous section with similar results for the SMB coefficients, but also adds insight into the impact of derivative usage on resource companies. The results from Panel A, B and C show that the resource regression coefficient is statistically significant, indicating that the resource sector has a strong impact on the weighted average total return achieved by the different portfolios of companies using derivative instruments. The positive resource factor coefficients in Panel A and B indicate a positive linear relationship between the excess return to the resource sector and the weighted average total return to companies using derivative instruments. The pure currency derivative portfolio in Panel C, however, is inconsistent and shows a negative regression coefficient. This indicates that, as the return to the resource sector increases, the return to companies that use only currency derivatives decreases.

A possible explanation as to why all types of derivative users (including specific currency, commodity and interest rate) have a positive relationship and pure currency derivatives a negative relationship may be the size of the companies in the five different portfolios. Table 17 shows that pure currency derivative portfolios typically include small to medium JSE companies as they only use currency derivatives, whereas the four other derivative portfolios use a combination of different types of derivatives that require more sophistication, governance and expertise which are characteristics typically found in larger companies. As proposition 4 suggests that the benefits of hedging are

concentrated in lar companies in the pure currency portfolio may have caused the negative relationship. Section 6.5 expands further on this issue.

In conclusion, there is strong evidence to suggest a relationship between the total return to resource companies and the return to companies that use derivatives. Given proposition four, this result is not unanticipated as JSE-listed resource companies are typically large and would be active in the use of derivatives due to their need to hedge their large exposure to market risk which includes mainly commodity prices and exchange rate volatility. The results of the study show that proposition 5 is true for the majority of the derivative-usage portfolios (all types and specific types of derivative users), but is not true for pure derivative users.

6.5 Apparent Inconsistencies between the Propositions

Although each of the five propositions is supported by statistically significant results, there appears to be three notable inconsistencies in the findings. Although further research will be required to fully understand the apparent inconsistencies between the propositions, possible explanations are provided below.

6.5.1 First Inconsistency

If hedging is concentrated in larger companies due the management sophistication and economies of scale necessary to run a hedging programme (first proposition); and the benefits of hedging are concentrated in larger

companies (fourth p lging not a value-adding strategy (second proposition)? In other words, what is the reason for the negative intercept terms of all derivative types, as well as for specific currency, commodity and interest rate derivatives, in Table 20 and Table 21 if these portfolios are dominated by large companies?

A possible reason for the inconsistency is that the intercept term for small to medium companies could be even more negative than for large companies. This indicates that even though the use of derivatives in large companies is a value-destroying strategy, there is even less benefit for small to medium companies in the use of derivatives. Therefore, the results still support the propositions in that hedging, except with the use of pure currency derivatives, is not a value-adding strategy and that any benefit that exists in using derivatives for hedging market risk is concentrated in larger companies.

6.5.2 Second Inconsistency

Why, if small to medium companies are using pure currency derivatives (first proposition) and the benefits of hedging are concentrated in larger companies (fourth proposition), is the use of pure currency derivatives a value-adding strategy (second proposition)? In other words, the analysis used to support the first proposition shows that pure currency hedging is concentrated in small to medium companies, not large companies, and yet it is the only type of derivative usage to show a positive intercept term (Table 20 and Table 21).

As a large proportion of the JSE market capitalisation is concentrated in only a few large companies, companies in the second and third size quartiles are in

fact significantly sm .1.6). Therefore, although Table 17 shows that companies in the second and third size quartiles are the largest users of pure currency derivatives, the majority of these companies have a low market capitalisation and contribute little to the total monthly return due to the weighted nature of the portfolios.

There are, however (as mentioned in Section 6.2.3), a few large market capitalisation companies in the pure currency derivative portfolio that, due to their relative size and large positive returns during the period under research, dominate the weighted average return to the pure currency derivative portfolio. The manner in which these few large companies dominate the weighted average total returns, creates what appears to be inconsistencies in the results. Therefore, the positive intercept term, and hence the benefit of using pure currency derivatives, is concentrated in larger companies and the results still support the propositions.

6.5.3 Third Inconsistency

The last inconsistency has already been raised in the discussion of the fifth proposition. Why does the pure currency derivative portfolio show a negative relationship between the resource regression factor and the return accruing to the portfolio of derivative users? The other four portfolios of derivative users (all types and specific currency, commodity and interest rate) show a strong positive relationship.

The manner in which the pure currency derivative portfolio shows a positive return has an impact on the relationship between the resource factor and the

total return to the p The few large companies that dominate the return to the pure currency derivative portfolio are not resource-related companies and are excluded from the resource factor. As a result, the return to the pure currency derivative portfolio will not necessarily correlate with the return to the resource factor, as the respective returns are dominated by different companies. Therefore, the pure currency derivative portfolio shows a negative relationship with the resource factor, whereas all types and specific currency, commodity and interest rate derivatives show a positive relationship with the resource factor.

6.6 Conclusion of Discussion

This study has shown that there is an extensive use of derivative instruments in South Africa to hedge market risk and that there is a strong relationship between derivative usage and stock price performance. In summary, the results with regard to the specific propositions are as follows:

1. Yes, South African companies make extensive use of financial derivative instruments to hedge their market risk.
2. No, companies that disclose the use of financial derivative instruments for hedging their market risk show a greater decrease in annual stock price performance than the market as a whole.
3. Yes, companies that disclose the use of derivatives for hedging their currency risk experience a greater increase in annual stock price performance than companies that disclose the use of interest rate or commodity derivatives. However, only pure currency derivative users experience a greater increase in annual stock price performance over the market. Specific currency users experience a smaller decrease in stock

price perform users of commodity and interest rate derivatives.

4. Yes, the greater annual increase in stock price performance over the market for companies that use derivative instruments is concentrated in larger firms.
5. Yes, there is a positive relationship between the annual increase in stock price performance over the market for companies that use derivative instruments and the return to resource-based companies. However, this is not exclusively so, as the portfolio of pure derivative users showed a negative relationship.

The concluding section (Chapter 7) will highlight the key points of this study and detail the impact of the findings on South African companies, especially companies who actively hedge their market risk or who are giving thought to a hedging programme. In addition, as this study was the first of its kind in South Africa, it has provided a broad base from which further research can be conducted. The next section will therefore conclude with future research opportunities.

7 CONCLUSI

All of the research undertaken to date on the extent of hedging and the relationship between hedging and company performance has been in developed markets such as the U.S. and the U.K. This study adds to the current debate on the value of corporate hedging internationally, provides the first insight into corporate hedging in an emerging market and, most importantly, provides an in-depth look into hedging from a South African perspective.

7.1 Key Findings

This study examined two broad issues related to hedging by non-financial companies listed on the JSE, namely the extent of corporate hedging in South Africa and the impact of corporate hedging on annual stock price performance. With regard to the first issue, the study documents the extensive use of financial derivative instruments for the purpose of corporate hedging. More than 67% of the sample of non-financial JSE-listed companies used derivatives to hedge market risk over the three-year period, from June 2002 to July 2005. It was found that when companies engaged in hedging activity, currency derivatives were far more frequently used (64.7%) than interest rate or commodity derivatives (only 24.4% and 13.4% respectively). Although this study shows that the prevalence of hedging in South Africa is far greater than in other markets, it is consistent with other studies that show that hedging activity is concentrated in larger companies. The use of pure currency derivatives is different, however, in that hedging activity is concentrated in small to medium companies

The results of this s t with earlier research in that derivative usage was found in a wide variety of sectors. However, the results are also inconsistent with earlier research in that derivative usage is more prevalent in consumer goods and services companies than in resource-related companies. At the lower level of derivative usage by type, commodity derivatives are not used consistently across all industry sectors, as is the case with interest rate and currency derivatives. The results also show that hedging activity did not increase over the three-year period, as the use of derivatives remained fairly constant (65% to 66%).

Second, the study documents the annual stock price performance of companies that disclose the use of derivative instruments for the purpose of hedging. Although the Fama and French four-factor model was used as the basis for regression analysis, it was augmented where necessary to provide greater insight into the four propositions related to company performance. The study finds consistent evidence that firms that hedge underperform the market by 0.92% to 1.57% per month (compounding to 10% to 17% per year on average), providing no support for the use of derivatives in corporate hedging programmes. Only companies using use pure currency derivatives showed positive results at a significant 1.62% per month (21.3% per annum), providing overwhelming evidence that corporate hedging through the use of derivative instruments is only a value-adding strategy for firms that exclusively use currency derivatives. The use of commodity or interest rate derivatives is not a value-adding strategy, nor is the use of currency derivatives in conjunction with commodity or interest rate derivatives.

Consistent with Alla Nelson *et al* (2005), the study showed a positive linear relationship between company size and the stock price performance of companies using derivative instruments for purposes of hedging. The results therefore suggest, that the increased stock price performance of companies using derivative instruments for corporate hedging is concentrated in larger firms. Similarly, but as yet unresearched, there is strong evidence to suggest a strong positive relationship between the total return to resource-based companies and the stock price performance of companies using derivatives. The use of pure currency derivatives is again different to that of all other derivative types as the results suggest a negative relationship between the return to companies using pure currency derivatives and the return to resource companies.

7.2 Recommendations to Stakeholders

This study is specifically aimed at chief financial officers, financial directors or other human resources in companies that need to make financial policy decisions related to hedging their company's market risk. South African companies that currently employ hedging programmes or are considering initiating a hedging programme should consider the following recommendations:

1. Only large companies should even consider initiating or running a corporate hedging programme. Any benefit that there may be in corporate hedging is concentrated in large market capitalisation companies, as a successful hedging programme requires economies of scale, management expertise and good governance. However, other than with pure currency hedging (which will be dealt with below), even large companies are not guaranteed an increased stock price

performance that large companies just realise a smaller loss than small to medium companies using derivative instruments in corporate hedging programmes.

2. Although this study is specific to the three year period from July 2002 to June 2005, it has shown overwhelming evidence that corporate hedging programmes are not a guaranteed means to increased stock price performance. The evidence in fact shows that, more often than not, hedging is a value-destroying strategy. Companies need to think very carefully about the reasons why they hedge or why they need to initiate a new hedging programme. It is possible that strategic reasons beyond simple company performance are at play, but in all likelihood this strategy will, over time, destroy value in the company.
3. Currency derivatives are the only derivative type that shows an increased stock price performance and are, therefore, value-adding. However, by default pure currency derivatives must be used in isolation and not in conjunction with commodity or interest rate derivatives. In addition, following on from point one above, the value from using pure currency derivatives is again concentrated in large companies and there is no evidence to suggest that small to medium companies can benefit from hedging programmes using currency derivatives exclusively.

A final recommendation to decision-makers in South African companies: Think very carefully about the reasons for hedging market risk, as the value that you are trying to protect or create is probably not being realised and in all likelihood you may be losing company value. This study has shown that only large

companies using c can in fact benefit from corporate hedging programmes through increased stock price performance.

7.3 Future Research Recommendations

This study, specific to South Africa, was aimed at adding to the existing international research on the extent of hedging activity and the relationship between hedging and company performance. These two broad issues have been dealt with adequately in this study, but further research will be required to fully understand the absolute reason why corporate hedging in South Africa yields such poor results and why only pure currency derivative users yield a positive abnormal return.

Future research in the area of corporate hedging should also focus on the following issues:

- Whereas this study used a market capitalisation weighted average of the total monthly return data, further work should investigate the impact of equally weighting the monthly returns.
- Investigating pure interest rate and commodity hedgers in more detail.
- Investigating the impact of a company initiating a new hedging programme on company performance.
- Extending the derivative-usage database created in this study to include the magnitude of the derivative positions to understand whether the relative value of derivative positions impacts on company performance.

- Redoing this by surveying companies rather than looking for the disclosure of derivative usage. This will ensure that off-balance-sheet hedging is also reflected.

Although more research is necessary to fully understand the impact of corporate hedging on company performance, this is the first study of its kind in South Africa and it provides a significant base from which to work. It has also opened the door to for a wide range of future research opportunities in the field of corporate hedging and derivative usage in South Africa.

7.4 Final Remarks

This study has investigated two main questions with regard to corporate hedging in South Africa: What is the extent of hedging in South Africa? and Is hedging in South Africa a value-adding or value-destroying strategy? The answer to these two questions increases in importance as South African companies become more exposed to market risks such as currency volatility and ever-increasing commodity prices. Unfortunately, there is neither consensus on the theoretical benefits of hedging, nor any empirical evidence to suggest whether hedging in South Africa is beneficial or not. This research provides answers to both of these broad questions and is the first source of knowledge on which South African decision-makers can draw when deciding to initiate a hedging programme.

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APPENDIX A

The following keywords were searched for:

- Derivative/s
- Swap/s
- Future/s
- Hedge or hedging
- Forward
- Swaption
- Option/s
- Risk management
- Instrument

APPENDIX B

Table 23: Results of the Fama and French four-factor with the R_m-R_f risk factor

Hedging Activity	Intercept	Rm - Rf	HML	UMD	Adj R^2
Panel A - All Types of Derivatives					
All Types	-0.0024	1.0482	-0.5161	-0.0244	0.9716
	(0.1855)	(0.0000)	(0.1115)	(0.7919)	
Panel B - Specific Type of Derivative					
Currency	-0.0020	1.0499	-0.4343	-0.0224	0.9755
	(0.2200)	(0.0000)	(0.1439)	(0.7921)	
Commodity	-0.0039	1.7808	-0.5119	-0.0258	0.8071
	(0.6385)	(0.0000)	(0.7314)	(0.9525)	
Interest Rate	-0.0048	1.2090	0.5394	0.0024	0.9522
	(0.0491)	(0.0000)	(0.2069)	(0.9847)	
Panel C - Specific "Pure" Type of Derivative					
Currency	0.0216	0.8428	0.9146	-0.3252	0.4405
	(0.0023)	(0.0003)	(0.4344)	(0.3397)	

Table 24: Results of the simple regression with the R_m–R_f factor

Hedging Activity	Intercept	Rm - Rf	R^2
Panel A - All Types of Derivatives			
All Types	-0.0022	1.1162	0.9710
	(0.2228)	(0.0000)	
Panel B - Specific Type of Derivative			
Currency	-0.0019	1.1066	0.9753
	(0.2552)	(0.0000)	
Commodity	-0.0038	1.8478	0.8173
	(0.6433)	(0.0000)	
Interest Rate	-0.0050	1.1325	0.9526
	(0.0396)	(0.0000)	
Panel C - Specific "Pure" Type of Derivative			
Currency	0.0209	0.6329	0.4426
	(0.0027)	(0.0000)	

Table 25: Results ı four-factor model with a resource risk factor replacing SMB

Hedging Activity	Intercept	Resources	Rm - Rf	HML	UMD	Adj R^2
Panel A - All Types of Derivatives						
All Types	-0.0004	0.2702	0.7551	-0.0434	-0.0126	0.9927
	(0.6654)	(0.0000)	(0.0000)	(0.7969)	(0.7884)	
Panel B - Specific Type of Derivative						
Currency	-0.0005	0.2416	-0.7878	-0.0118	-0.0118	0.9927
	(0.6169)	(0.0000)	(0.0000)	(0.9439)	(0.7990)	
Commodity	0.0103	1.3656	0.2994	1.8769	0.0338	0.9747
	(0.0028)	(0.0000)	(0.0406)	(0.0021)	(0.8292)	
Interest Rate	-0.0014	0.3284	0.8528	1.1139	0.0167	0.9817
	(0.3679)	(0.0000)	(0.0000)	(0.0003)	(0.8259)	
Panel C - Specific "Pure" Type of Derivative						
Currency	0.0125	-0.8745	1.7914	-0.6151	-0.3634	0.7610
	(0.0089)	(0.0000)	(0.0000)	(0.4418)	(0.1077)	