The impact of derivative use on firm risk and firm value. Evidence from South African non-financial firms

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I certify that the work presented in this dissertation is my work and that all the references used have been accurately recorded.

Edwin Mwangi

Abstract

This dissertation investigates the extent of derivatives use in South Africa. In addition, it examines the effect of derivatives use on firm risk and value. The dissertation is based on a sample of 91 South African non-financial firms listed on the FTSE/JSE Africa All Share Index on the JSE over the sample period 2012 to 2016. Firm risk is measured using total risk, systematic risk and unsystematic risk while the Tobin's Q is used as the proxy for firm value. The results of this dissertation show that 62% of firms included in this sample use derivatives. Foreign currency derivatives were the most commonly used as 80.3% of firms used them followed by interest rate derivatives at 46% and then commodity price derivatives at 21.8%. This dissertation provides evidence that the use of derivatives significantly reduces total risk and unsystematic risk. However, the use of derivative does not have an effect on systematic risk. The use of derivatives increases firm value although this increase is not statistically significant. Overall, this dissertation finds evidence of risk reduction related to derivative usage but fails to establish the value premium that is created by derivative use.

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Chapter 1: Introduction

1.1 Background to the study

The management of risk in firms is becoming increasingly important. According to Smith and Stulz, (1985) managers are risk averse. Therefore, they hedge to reduce financial risk. It has become very common amongst managers to mitigate financial risk with derivatives. Managers are particularly weary of short-term risks that may arise over changes in things like interest rates, commodity prices and exchange rates. Stulz, (2004) states that while there are clear benefits from the use of derivatives, there are associated additional costs that can be expensive. These costs could lead to adverse effects on the firms if not appropriately managed. Similarly, Buffet, (2003) in a report to shareholders described derivatives as "financial weapons of mass destruction, carrying dangers that, while now latent, are potentially lethal." Previously there have been famous episodes of financial losses linked to derivatives that included end users such as 'Metallgesellschaft, Allied Lyons, Orange County and Proctor and Gamble.' Besides, the Asian financial crises in 1997 and 1998 and the subprime US financial crises of 2007-2008. Consequently, this has led to investigations to understand the fundamental reasons for the usage of derivatives.

A confluence of factors caused the subprime US financial crises of 2007-2008. The main cause of this crisis was the proliferation of derivative instruments that lacked proper regulation. The financial crises in the US and the subsequent euro debt crisis led to a global financial crisis. During this financial crisis South Africa's economy went into negative growth because it depended on the developed economies through foreign trade, foreign direct investment and favourable commodity prices. South Africa experienced an economic recession for the first time since 1992. According to the quarterly bulletin of the South African Reserve Bank, South Africa's GDP growth was at a low of 1.8% in the last quarter of 2008. In 2009, there was a negative growth over three consecutive quarters. Consequently, the use of derivatives by firms continues to increase concerns by different stakeholders. Employees are worried about their jobs, investors are worried about the value of their investments, creditors are concerned about the creditworthiness of firms, and policymakers are concerned about the general health of the economy. In short, there exists an empirical question: Does the usage of derivatives by firms mitigate firms' risk and positively enhance firm value.

It is important to highlight that the global financial crises did not affect all the countries in a similar manner. South Africa has unique characteristics that helped it manage the global recession. According to Baxter, (2009) South Africa has relatively low levels of foreign debt, a good fiscal and monetary policies and a flexible exchange. The author adds that even though South Africa experienced an economic recession it weathered the financial storm relatively well. The author states that the South African markets operated without significant disruptions. There were rarely substantial incidents that

required emergency assistance from the authorities. The author states that the main reason for this was that South Africa's exchange controls for resident firms restrict to a certain extent their participation in foreign financial markets. Besides, the financial market in South Africa is concentrated in a handful of large financial institutions that are highly capitalised.

The global financial crises of 2008 led to an examination of the over the counter derivatives market. The financial services board of South Africa (Memorandum, 2009) stated that financial fragilities that contributed to the financial crisis in 2008 happened because of the failure to regulate and supervise the banks and other financial institutions taking reckless and irresponsible risks. It is important to highlight that both scholars and corporate managers argue that non-financial institutions had little blame for the financial crises regarding their use of derivatives.

The financial crises have led to recommendations to strengthen the regulatory oversight. In response to the call by the G-20 to introduce specific new measures to be enacted in the over the counter (OTC) derivatives market in South Africa, there was an aim to enhance the level of transparency and, reduce systematic risk and at the same time trying to avoid abuse in the markets. A key question remains on whether this new regulations and recommendations are working.

1.2 Problem statement

It has become increasingly complicated to have effective risk management due to the evolution of derivative instruments. Hence, the usage of derivatives by non-financial firms has become important to various stakeholders of these firms. Academics have responded with several studies investigating the use of derivatives by firms. For instance the famous Wharton studies (Bodnar *et al.*, 1995; Bodnar, Hayt and Marston, 1998) that investigate the use of derivatives by non-financial firms in the US. There have been similar studies outside the US that have followed. A few examples would include: Bodnar and Gebhardt, (1998) in Germany; Alkebäck, Hagelin and Pramborg, (2006) in Sweden; Júnior (2007) in Brazil; Ameer, (2009) in Malaysia; Khediri, (2010) in France and Ahmed, Azevedo and Guney, (2014) in the UK.

Most of these studies have focused on developed countries. There are few studies dealing with data from developing nations. Very few studies have used data from South African firms to investigate the effect of the derivative use on firm risk and value. The papers that have used South African data have sample period from 1990 to 2002 and therefore are outdated. In addition, the sample population of South African non-financial firms included in these studies does not exceed 55 firms. For instance, Bartram, Brown and Conrad, (2011) include 55 large South African firms in their total sample of 6888 non-financial firms to investigate the effect of derivative use on firm value and risk over the sample period 2001 to 2002. Allayannis, Lel and Miller, (2009) includes 27 South African non-financial firms in a sample of 1605 non-financial firms to investigate the effect of using foreign currency derivatives

on firm risk over the sample period 1990 to 1999. It is important to note that these papers have used South African data in collaboration with data from other countries. Their results were therefore not exclusive to South Africa but to the whole sample of countries. It is important therefore to do an evaluation where we isolate South Africa.

In the same line, academics have investigated the effect of derivatives use on firms' risk and value. It is important to note that, the effect of derivative use by non-financial firms on their value and risk is mixed. For instance, Allayannis and Weston, (2001) report that using foreign currency derivatives increases market value by 4%. On the other hand, Graham and Rogers, (2002) state that using derivatives increase firm value by 1.1%. Hentschel and Kothari, (2001) establish that using derivatives has no significant effect in reducing firm risk while Bartram, Brown and Fehle, (2009) find that using derivatives could reduce firm risk by 20-30%.

Prior studies that have investigated the use of derivatives by South African firms are outdated. Correia, Holman and Jahreskog, (2012) conducted their study in the sample period of 2006. Holman et al., (2013) conducted their survey over the sample period 2008 to 2009. Modack, (2011) conducted a study over sample period 2008 to 2009. The data about the use of derivatives by non-financial firms in South Africa needs an update. This study covers a more recent period of 2012 to 2016. The financial crisis has caused regulation of the derivatives market to increase. For instance the financial markets act that governs the provision of securities services including over the counter derivatives is been enacted progressively into law since 2012. In light of these new regulations, it is important to investigate whether these new regulations have affected the use of derivatives.

According to prior literature, the usage of derivatives by non-financial firms in South Africa is high. According to Modack, (2011) 93% of the top 100 largest firms in the Johannesburg Stock Exchange (JSE) use derivatives. Similarly Correia, Holman and Jahreskog, (2012) report that 90% of the 98 large non-financial firms listed on the JSE hedge risks with derivatives. These studies however, do not delve deeper to examine the effect of derivative use on firm risk and value.

This dissertation has two main objectives. Firstly to investigate the use of derivative by South African firms. Secondly to provide a comprehensive analysis of the effects of derivative use on firm value and risk from a South African perspective. This analysis will be useful to investors, employees, policy makers, regulators and employees.

1.3 Research questions

1.3.1 Research question 1

What percentage of non-financial firms listed in FTSE/JSE Africa All Shares Index are using derivatives?

1.3.2 Research question 2

Does the usage of derivatives by non-financial firms listed in FTSE/JSE Africa All Shares Index on the Johannesburg stock exchange reduce firm risk significantly?

1.3.3 Research question 3

Does the usage of derivatives by non-financial firms listed in FTSE/JSE Africa All Shares Index on the Johannesburg stock exchange enhance firm value significantly?

1.4 The relevance of the proposed research

The main objectives of this study is to provide an update on the usage of derivatives and analyse the effect of derivative use on a firms' value and risk from a South African context. This study starts by analysing the frequency of derivative use by non-financial firms in South Africa listed on the FTSE/JSE Africa All Share Index on the JSE .This research consequently adds value by investigating the effect of derivative use on firm value and firm risk. Moreover, it adds evidence based on research from a developing country.

As stated earlier there is mixed evidence on the effect of derivative usage by non-financial firms on their value and risk. Conducting this study would help in contributing to the existing pool of research. The results of this dissertation show that derivative use reduces firm risk significantly. However even though the results show that derivatives increase firm value this is still not statistically significant.

Conducting this study would, help in the analysis of using derivatives post the 2008-2009 financial crisis. The research is over the period 2012 to 2016. A few years after the subprime financial crisis of 2008-2009 in which derivative instruments played a significant role. Financial markets regulators have stated that one of the primary reasons there were systemic failures in global markets was due to OTC derivative instruments. As a result, regulators and policymakers have been instituting mechanisms to reduce the use of OTC derivatives. According to Finavker, (2014) specific changes have been implemented. For instance, the use of exchange-traded instruments has been encouraged. According to Finavker, (2014) users of derivatives have started to use more exchange-traded instruments and centralised clearing. The author adds that the non-financial firms have complained that the new regulations have increased the cost of using derivative instruments. The non-financial firms have requested to be excluded from the new rules and regulations as they use derivative instruments for risk management practices.

South Africa has unique characteristics that differentiate it from other countries. This research is therefore essential from a South African perspective for a few reasons. First, conducting such a study in South Africa would be advantageous because of the availability of data in South Africa as compared to other African countries. According to Holman *et al.*, (2013) 54.1% of South African firms use

derivatives relative to the rest of Africa at 5.1%.In their sample of 201 firms that were using derivatives 166 were from South African.

Secondly, the South African economy presents an impressive set of dynamics that makes it unique. According to Correia, Holman and Jahreskog, (2012) South Africa's economy is open, but its subject to capital flows restrictions. It is one of the world's emerging economies. It has a volatile exchange rate and has had volatile interest rates in the past. Therefore, firms operating in South Africa face exchange rate and interest rate risks. Data from previous studies show that exchange rate risk and interest rate risk are the most hedged risks by firms across the world. Correia, Holman and Jahreskog, (2012) state that the exchange controls in South Africa means that firms operating in South Africa are not able to manage anticipated risks, but instead, they can hedge actual contractual exposures.

Thirdly, South African data has not been used explicitly to investigate the effect of using derivatives on firm's value and risk. Most of the research conducted in this area of study has concentrated in developed countries with developed derivatives markets. South Africa has a relatively small derivatives market (Adelegan, 2009). The Johannesburg stock exchange (JSE) although large in terms of market capitalisation has low levels of liquidity (Smith, Jefferis and Ryoo, 2002). The JSE is also a weak form efficient market (Mlambo and Biekpe, 2007).Therefore, it's fundamental to contribute research into countries with developing derivative markets such as South Africa. Thus, there is a gap to be filled.

The structure of the paper is as follows: The first part of this paper has discussed the introduction, the relevance of this research and the research questions. The remainder of this paper will discuss the literature review, the methodology, the results, finding, and the conclusion.

2 Chapter 2: Literature review

The objective of this chapter is to evaluate prior literature associated with the three research questions presented in chapter 1.This chapter is organised as follows section 2.1 presents prior literature on derivative use. In section 2.1 this dissertation discusses the growth trends in derivatives markets, the various uses of derivatives and finally gives review of prior studies that have done a survey of derivative use. Section 2.2 starts with presenting the theoretical review of corporate hedging and then analyses prior research papers that deal with the effect of derivative use on firm value and firm risk.

2.1 Use of derivatives

2.1.1 The growth trend in derivatives market

There has been tremendous growth on derivatives that cover specifically the three risks afro mentioned. Foreign currency risk, interest rate risk and commodity price risk. The bank of international settlement did a statistical release in May 2017. The statement was on the over the counter derivatives statistics at the year ended December 2016. Over the counter (OTC), derivative contracts had an outstanding notional amount of 483 trillion dollars at year-end- December 2016. The derivatives contracts outstanding-which provide a better aggregate estimation of amounts at risk, had a 15 trillion dollars gross market value. The gross credit exposures were at 3.3 trillion dollars at the end of December 2016. OTC interest rate derivatives had a notional amount of 368 trillion dollars at the end of December 2016.This was the lowest amount recorded since 2007.

The interest rate derivatives were at a gross market value of 10 trillion dollars at year-end December 2016. 57% and 59% of the notional amount and gross market value respectively of all the outstanding OTC derivatives constituted interest rate swaps. Therefore, the single largest segment in the OTC derivatives market are interest rate swaps. OTC interest rate swaps and interest rate derivatives accounted for 89% of the gross market value and 75% of the notional amount. Foreign currency derivatives had a notional amount of 68.6 trillion dollars at the year-end December 2016. Their gross market value was at 3 trillion dollars for the same period. OTC commodity contracts had a notional amount of 1.350 trillion dollars, and gross market value was $0.163 trillion at the end of December 2016.

The local derivative market in South Africa has also grown. The bank of international settlement reported that the turnover of over the counter foreign exchange instruments on a net gross basis had grown from 5 billion dollars in 1995 to 21 billion dollars to by year-end December 2016. Regarding OTC interest rate derivatives, they have grown from 1 billion dollars to 11 billion dollars in 2013 and has decreased to 9 billion dollars in 2016.

2.1.2 The types of risks hedged using derivatives

Firms use derivatives to hedge various types of risks, like interest rates fluctuations, changes in foreign currency rates and commodity prices changes. The first significant risk is foreign currency risk. According to Lau, (2016) firms, especially large firms that are listed are more involved in international trade. Consequently, they have faced foreign exchange rate risks. Globalisation has been on the rise in the business environment hence even firms that are not directly involved in foreign currency transactions are prone to foreign exchange currency risk. For instance, changes in the exchange rate on the common currency used by a firm could have some effects. It could affect critical items that affect the firm's sales or cost of sales affecting gross and operational margins.

Similarly, Allayannis and Ofek, (2001) researched a sample of S&P 500 firms, and their results showed there is a significant positive correlation between firms exposure to foreign sales and trade as well as firm size and hedging foreign currency risk. In addition, Swedish firms that had international operations and hedged transaction risk experienced positive results (Pramborg, 2004). Besides, there are other reasons why firms used foreign currency derivative. For instance, Geczy, Bernadette and Schrand, (1997) report that firms with high volatility of cash flow and high financial distress have a higher likelihood of using foreign currency derivatives.

The second significant risk is interest rate risk. Lau, (2016) states that even though interest rates in most countries are less volatile than commodity prices and foreign exchange rates, they can have significant repercussions on firms if inappropriate risk management practices are applied. The author states that most debt commitments undertaken by firms are fixed at the date when the loan is issued. Therefore, interest rate volatility can affect the amount of interest payments consequently affecting profits before tax. The author adds that it is because of this that many firms have therefore utilised interest rate derivatives like interest rate swaps to mitigate interest rate risk.

Consequently, these firms have been able to reduce their interest rate risk and therefore are able to acquire more debt. Their debt capacity has increased because if a firm, for instance, does not become subject to pay higher interest rate payments, it should be able if required, to switch interest rate commitments after the initial borrowing (Graham and Rogers, 2002;Bartram,Brown and Fehle, 2009). Similarly, Titman, (1992) state that interest rate swaps have affected the way firms make finance decisions. According to the author, firms can borrow cheaper short-term loans with the expectation that the firm’s credit rating would subsequently improve, and the firms would have access to better terms of credit terms. Graham and Rogers,(2002) add that firms are likely to hedge in anticipation of incentives in tax that will offer a higher debt capacity and tax benefits from interest rate saving.

The third significant risk is commodity price risk. Amongst industries, the cost of primary product outputs and material inputs are subject to fluctuations in commodity prices. Therefore, any significant volatility on commodity price can have severe effects on firms’ sales and cost of sales affecting gross

margins and operational incomes. Risk managers in most firms, therefore, hedge against commodity price volatility risk. When firms hedge they can offer competitive and consistent prices, consequently enhancing firm value and reducing firm risk. A few examples of industries that are common in using commodity price derivatives are oil and gas, gold mining and the airline industry (Jin and Jorion, 2006; Lau, 2016).

2.1.3 The corporate use of derivatives by non-financial firms

Before embarking on a study to investigate the effect of derivative use on firm value and risk, it would be essential to get a census of how many firms use derivative in South Africa. An IMF study conducted by Adelegan, (2009) concluded that the growth of the derivatives market in South Africa in the recent years has been significant. The author states one of the reasons behind this growth has been the need by firms to insure themselves against volatile capital flows. The other reason has been the management of financial risks associated with the high sensitivity of underlying prices of assets. On the contrary Correia, Holman and Jahreskog, (2012) observed that South African firms had a reduction in the use of derivatives. This reduction is because; firms have had little exposure to interest rate risk, foreign currency exchange rate risk, equity price risk and commodity price risk. Moreover, the authors add that the requirement to account for derivatives using the international financial reporting standards requirements has made it difficult for firms to use derivatives due to the complex nature of the accounting standards.

A study of the annual financial statements reports that 93% of the 100 largest firms listed on the JSE use derivatives for risk management and hedging (Modack, 2011). A survey questionnaire done by Correia, Holman and Jahreskog, (2012) conducted a survey by using a questionnaire and stated that 90% of the 50 large non-financial firms listed on the JSE that responded hedged risks by using derivatives. The authors add, as much as 75% of firms in South Africa utilise derivatives for hedging contractual obligations, and 11.1% hedge the balance sheet with derivatives. The authors state that for South African firms hedging the balance sheet helps to reduce the sensitivity of balance sheet figures to external factors outside the control of the firm. The authors add that there is evidence to show that over 80% of South African firms do not utilise derivatives for speculation. The author state, 75% of firms do not take a view of the market while trying to reduce their funding requirements.

Bartram, Brown and Conrad, (2011) conducted a survey which had 58 large non-financial firms from South Africa. The authors reported that 89.9% of these firms used derivatives. An examination of the extent to which non-financial firms listed on the different stock exchanges in Africa use derivatives found that in South Africa 54% of firms use derivatives (Holman *et al.*, 2013).17% of South African small firms listed on the Johannesburg stock exchange and the Alt X, use derivatives (Pitt, 2011). This evidence indicates that the study on the effect of derivative use on firm risk and firm value is feasible because of the availability of data.

Prior studies show that the rate of derivative use in South Africa is high compared to the rest of the world. The rate of derivative use ranges from 40% to 93%. Bartram, Brown and Conrad, (2011) report that 60.5% of firms from all 47 countries use derivatives. This is much lower than the 93% recorded in South Africa by (Modack, 2011).

Countries with open economies also seem to have a high percentage rate of derivative use. In Sweden, 86% of large firms employ derivatives (Alkebäck, Hagelin and Pramborg, 2006). In Germany, 81% of large firms use derivatives (Bodnar and Gebhardt, 1998). In the UK Finavker, (2014) reports that in a sample of LSE (London Stock Exchange) listed firms 86.61% of the firms used derivatives. In the U.S. 83% of large firms use derivative (Bodnar, Hayt and Marston, 1998).

South Africa also seems to be ahead of its peers who also have middle-income economies concerning derivative use. These middle-income economies are similar in terms of having illiquid derivative markets and less developed capital markets. The rate of derivative use these countries is much lower. A study by Bartram, Brown and Conrad, (2011) illustrated this point perfectly. It reported that the rate of derivative use in countries like the Czech Republic, Greece and Malaysia to be 26.1%, 21.1% and 20.1% respectively. At the same time, it reported the rate of derivative use amongst South African firms to be at 89.9%.

An analysis of which type of derivatives are used most by non-financial firms show that foreign currency derivatives are the most frequently used. Interest rate derivatives follow and then commodity price derivatives. Correia, Holman and Jahreskog, (2012) reports that in their surveys non-financial firms mostly used derivatives to hedge exchange rate risk followed by interest rate exposure. A study conducted on 6888 firms across 47 countries by Bartram, Brown and Conrad, (2011) show that at 45.5% of the firm's hedge exchange rate risk, followed by interest rate risk at 33.1% and commodity price risk at 9.8%. This observation is similar across both developed and developing economies. For example, in France, 47% of derivatives were foreign currency derivatives, and 46.8% of derivatives were interest rate derivatives (Khediri, 2010). In Malaysia, 94% of firms use foreign currency derivatives, 29% use interest rate derivatives, while 9% use commodity derivatives (Lau, 2016).

2.2 The effect of derivatives use on firm value and risk

2.2.1 Theoretical review of corporate hedging

Modigliani and Miller, (1958) argue that using derivatives to hedge would not have any effect on firm value in a perfect capital market. According to the authors, the shareholders can hold a well-diversified portfolio that reduces their risk. Hence, there will be no value creation for mitigating the financial risk of a single firm. Financial markets are however subject to an array of frictions such as taxes, costly external sources of finance, cost of financial distress, market supervision, agency costs bankruptcy costs and asymmetric information. When Modigliani and Miller's assumptions are relaxed, there might be various reasons to hedge. The cost of financial distress will decrease (Smith and Stulz, 1985), the debt capacity will increase (Stulz, 1996; Leland, 1998), an optimal tax payment will be reached (Smith and Stulz, 1985), and an optimal investment strategy will be reached (Froot, Schafstein and Stein, 1993).

The first benefit of using derivatives is the ability to minimise corporate tax liability by having an optimal tax payment. Smith and Stulz, (1985) state, when a company has a convex tax function, it can be able to reduce its future tax liabilities, using hedging to smoothen out taxable income. The convexity of the tax function enables a firm to benefit by managing its taxable income to fall within an optimal range (Lang and Stulz, 1994). Accordingly, risk management enables a firm to reduce volatility in income that is taxable. This decrease in volatility results in lower taxable income for the firm as the firm's income falls in an optimal range for tax rates (Stulz, 1996).

The second benefit of using derivatives is the ability to improve the portfolio of wealth of managers. Stulz, (1984) state there is the possibility that investors and managers may analyse the risk vs returns trade-off from very different perspectives. Therefore, leading to varying views in risk management. According to the author, managers are highly incentivised to hedge when their remuneration, leaves them managing an extensive portfolio of firm unsystematic risk that is undiversified. The author continues to state that managers may not hedge in the case where the firm equity value has a positive association with asset volatility. Additionally, the author states that when managers are in charge of financial share portfolio that is undiversified, they are incentivised to hedge the risk that is non-diversifiable. This may reduce the wealth of the shareholders. Hence, a manager’s remuneration plan can lower the risk aversion of the manager. Consequently, this affects their hedging policies. Hedging may assist investors who want to assess how well managers are performing and therefore develop more efficient remuneration packages (Demarzo and Duffie, 1995).

The third benefit of using derivatives is to provide an optimal investment strategy. Bessembinder, (1991) states that there exists conflicting interest between bondholders and shareholders. The conflict of interest exists because of income distribution and financial constraints. The conflict of interest affects the financing and investing decisions of a firm. The conflict of interest could mean that shareholders

will refuse to invest in future projects that are good for the firm, i.e. have a positive net present value if all the project benefits accrue to bondholders. The author states that derivatives can help curb this conflict. The author states that a derivative can improve the coordination between financing and investing decisions by aligning the interest of bondholders with that of shareholders hence increasing shareholder value.

The fourth benefit is that the expected cost of financial distress will reduce. According to Smith and Stulz, (1985) the use of derivatives will reduce financial distress in a firm. According to the authors, an increase in cash volatility decreases the ability of the firm to pay its loans, therefore, increasing financial distress. The market penalises the firm through a value discount when the firm's financial distress costs increases. The authors, therefore, recommend that derivatives can reduce cash flow volatility and consequently reduce financial distress. Similarly, Stulz, (1996) state that a firm with a proper policy for risk management can lower the probability of bankruptcy and consequently add to firm value. The author adds that a decrease in the likelihood of bankruptcy in a firm can increase the amount of debt a firm can hold. A raised debt capacity provides interest rate tax shield that increases firm value (Leland, 1998).

2.2.2 The effect of derivative use on firm risk

If firms are using derivatives for risk management, the risk should reduce. However, if firms are speculating with derivatives, then the risk should increase. If a firm's equity returns change because of changes in interest rates, foreign exchange rate and commodity prices this would be the case. Therefore, where a firm can use derivatives to protect itself from these risks it should reflect in the firm's equity returns.

Literature on risk management that examines the impact of derivative use of firm risk has been done all across the world but has mostly focused on countries with developed derivatives markets. The following studies have established that derivative use leads to a decrease in firm risk (see Tufano, 1996;Guay,1999; Allayanis and Ofek,2001;Bartram,2009;Bartram, Brown and Conrad,2011;Finavker 2014; Nguyen and Faff, 2010 and Kamphius,2013). A number of studies focused on America (see Tufano, 1996;Guay, 1999;Allayanis and Ofek,2001 and Kamphius,2013).Other studies focused on more developed derivatives markets outside of America. Nguyen and Faff, (2010) investigated firms in Australia while Finavker, (2014) conducted the study on UK firms listed on the London Stock Exchange. A few studies have looked at countries with less developed derivatives markets. Bartram, 2009 investigates the subject matter using data from 47 countries. In addition Bartram, Brown and Conrad,(2011) analyses the subject matter using data from 6888 non-financial firms across 47 countries. In their sample they included 58 large firms form South Africa.

Among the studies that found that derivative use reduces firm risk there are two studies that stated that derivative use and firm risk have a non-linear correlation. That is that derivative use will only reduce

firm risk up to a certain point and an increase in derivative use above this point is associated with speculation. Nguyen and Faff, (2010) established that for Australian non-financial firms the optimal extent of derivative use was 40%. Kamphius, (2013) establishes that UK non-financial firms listed on the London Stock Exchange have an optimal level of derivative use of 1,53%.

On the contrary, Hentschel and Kothari, (2001), conducted an investigation from 1991 to 1993 of 425 large non-financial firms in the US with an average level of derivative usage by considering the firms risk characteristics. The authors concluded the usage of derivatives by firms and the volatility share price returns have an insignificant relationship. The results were consistent even for firms that had large derivative positions. The author also concluded that lack an economic and statistically significant relationship between the extent of the firms' participation in derivative markets and the firms' risk characteristics. Similarly, Guay and Kothari, (2003) state that there lacks a significant relationship between stock volatility and derivative use as stated by Hentschel and Kothari, (2001) because of the small derivative positions that are taken by the firms relative to their firm size.

It is important to note that the majority of these studies have been concentrated on exchange rate exposure more than interest rate exposure. Similarly, Smithson and Simkins, (2005) supported by empirical evidence argued that exchange rate exposure is considered a greater risk than interest rate risk for industrial firms. The author gave a summary of the prior literature on this topic, and only one of 12 studies of derivative use by industrial firms investigated interest rate exposure the other 11 were on foreign exchange rate exposure.

2.2.3 The effect of derivative use on firm value

This research conjectures the firms using derivatives should perform better financially. Research concerning capital markets in areas of accounting, for instance, the quality of earnings and the value relevance have provided support and evidence that indicators of the financial performance of a firm for instance reported earnings have a positive correlation with firm returns and market value (Mari and Lin, 2008). There ought to be a better operational approach to evaluate whether the use of derivatives affects firm value.

Literature focusing on the use of derivatives to enhance firm value can be put in a few categories. The first category to examine are studies that looked at the general use of derivatives. A few studies have found that the use of derivatives enhance firm value (see Graham and Rogers,2002; Pramborg, 2004;Bartram, Brown and Fehle,2009,Gomez et al.2009 and Ameer, 2009). Most of these studies focused on countries with developed derivative markets. The only exceptions were Gomez et al. (2009) who studied firms from Colombia and Ameer, (2009) who focused Malaysian firms. On the contrary Guay and Kothari, (2003) was the only study that found that derivative use does not enhance firm value.

Some studies have been more specific and concentrated their studies into investigating the role of foreign currency derivatives in enhancing firm value. These studies are as follows (Allayanis and Weston, 2001: Nguyen and Faff, 2007; Allayannis, Lel and Miller,2009). All these studies focused om different countries. Allayannis and Weston, (2001) focused on large non-financial firms in the U.S. between 1990-1995. Nguyen and Faff, (2007) focuses on 428 non-financial firms from Australia between 1999-2001. Allayannis, Lel and Miller, (2009) investigates firms from 39 countries between 1990-1999. On the contrary Khediri,(2010) establishes that for French non-financial companies derivative use does not enhance firm value.

A few studies have investigated whether hedging interest rate exposure for firms will lead to an increase in firm value. Bartram, Brown and Fehle, (2009) investigates this narrative across non-financial firms from 48 countries and establishes that interest rate derivatives increase firm value more than foreign currency derivatives. On the contrary Khediri, (2010) establishes that for 250 French companies interest rate derivative use do not enhance firm value.

Studies that have focused on investigating whether commodity price derivatives enhance firm value have mixed evidence. Jin and Jorion,(2006) and Lookman, (2004) report that the use of commodity price derivatives in the U.S. oil and gas industry does not lead to the enhancement of firm value. Similarly Callahan,(2002) states that North American gold mining companies that use derivatives do not have any enhancement in value. On the contrary Carter, Roger and Simkins, (2003) states that for the U.S. airline the use of commodity price derivatives leads to enhancement of value. Similarly Lin and Chang, (2009) hedging jet fuel for airline firms from 39 countries increases firm value.

3 Chapter 3 Research Methodology

This chapter will outline the data, design and research methodologies that were employed in this study. The main aim of this chapter is to discuss research methodologies and the variables used in this paper. Part 3.1 details how the sample was selected and the sample period. Part 3.2 describes the sources that were used to collect the data and the measurements of the variables. Part 3.3 discusses the control variables. Part 3.4 discusses the estimation framework. Finally, part 3.5 discusses the estimation methods.

3.1 Sample construction and Sample period

3.1.1 Sample Construction

This dissertation uses the non-financial firms listed in the FTSE/JSE Africa All Share Index in the Johannesburg Stock Exchange. According to Bloomberg, (2018) 99% of the total pre free float market capitalisation on the JSE is made up of the firms included in the FTSE/JSE Africa All Share Index. We have excluded firms classified as financial firms. The Bloomberg Industry Classification Standard classifies the following firms as financial firms: insurance firms, banks, investment banks, asset managers, real estate, and investment trusts. According to Guay, (1999) financial firms got excluded because they are the providers of derivatives and their inclusion would lead to bias in the empirical finding. The author adds that, financial firms have different objectives when using financial derivatives to non-financial firms.

The classification of the sectors was according to the Bloomberg Industry Classification Standard (BICS). The industry classifications included in the sample were: Consumer Discretionary, Communications, Consumer Staples, Healthcare, Energy, Industrials, Materials, Multimedia and Technology.

The total population of firms listed on the FTSE/JSE Africa All Share Index in the Johannesburg Stock Exchange is 165 firms. The total population of the firms classified under the financials is 64 firms. Therefore, the original sample was 101 non-financial firms. For the time series analysis, ten firms that have had acquisitions or spin-offs or have not been listed for the whole duration over the period 2012-2016 were excluded from the sample. Ninety-one firms make up the sample. Appendix B has a list of all the firms included in the sample.

3.1.2 Sample period

The period of the study was over 2012 to 2016. All the variables were collected from 2012 to 2016.The reason behind using this period is because of the availability of data on the use of derivative by firms. In addition, as discussed in chapter 1 most studies done in South Africa concerning this topic have

happened before this period. The period 2012 to 2016 examined in this study presents significant and varying macroeconomic conditions of the South African Economy. The period is after the financial crisis of 2007 to 2009, and therefore it can investigate whether the corrective measures put in place after the financial crisis are working.

3.1.3 The sources of data

3.1.3.1 Data from annual financial statements

This dissertation uses annual financial statements to collect data on derivative use. The key independent variables used in this research are the measures of if a firm uses derivatives or not. Studies done previously for example Bodnar *et al.*, (1995) and Bodnar, Hayt and Marston, (1998) have relied on the use of survey questionnaires to collect data. However, there has been a release of international financial reporting standards (IFRS) that have required disclosure of derivative use in the annual financial statements. Studies by Nguyen and Faff, (2010b), Bartram, Brown and Conrad, (2011) and Ahmed, Azevedo and Guney, (2014) have all collected their data on derivative use by analysing annual financial statements. Examining the annual financial statements is a better approach compared to the use of questionnaires because the use of a survey questionnaire puts much reliance on the response rate of firms. Besides, reviewing annual financial statement accommodates for much broader coverage of the sample and does not have problems with low percentage rates of response and the bias of non-response (Bartram, Brown and Conrad, 2011).

It is mandatory for firms listed in the JSE to prepare and report historical financial information per IFRS (Johannesburg Stock Exchange Limited, 2018).IFRS has provided various standards that deal with derivatives. The Derivative instruments are financial instruments that are under the scope of IAS 39. According to IAS 39, derivative instruments should be initially recognised at fair value on the statement of financial position and they subsequently have to be marked to market at the end of each financial reporting period. IAS 39:9 defines fair value as “the amount for which an asset can be exchanged, or a liability settled, between knowledgeable and willing parties in an arm’s length transaction”.

IFRS 7, deals with 'Financial instrument Disclosure’. The first section of IFRS 7 relates to quantitative disclosures about figures presented in the financial statements. The second part of IFRS 7 refers to risk disclosures arising from the financial instruments. Paragraph 25 of IFRS 7 requires the disclosure of the fair value of financial assets and liabilities by class. IFRS 7 requirements for the disclosure of the derivatives varies between the distinctions of cash flow hedging, accounting hedging or fair value hedging.

For each firm, there was a search done manually for the annual financial report. The annual financial statements are reviewed to identify risk management policy, the use of derivatives, the type of risks being hedged through the use of the derivatives (foreign currency risk, interest rate risk or commodity

price risk), the kind of derivative instruments being used (forwards, swaps, futures and options) and the fair value of the derivatives.

There are two variables based on derivative usage: 1) a binary variable that is one if a company uses derivatives and zero if a company does not use derivatives and 2) a continuous variable that measure the extent of derivatives use based on a firm's fair value of derivatives divided by total assets. The total fair value includes the absolute amounts of derivative assets and liabilities.

It is important to note that some prior studies measure the extent of derivative use with notional value of derivative contracts divided by total assets. For instance (Khediri, 2010; Nguyen and Faff, 2010a; Bartram, Brown and Conrad, 2011; Finavker, 2014).The reason why we use the fair value of firms' derivative contracts rather than the notional value is that most of the firms in our sample did not report the notional value amounts of their derivative contracts. The use of fair value data, therefore, allowed us to have a larger sample.

There are some prior studies that have measured the extent of derivative use with fair value of derivative contracts. Lantara, (2012) also uses the fair value of derivatives in examining the use of derivatives as a risk management tool because of the unavailability of notional value data. Zhou and Wang, (2013) uses fair value data of 148 UK non-financial firms to examine the impact of using derivative to hedge exchange rate risk on a firm's foreign exchange rate risk. Naito and Laux, (2011) also use fair value of derivatives to investigate the effect of derivative use on the firm risk of 434 S&P 500 firms.

3.1.3.2 Data from Bloomberg

The firm's financial data is retrieved from Bloomberg. Data collected to calculate, total risk, market risk, unsystematic risk, Tobin's Q, leverage, firm size, profitability, dividend yield, managerial discretion, geographical diversification, industrial diversification and investment growth. The dependent variables that measure risk were calculated from share price returns. The share prices got retrieved from Bloomberg. The dependent variable, Tobin's Q that measure firm value was retrieved from Bloomberg. All other control variables were derived from Bloomberg.

The firms have different fiscal year ends. The data from the firms vary depending on the firm's financial year-end. For instance, if company A has the financial year-end of 31st of December the first year contains data from the 31st of December 2012 until 31st of December 2013 whereas if company B has a fiscal year end of 31st of March the data will run from the period 31st of March 2012 to the 31st of March 2013. This financial year-ends overlap. Since external factors that affect firms for instance changes in exchange rate or interest rate affect all the firms at the same time, an ideal comparative analysis between all firms would require that data collected from the firms should fit the same time frame. Uniformity of data across all firms for a comparative study is essential .In order to be uniform across all firms in relevance to time, the variables used in the study from the different measures of risk

and value are measured from the start of each period of the years to the end. For instance, to calculate firm risk the daily share prices were retrieved from Bloomberg, from the start date 31st of December 2011 to 31st December 2012 for the financial year 2012, and same for the year 2013,2014,2015 and 2016.

3.2 Variables Specification

This section explains the different measures of risk and value and how all the dependant, independent and control variables were selected.

3.2.1 Dependent variable: Firm risk

There are several measures of defining risk. Academic researchers have been using both market and non-market variable.

3.2.1.1 Market vs non-market variables

This dissertation uses the standard deviation of share price returns, a market variable, to measure risk. Three dependent market variables used are: total risk, systematic risk and unsystematic risk. The three variables are similar to those in the study of (Nguyen and Faff, 2010b; Bartram, Brown and Conrad, 2011; Bartram, 2019). The reason we choose these market variable is because, all-important and relevant information of a company including the risks of a firm can be estimated empirically using a firm's share price.(Nguyen and Faff, 2010a).

Proposers of non-market variables like Allayannis and Weston, (2003) use variables like the standard deviation of cash flows from operations. They argue that market risk measures do not explain the stability of the firm's financial statements. They add that they are also not directly related to a company's risk management policies. Authors like Bartram, Brown and Conrad, (2011) state that the volatility of the cash flow can incorporate other types of activities under risk management. An example of these risk management activities is when there is the use of foreign assets for operational hedging, an essential tool for exchange rate risk management.

However, there are some limitations on the use of non-market variables. Firstly, there might be a limited amount of data hence one cannot measure net exposure with enough precision compared to stock price data (Nguyen and Faff, 2010). Secondly, financial statements get prepared internally; therefore, managers may have the incentive to alter the financial statements systematically to present a skewed picture. Finally, in the case where commodity price derivatives and exchange rate derivatives transactions do not utilise hedge accounting, the transactions may not be able to be reported under cash flows from operations. Therefore, cash flows may not be able to represent the use of all derivatives in all firms (Bartram, Brown and Conrad, 2011).

3.2.1.2 Total risk

Total risk is the annualised standard deviation of the daily share price returns each year multiplied by 252^1/2.Share price data was retrieved from Bloomberg. Total risk is broken down into systematic risk and unsystematic risk. The reason for breaking down total risk is to acquire further information to evaluate the impact of the derivative use on firm risk.

Share price returns have been retrieved using this formula.

$$r_t = log\ (H_t / H_{t-1}) = log\ (H_t) - log\ (H_{t-1}) \quad (1)$$

3.2.1.3 Systematic risk

The systematic risk is the product of the variance of the share price return with the daily frequency on the FTSE/JSE Africa All-share Index and firm ¡ market beta squared. A security Beta is a measure of how sensitive a share price is to the market broad risk factors. It can also be interpreted as how responsive the company's revenue and cash flows are to the general economic conditions of South Africa. The FTSE/JSE Africa All share Index returns are regressed on the returns of the individual firms share price returns to calculate beta. Firm beta is then used to calculate firm systematic risk as prescribed below. A security beta may vary substantially based on whether it is estimated from daily, weekly or monthly returns (Hawawini, 1983). Daily returns compared to weekly and monthly returns have the smallest standard errors of beta, in other words, the highest precision of the beta estimate (Daves, Ehrhardt and Kunkel, 2000). The systematic risk variable formed by the market model is specified as follows:

$$R_{it} = \beta_0 + \beta_m R_{mt} + \varepsilon_{it.} \quad (2)$$

The systematic risk variable is *(βm).* The variable R_{it} is the daily share price return on stock ¡, R_{mt} is the daily return on the index and ε_{it} is the error term.

3.2.1.4 Unsystematic risk

Unsystematic risk is the annualised standard deviation of the residuals ε_{it} from equation 2. It is the risk that is endemic to the company. It is associated with factors that affect the company at the microeconomic level.

3.2.2 Dependent variable: Firm value

In the quest for understanding the behaviour of a firm's market value concerning the use of derivatives as a hedging policy, a dependent variable that captures the market value of the firm was selected. Tobin's Q ratio is a good proxy to measure firm value as emphasised by (Wernerfelt and Montgomery, 1988; Bartram, Brown and Conrad, 2011). Examples of previous studies that have used Tobin's Q to measure firm value are (Allayannis and Weston, 2003; Khediri, 2010; Nguyen and Faff, 2010b; Bartram, Brown and Conrad, 2011; Alam, 2017).

According to Bloomberg (2018), Tobin's Q represents the ratio of the market value of a firm to the replacement cost of the firm's assets. The logic behind Tobin's Q is that a firm's market value should be equal to the cost of replacing its assets in the long run. The ratio is calculated as follows:

$$= (Market\ Capitalisation + Preferred\ Equity + Minority\ Interest + Total\ Liabilities) / Total\ Assets \quad (3)$$

This approximation ratio was introduced by (Chung and Pruitt, 1994). Prior literature that has used the same approximation ratio is related to (Allayannis and Weston, 2003; Jin and Jorion, 2006). We choose a simple Tobin's q as opposed to a more complex Tobin's Q. There are two reasons for this. Firstly Allayannis and Weston, (2003) reports that the correlation coefficient between the complex Tobin's Q and the simple Tobin's Q is as high as 0.93. Secondly Chung and Pruitt, (1994) state that simple Tobin's Q does not need a substantial amount of data hence it is more efficient. This dissertation uses the natural logarithm transformation of Tobin's Q because it has a better statistical distribution property compared to raw Tobin's Q as emphasised by (Hirsch and Seaks, 1993).

3.3 Control Variables

3.3.1 Control variables for firm risk

The study aims to examine the role of derivatives in minimising firm risk empirically. However, they are other firm-specific factors that are significant determinants of a firm's risk. In determining the effect of derivative use in general and the different distinctions, it is necessary to differentiate these factors. Therefore, using multivariate regression, the study will examine the impact of derivatives in minimising firm risk alongside these control variables. After a careful examination of academic literature concerning this area, the control variables are more or less the same. The nine most significant variables from the papers (Hentschel and Kothari, 2001; Nguyen and Faff, 2010a; Bartram, Brown and Conrad, 2011) were selected.

1. Leverage:

Leverage is measured as the book value of long-term debt divided by total equity. The hedging theory states that an increase in a firm's leverage will increase the probability the firm defaulting on debt and therefore an automatic rise in the cost of financial distress (Smith and Stulz, 1985). There is substantial prior literature that details the association between the amounts of debt a firm acquires and firm risk. Hentschel and Kothari, (2001) state that when a firm's leverage increases the level of risk also increases significantly. The authors add that leverage increases the costs of financial distress which increases firm risk .Bartram, Brown and Conrad, (2011) establish that derivative users are more exposed to various measures of risk even before considering the potential effect of risk management by using derivatives because of a high leverage ratio. Nguyen and Faff, (2010a) set leverage as a control variable to illustrate

the sensitivity in total risk, systematic risk and unsystematic risk. According to the authors, leverage is a key control variable that determines the level of total risk and systematic risk in a firm. The authors state that an increase in the leverage of a firm will result in a significant rise in total risk and systematic risk.

2. Market Capitalisation to Book Value:

It is measured as Market Capitalisation/ Book Value. It is a measure of the relative value of a company compared to its market value. This ratio also presents the growth options available to a firm. High growth firms have the risk of underinvestment, where a firm can fail to maximise shareholders wealth and are therefore considered riskier (Froot, Schafstein and Stein, 1993). Studies like those of Hentschel and Kothari, (2001) and Bartram, Brown and Conrad, (2011)use market to book value ratio as a control variable to evaluate the impact that derivatives have on different measures of firm risk. Nguyen and Faff, (2010a) state that an increase in a firm's market to book ratio will lead to a significant increase in the firm's total risk and unsystematic risk.

3. Size:

The size is measured as the natural logarithm of total assets. Current empirical evidence is ambiguous about the effect of firm size on firm risk. There is evidence showing that an increase in firm size lowers a firm's total risk (Guay, 1999; Hentschel and Kothari, 2001). Similarly, Bartram, Brown and Conrad, (2011) establish that an increase in firm size lowers the level total risk and systematic risk. The authors add that size is an important factor in determining a firm's level of total and systematic risk. According to Nance, Smith and Smithson, (1993) large firms have a higher likelihood of managing risk, which reduces risk. In contrast, Guay and Kothari, (2003) establish that an increase in firm size increases total risk of a firm.

4. Liquidity:

Liquidity is measured by the current ratio. The current ratio indicates the firm's ability to cover its short-term liabilities with its short-term assets. The current ratio is measured as Current Assets / Current Liabilities. According to Nance, Smith and Smithson, (1993) an increase in liquidity lowers firm risk. An increase in a firm's liquidity increases a firm's distance to default (Marin, 2013). Jensen and Meckling, (1976) state that firms with enough internal financing can reduce the risk of obtaining external finance, which is expensive, and therefore hedge less. The authors add that liquid firms have a low risk of underinvestment, which lowers overall risk. On the contrary, the author adds that extreme liquidity can cause managers to be entrenched and therefore induces additional volatility. Thus, the authors recommend that a firm should have a reasonable amount of liquidity. The authors add that due to lower levels of underinvestment the increase in liquidity is expected to lower firm risk. On the contrary, extreme liquidity causes agency problems and therefore increases risk. Nguyen and Faff,

(2010a), also add that the relationship between liquidity and firm risk is nonlinear. The authors add that an increase in liquidity reduces firm risk up to a certain point after that point an increase in liquidity will start to increase the firm risk.

5. Managerial discretion:

Managerial discretion is measured as the percentage of outstanding shares currently held by insiders. According to Bartram, Brown and Fehle, (2009), management with too much control may use that to implement risk management policies that maximise their own wealth and this may increase a firm risk. The authors state that most executives are remunerated of the wealth of the firms they work for. These managers, therefore, receive monetary and non-monetary wealth that is undiversified. The authors argue that because managers are risk averse they may embark in extreme risk management policies that may end up hedging risk that can be diversified. This may be against the best interest of shareholders. The authors give the example of a theoretical model (Merton, 1974) that shows an increase in equity value also increases asset volatility. Demarzo and Duffie, (1995) state that the use of derivatives for risk management may assist investors in developing efficient remuneration packages for managers that will help align manager's interest to those of shareholders. The authors argue that this efficient remuneration packages will help reduce firm risk.

6. Dividend 12 Month yield:

Dividend, 12 Month yield, is measured as the sum of dividend per share amounts that have become ex-dividend over the past 12 months, divided by the current stock price. Firms with a higher dividend yield have higher stable cash flows and lower financial constraints (Bartram, Brown and Conrad, 2011). Dividend-paying firms have a lower likelihood of being constrained financially and therefore have lower risks (Allayannis and Weston, 2001). Additionally, Nguyen and Faff (2010a) state that an increase in dividend yield reduces risk.

7. Industrial diversification:

A dummy variable of one is used if a company derived income from more than one industry sector and zero if a company derived income from only one industry sector. Diversified firms are expected to have operations in various industries and have diversified income. Having diversified income streams lowers firm risk. Diversified firms increases the debt capacity of firms hence reducing risk and reducing the probability of being bankrupt. Firms are able to reduce their risks by operating in more than one industry and benefit from the inverse relationship between firm risk and diversification (Jafarinejad, Ngo and Escobari, 2018). Hann *et* al. (2013) state that the imperfect correlation of cash flow amongst firms that are industrially diversified reduces the dead weight counter cyclical cost, which reduces firm risk.

8. Geographical diversification:

This study measures geographical diversification as foreign turnover divided by total turnover. Geographical diversification measures the foreign exchange risk of a firm. According to Carter, Pantzalis and Simkins, (2001) firms with a widespread network of operations across countries can manage long-term economic exposure by setting up operational hedges. Therefore, the management of this long-term economic exposure has an effect of reducing total risk. Other research papers that have included geographical diversification as a control variable are (Bartram, Brown and Conrad, 2011; Allayannis, Lel and Miller, 2012). Both papers state that geographical diversification has a negative relationship with total risk.

9. Profitability:

Profitability is measured by the Return on Assets (ROA). Calculated as: (Trailing 12M Net Income / Average Total Assets) * 100.ROA indicates the profitability of a company relative to its total assets. ROA presents management efficiency in using assets to create value. An increase in profitability of a firm makes it less likely for the firm to default on its debt commitments and a firm becomes less prone to being bankrupt. Highly profitable firms have a cheaper source of financing within them compared to being financed externally. The lower cost of financing from retained earning means that they have a lower rate of default on borrowing from outside the firm. An increase in profitability reduces the likelihood of a firm failure (Campbell, Hilscher and Szilagyi, 2008). Similarly, Bartram, Brown and Conrad, (2011) state that an increase in profitability reduces firm risk measures. The author elaborates that firms that are highly profitable are less risky and therefore they have lower financial distress. In support of this Campbell, Hilscher and Szilagyi, (2008) states that an increase in profitability in a firm can lower its cost of borrowing consequently lowering risk.

3.3.2 Control variables for firm value

1. Size:

Size is measured by the logarithm of total assets. According to Allayannis and Ofek, (2001) an increase in firm size reduces firm value. The authors states that large firms have different Tobin's Q to smaller firms. The author reported that large firms had a lower Tobin's Q, than small firms. Papers that have included size as a control variable for firm value include :(Allayannis and Weston, 2003; Ben Khediri, 2010; Nguyen and Faff, 2010a; Ahmed, Azevedo and Guney, 2014).

2. Leverage:

Leverage has been measured as the book value of long-term debt divided by total equity. The relationship between firm value and leverage can be explained by capital structure theories. Increase in leverage is associated with the tax benefit generated from debt (Modigliani and Miller, 1958), the agency cost of debt (Myers, 1977) and using debt as an anti-takeover mechanism (Jensen and Meckling,

1976). A firm's capital structure affects its value. The increase in leverage increases tax shields on the interest payments, hence an increase in firm value. However high debt levels within a firm increase the risk of default consequently increasing financial distress, which reduces firm value. Titman and Wessels, (1988) report that overall an increase in debt reduces firm value. The level of a firm's leverage seems to represent a firm's financial distress and the higher the leverage ratio, the higher the probability that a firm will hedge (Smith and Stulz, 1985). Therefore, the capital structure of a firm influences a firm's risk management policies. Similarly, Allayannis and Weston, (2003) established that an increase in leverage reduces firm value. On the contrary Bartram, Brown and Conrad, (2011) found that an increase in leverage increases firm value.

3. Liquidity:

Liquidity is measured by the current ratio, which illustrates the company's capability to cover back its short-term liabilities with its short-term assets. Current ratio is calculated as Current Assets / Current Liabilities. Firms that have adequate internal financing can avoid the cost of raising external financing that is very expensive to undertake projects whose net present value are positive. Consequently, an increase in liquidity is expected to increase firm value. However, excess liquidity may reduce shareholder wealth by making firms to get into negative present value projects. (Jensen, 1986).On one hand Nguyen and Faff, (2007) establish that an increase in liquidity will reduce firm value. On the other hand Akpınar and Fettahoğlu, (2016) state that an increase in liquidity will improve firm value.

4. Profitability:

Profitability is measured by the Return on Assets (ROA). ROA illustrates how profitable a company is relative to its total assets, in percentage. ROA evaluates management efficiency in using assets to create value. ROA is calculated as (Trailing 12M Net Income / Average Total Assets) * 100. This dissertation uses the same logic as (Allayannis and Weston, 2003) and include the return on asset variable to control for profitability. Firms that are profitable have a higher probability to trade at a premium compared to less profitable firms hence they will have a higher market value (Jin and Jorion, 2006). According to Allayannis and Weston, (2003) an increases in the level of a firm's profitability will have a significant positive impact on the firm's value.

5. Investment growth:

Investment growth is measured using the Market to book ratio, which is a measure of the relative value of a company compared to its market value. It is calculated as Market Capitalisation/ Book Value. This ratio shows that growth options available in a firm. It is expected that an increase in investment growth will enhance firm value. The market to book ratio can also be a close alternative of the measure of a firms performance because it presents the differential between the valuation that the market gives to a firms assets and the book value of those assets (Sharma *et al.*, 2013). The ratio represents the discount

or the premium that the market gives the firm on its net assets. Therefore, the ratio indicates what the market's view of how the firm is managed. A firm with a high market to book ratio suggest that the market has placed high value premiums on the firm. The market expects good returns for every rand invested in the firm. On the other hand, a low market to book ratio suggests the market has placed low value premiums on the firm. The market does not expect good returns for every rand invested in the firm. The Market to Book ratio is indicative of both how efficiently assets are utilised and the future growth potential of the firm (Lenox, Rockart and Lewin, 2010). Scholars have used the market to book ratio as a critical measure of firm performance to highlight the efficiency of use of assets and firm growth options. Sharma *et al.*, (2013) state that an increase in market to book ratio goes hand in hand increases in efficiency and growth.

6. Dividend yield:

Dividend, 12 Month yield, is measured as the sum of dividend per share amounts that have gone ex-dividend over the prior 12 months, divided by the current stock price. Fama and French, (1998) state that a firm's dividend conveys information about the future profitability of a firm in the form of expected future cash flows. The author adds that firms with a higher dividend yield have higher stable cash flows and lower financial constraints. Allayannis and Weston (2003) state that a firm that pays dividends has a lower probability of being capital constrained and therefore may have a lower Tobin's Q. The author adds that if firms that hedge forego projects because of being unable to acquire the necessary financing, the firms Tobin's Q might remain high because it will undertake projects that have a positive net present value only (Allayannis and Ofek, 2001).

7. Managerial discretion:

Managerial discretion is measured by the Percentage of outstanding shares currently held by insiders. Morck, Shleifer and Vishny, (1988) showed that Tobin's Q has a positive correlation with managerial ownership exhibiting a non-monatomic relationship. Firm in their sample experienced a rise in Tobin's Q at first then a decline and finally a slight rise as ownership of shares by insiders increased. Jensen and Meckling, (1976) have pointed out the offsetting cost of significant management ownership. Managers are able to use the firm for their own benefit when they hold enough equity and shareholders are too dispersed to have a united enforcement of control. Managers may embark on selfish activities like employee welfare, empire building, and increase in sales or undertaking negative net present value projects. Jensen and Meckling, (1976) state that the cost of deviating from value maximisation decline as management shareholding increases. Morck, Shleifer and Vishny, (1988) argue that managers who have a small percentage of equity may still be forced by the market to maximise firm value. On the other hand, managers who have a substantial percentage in equity may enforce the controlling power for selfish gains like guaranteed employment.

8. Geographical diversification:

This study measures geographical diversification as foreign turnover divided by total turnover. This is similar to previous papers such as (Allayannis and Ofek, 2001; Ben Khediri, 2010). The theory behind geographical diversification is that many geographical locations postulate higher market values and therefore increases market value. Allayannis and Weston, (2001) state that the internationalisation theory postulates that a company that is geographically diversified is able to increase in value by taking advantage of international markets, some of its intangible assets like advanced production and consumer goodwill. Júnior, (2007) and Ahmed, Azevedo and Guney, (2014) state that an increase in geographical diversification increase firm value. Errunza and Senbet, (1981) state through overcoming systematic hurdles like tax regimes multinational firms can increase in value. Kogut and Kulatilaka, (1994) adds that geographically diversified firms also increase their value through operational flexibility. According to Carter, Pantzalis and Simkins, (2001) firms with a widespread network of operations across countries can manage long-term economic exposure by setting up operational hedges. Morck and Yeung, (1991) established that multinationalism is positively related to value. On the contrary Allayannis and Weston, (2001) state that geographical diversification can be value destroying by generating agency problems.

9. Industrial diversification:

We used a dummy variable of one if a company derived income from more than one industry sector and zero if a company derived income from only one industry sector. This is similar to other studies done for example (Nguyen and Faff, 2010). Yücel and Önal, (2016) state that an increase in diversification increases the Tobin's Q of a firm. The authors add that an increase in industrial diversification increases firm performance. Lewellen, (1971) states that industrial diversification reduces a firm cash flow volatility consequently enhancing value. On the contrary Jensen, (1986) states that industrial diversification reduces firm value due to increased agency cost of free cash flow . Allayannis and Weston, (2001) state that firms that are industrially diversified are able to increase their debt capacity and therefore have an increased tax shield. The authors add that these firms are able to diversify their income streams hence offsetting losses against profits from different industry segments.

3.3.3 Estimation methodologies

Hsiao, (2003) states, "A panel data set is one that follows a given sample of individuals over time, providing multiple observations to each." The data set in this research is similar to the above-prescribed definition as it combines time series and cross-sectional data. The sample data in this dissertation follows firms from the FTSE/JSE Africa All Share Index for the period 2012 to 2016. As mentioned before it is possible to perform cross-sectional and time series analysis over the periods 2012, 2013, 2014, 2015 and 2016. Panel data allows for control variables we cannot observe or measure. Therefore, one can have more informative results because of more variability within variables and trend within variables. The more variability leads to less collinearity, and more degrees of freedom and the estimates

are more efficient. Panel data also accounts for individual heterogeneity within cross-sectional data. Besides panel data controls for unobserved heterogeneity, and this results in better estimates.

This dissertation uses a balanced panel data. Hsiao, (2003) states "A balanced panel data will allow for the control of the potential existence of non-observable individual characteristics that may vary across cross-sections but remain constant over time."

3.4 Estimation Framework

An array of econometric and statistical data analysis techniques have been employed. Previous studies for example Khediri, (2010) and Bartram, Brown and Conrad, (2011)have emphasised that firms that use derivatives have significant and different firm characteristics to firms that do not use derivatives. This dissertation uses univariate test for differences in means to investigate the differences in the firm characteristics in the sample. Univariate tests have some limitations, as they do not reveal significant firm characteristic differences. Therefore, we also make use of multivariate analysis.

3.4.1 Empirical models:

The regression equations will be as follows: Each variable used to measure risk and value first of all has three categories: Derivative use (if a firm uses derivatives or not), derivative use to hedge types of risks (these are foreign currency derivatives, interest rate derivatives and commodity derivatives, and the instruments being used to hedge the risk (this are forwards, swaps, options and futures).

Each category has two equations; one for dummy variable (dummy variable of one if a firm uses derivatives, hedges that type of risk or uses that type of derivative product and zero if otherwise) and the other is a continuous variable for the extent of use (total fair value divided by firm size (total assets)).

Similar to recent studies like Allayannis and Weston, (2003), Nguyen and Faff, (2007), Khediri, (2010) and Bartram, Brown and Conrad, 2011)this dissertation has incorporated multivariate models to establish the effect of derivative use on firm risk and firm value. In the multivariate structure, we estimated the models that follow.

3.4.2 Firm risk

3.4.2.1 The effect of derivative use on firm risk

Equation 4 estimates the impact of derivative use on firm risk measures. A dummy variable for derivative use equal to one is used if a firm uses derivatives and zero if otherwise. This is based on the disclosure in the annual financial statements. Firm risk is a representative of total risk, systematic risk and unsystematic risk.

$$\textbf{Firm risk}_{it} = \alpha_{it} + \beta_1 \textbf{Derivatives Dummy}_{it} + \beta_2 Leverage_{it} + \beta_3 Size_{it} + \beta_4 Market\ To\ Book_{it} + \beta_5 Liquidity_{it} + \beta_6 Managerial\ Discretion_{it} + \beta_7 Dividend\ Yield_{it} + \beta_8 Industrial\ Diversification_{it} + \beta_9 Geographical\ Diversification_{it} + \beta_{10} Profitability_{it} + \varepsilon_{it}.$$

(4)

Equation 5 estimates the impact of the extent of derivative use on firm risk measures. The extent of derivative use is measured by the total fair value of derivatives (total fair value of derivative assets plus the total fair value of derivative liabilities) divided by total assets.

$$\textbf{Firm risk}_{it} = \alpha_{it} + \boldsymbol{\beta_1}\ \textbf{Extent Derivative Use}_{it} + \beta_2\ Leverage_{it} + \beta_3 Size_{it} + \beta_4 Market\ to\ Book_{it} + \beta_5\ Liquidity_{it} + \beta_6\ Managerial\ Discretion_{it} + \beta_7\ Dividend\ Yield_{it} + \beta_8 Industrial\ Diversification_{It} + \beta_9 Geographical\ Diversification_{it} + \beta_{10} Profitabilty_{it} + \varepsilon_{it}. \quad (5)$$

3.4.2.2 Type of risk being hedged by the derivatives

Equation 6 and 7 estimates the effects of derivative use on firm risk measures by partitioning the use of derivatives the types of risks being hedged (i.e. foreign currency risk derivatives, interest rate risk derivatives and commodity price risk derivatives.)

$$\textbf{Firm risk}_{it} = \alpha_{it} + \boldsymbol{\beta_1}\ \textbf{FCD}_{it} + \boldsymbol{\beta_2}\ \textbf{IRD}_{it} + \boldsymbol{\beta_3}\ \textbf{CD}_{it} + \beta_4\ Leverage_{it} + \beta_5 Size_{it} + \beta_6 Market\ to\ Book_{it} + \beta_7\ Liquidity\ it + B_8\ Managerial\ Discretion_{it} + \beta_9\ Dividend\ Yield_{it} + \beta_{10}\ Industrial\ Diversification_{it} + \beta_{11}\ Geographical\ Diversification_{it} + \beta_{12}\ Profitability_{it} + \varepsilon_{it}. \quad (6)$$

$$\textbf{Firm risk}_{it} = \alpha_{it} + \boldsymbol{\beta_1}\ \textbf{Extent FCD}_{it} + \boldsymbol{\beta_2}\ \textbf{Extent IRD}_{it} + \boldsymbol{\beta_3}\ \textbf{Extent CD}_{it} + \beta_4\ Leverage_{it} + \beta_5\ Size_{it} + \beta_6 Market\ to\ Book_{it} + \beta_7\ Liquidity_{it} + B_8\ Managerial\ Discretion_{it} + \beta_9\ Dividend\ Yield_{it} + \beta_{10}\ Industrial\ Diversification_{it} + \beta_{11}\ Geographical\ Diversification_{it} + \beta_{12}\ Profitability_{it} + \varepsilon_{it}. \quad (7)$$

3.4.2.3 The type of derivative instruments used to hedge the risk

Equation 8 and 9 estimates the effects of derivative use on firm risk measures by partitioning the use of derivatives by the types instruments being used to hedge (i.e. forwards, swaps, options and futures).

$$\textbf{Firm risk}_{it} = \alpha_{it} + \boldsymbol{\beta_1}\ \textbf{Forward}_{it} + \boldsymbol{\beta_2}\ \textbf{Swap}_{it} + \boldsymbol{\beta_3}\ \textbf{option}_{it} + \boldsymbol{\beta_4}\ \textbf{future} + + \beta_5\ Leverage_{it} + \beta_6\ Size_{it} + \beta_7 Market\ to\ Book_{it} + \beta_8\ Liquidity_{it} + B_9\ Managerial\ Discretion_{it} + \beta_{10}\ Dividend\ Yield_{it} + \beta_{12}\ Industrial\ Diversification_{it} + \beta_{13}\ Geographical\ Diversification_{it} + \beta_{14}\ Profitability_{it} + \varepsilon_{it}. \quad (8)$$

$$\textbf{Firm risk}_{it} = \alpha_{it} + \boldsymbol{\beta_1}\ \textbf{Extent Forward}_{it} + \boldsymbol{\beta_2}\ \textbf{Extent Swap}_{it} + \boldsymbol{\beta_3}\ \textbf{Extent option}_{it} + \boldsymbol{\beta_4}\ \textbf{Extent Future} + \beta_5\ Lev_{it} + \beta_6\ Size_{it} + \beta_7 Market\ to\ Book_{it} + \beta_8\ Liquidity\ it + B_9\ Managerial\ Discretion_{it} + \beta_{10}\ DY_{it} + \beta_{12}\ Industrial\ Diversification_{it} + \beta_{13}\ Geographical\ Diversification_{it} + \beta_{14}\ Profitability_{it} + \varepsilon_{it}. \quad (9)$$

3.4.2.4 Portfolio analysis

In this section this dissertation follows the example of (Nguyen and Faff, 2010a) and performs a portfolio analysis. A univariate portfolio analysis will be conducted to aid with preliminary investigation on whether the derivative use has a linear or nonlinear relationship with firm risk. Firms will be estimated for their level the extent of derivative use. This was measured by the total fair value of all derivative contracts divided by total assets. There after all firm years will be divided into ten portfolios according to the extent of derivative use. Since the firms are separated by firm years it will not matter if a firm has a large derivative usage one year and a small derivative usage the year after. Portfolio 0 contains all the non-users firms. The least intensive derivative users are in portfolio 1 and the most intensive derivative users are in portfolio 10. If the case firm risk is a linear function of derivative use we expect that firms in portfolio 1 (portfolio 10) will be associated with the highest (lowest) level of risk.

Previous empirical evidence see (Guay, 1999; Nguyen and Faff, 2010a) in this area has been characterised by an insignificant coefficient. The reason for the insignificant coefficient is because the relationship between derivative use and firm risk is not linear(Guay, 1999). The portfolio analysis may suggest that the relationship between derivative use and firm risk is not significant because it is not linear.

$$\textbf{Total risk}_{it} = \textbf{D}_{Si}[\alpha_{it} + \boldsymbol{\beta_1}\textbf{ Extent Derivatives}_{it} + \beta_2 Leverage_{it} + \beta_3 Size_{it} + \beta_4 Market\ to\ Book_{it} + \beta_5 Liquidity_{it} + \beta_6 Managerial\ Discretion_{it} + \beta_7 Dividend\ Yield_{it} + \beta_8 Industrial\ Diversification_{it} + \beta_9 Geographical\ Diversification_{it} + \beta_{10} Profitability_{it}] + \textbf{D}_{Li}[\alpha_{it} + \boldsymbol{\beta_{11}}\textbf{ Extent Derivative}_{it} + \beta_{12} Leverage_{it} + \beta_{13} Size_{it} + \beta_{14} MTBV_{it} + \beta_{15} Liquidity_{it} + \beta_{16} Managerial\ Discretion_{it} + \beta_{17} Dividend\ Yield_{it} + \beta_{18} Industrial\ diversification_{it.} + \beta_{19} Geographical\ Diversification_{it} + \beta_{20} Profitability_{it}] + \varepsilon_{it}. \quad (10)$$

As per the portfolio analysis results we will establish two optimal portfolios. The optimal portfolios will be the portfolios that record the least amount of total risk. The extent of derivative use in these two portfolios will then be the two thresholds that we use in our regressions. The first threshold will be the extent of derivative use of the portfolio that has the lowest total risk. The second threshold will be the extent of derivative use of the portfolio that has the second lowest total risk. Similar to Nguyen and Faff, (2010a) this dissertation uses two thresholds to test for sensitivity in results when the threshold changes. Two dummy variables have been calculated and put into equation 10. The first dummy variable D_{Si} is set to one if the extent of derivative use is equal the first threshold or less and zero if otherwise. The optimal level will be the average extent of derivative usage where the maximum risk reduction is achieved from the results of our portfolio analysis. The second dummy variable D_{Li} is set to one if the extent of derivative usage is equal to the first threshold or higher. β_1 and β_{11} will be of primary essence in this test. This process is repeated for the second threshold to check for sensitivity in

results when the threshold changes. In addition, regressions are run where non-derivative users are included and when they are excluded.

According to Nguyen and Faff, (2010a) firms with the optimal level of the extent of derivative use will experience the best reduction and therefore the coefficient β_1 is expected to be negative. The converse is expected that firms that have a higher intensity of derivative use than the optimal level. The coefficient β_{11} is expected to be positive as these firms are expected to increase firm risk as their level of derivative use extends past the optimal level.

3.4.3 Firm value

3.4.3.1 The effect of derivative use by the firm value

Equation 11 estimates the effects of derivative use on the firm value. A dummy variable for derivative use equals to one is used if a firm uses derivatives and zero if otherwise. This is based on the disclosure in the annual financial statements. Firm value represents the natural log of Tobin's Q (***Ln Tobin's Q*** $_{it}$).

$$\textbf{Firm value}_{it} = \alpha + \boldsymbol{\beta_1}\ \textbf{Derivative Dummy}_{it} + \beta_2\, Leverage_{it} + \beta_3 Size_{it} + \beta_4 Investment\ growth_{it} + \beta_5\, Liquidity_{it} + \beta_6\, Managerial\ Discretion_{it} + \beta_7\, Dividend\ Yield_{it} + \beta_8 Industrial\ Diversification_{it} + \beta_9\, Geographical\ diversification_{it} + \beta_{10}\, Profitability_{it} + \varepsilon_{it}. \quad (11)$$

Equation 12 estimates the effect of the extent of derivative use on the on the firm value. The extent of derivative use is measured by the total fair value of derivatives (total fair value of derivative assets plus the total fair value of derivative liabilities) divided by total assets.

$$\textbf{Firm value}_{it} = \alpha + \boldsymbol{\beta_1}\ \textbf{Extent Derivative use}_{it} + \beta_2\, Leverage_{it} + \beta_3 Size_{it} + \beta_4 Investment\ Growth_{it} + \beta_5\, Liquidity_{it} + \beta_6\, Managerial\ Discretion_{it} + \beta_7\, Dividend\ Yield_{it} + \beta_8\, Industrial\ Diversification_{it} + \beta_9\, Geographical\ Diversification_{it} + \beta_{10}\, Profitability_{it} + \varepsilon_{it}. \quad (12)$$

3.4.3.2 The type of risk being hedged by the derivatives

Equation 13 and 14 estimates the effects of derivative use on the firm value by partitioning the use of derivatives the types of risks being hedged (i.e. foreign currency risk derivatives, interest rate risk derivatives and commodity price risk derivatives.)

$$\textbf{Firm value}_{it} = \alpha_{it} + \boldsymbol{\beta_1}\ \textbf{FCD}_{it} + \boldsymbol{\beta_2}\ \textbf{IRD}_{it} + \boldsymbol{\beta_3}\ \textbf{CD}_{it} + \beta_4\, Leverage_{it} + \beta_5 Size_{it} + \beta_6\, Investment\ Growth_{it} + \beta_7\, Liquidity_{it} +$$

$B_8 Managerial\ Discretion_{it} + \beta_9 Dividend\ Yield_{it} + \beta_{10} Industrial\ Dividend_{it} + \beta_{11} Geographical\ diversification_{it} + \beta_{12} Profitability_{it} + \varepsilon_{it}.$ (13)

$$\textbf{Firm value}_{it} = \alpha_{it} + \boldsymbol{\beta_1}\ \textbf{Extent FCD}_{it} + \boldsymbol{\beta_2}\ \textbf{Extent IRD}_{it} + \boldsymbol{\beta_3}\ \textbf{Extent CD}_{it} + \beta_4 Leverage_{it} + \beta_5 Size_{it} + \beta_6 Investment\ Growth_{it} + \beta_7 Liquidity_{it} + B_8 Managerial\ discretion_{it} + \beta_9 Dividend\ Yield_{it} + \beta_{10} Industrial\ Diversification_{it} + \beta_{11} Geographical\ Diversification_{it} + \beta_{12} Profitability_{it} + \varepsilon_{it}.$$ (14)

3.4.3.3 The type of derivative instruments used to hedge

Equation 15 and 16 estimates the impact of derivative use on the firm value by partitioning the use of derivatives by the types instruments being used to hedge (i.e. forwards, swaps, options and futures).

$$\textbf{Firm value it} = \alpha_{it} + \boldsymbol{\beta_1}\ \textbf{Forward}_{it} + \boldsymbol{\beta_2}\ \textbf{Swap}_{it} + \boldsymbol{\beta_3}\ \textbf{option}_{it} + \boldsymbol{\beta_4}\ \textbf{future} + \beta_5 Leverage_{it} + \beta_6 Size_{it} + \beta_7 Investment\ growth_{it} + \beta_8 Liquidity_{it} + B_9 Managerial\ Discretion_{it} + \beta_{10} Dividend\ Yield_{it} + \beta_{12} Industrial\ Diversification_{it} + \beta_{13} Geographical\ Diversification_{it} + \beta_{14} Profitability_{it} + \varepsilon_{it}.$$ (15)

$$\textbf{Firm value}_{it} = \alpha_{it} + \boldsymbol{\beta_1}\ \textbf{Extent Forward}_{it} + \boldsymbol{\beta_2}\ \textbf{Extent Swap}_{it} + \boldsymbol{\beta_3}\ \textbf{Extent option}_{it} + \boldsymbol{\beta_4}\ \textbf{Extent future} + \beta_5 Lev_{it} + \beta_6 Size_{it} + \beta_7 Investment\ growth_{it} + \beta_8 Liquidity_{it} + B_9 Managerial\ Discretion_{it} + \beta_{10} Dividend\ yield_{it} + \beta_{12} Industrial\ Diversification_{it} + \beta_{13} Geographical\ Diversification_{it} + \beta_{14} Profitability_{it} + \varepsilon_{it}.$$ (16)

3.4.3.4 Portfolio analysis

In this section this dissertation follows the example of (Nguyen and Faff, 2010b) and performs a portfolio analysis. A univariate portfolio analysis will be conducted to aid with preliminary investigation on whether the derivative use has a linear or nonlinear relationship with firm value. Firms will be estimated for their level the extent of derivative use. This was measured by the total fair value of all derivative contracts divided by total assets. There after all firm years will be divided into ten portfolios according to the extent of derivative use. Since the firms are separated by firm years it will not matter if a firm has a large derivative usage one year and a small derivative usage the year after. Portfolio 0 contains all the non-users firms. The least intensive derivative users are in portfolio 1 and the most intensive derivative users are in portfolio 10 .In the case firm value is a linear function of derivative use we expect that firms in portfolio 10 (portfolio 1) will be associated with the highest (lowest) level of Tobin's Q.

$$\textbf{Firm value}_{it} = \boldsymbol{D_{Si}}\ [\ \alpha_{it} + \boldsymbol{\beta_1}\ \textbf{Extent Derivative}_{it} + \beta_2 Leverage_{it} + \beta_3 Size_{it} + \beta_4 Investment\ Growth_{it} + \beta_5 Liquidity_{it} + \beta_6 Managerial\ Discretion_{it} + \beta_7 Dividend\ Yield_{it} + \beta_8 Industrial\ Diversification_{it} + \beta_9 Geographical\ Diversification_{it} +$$

β_{10} *Profitability* $_{it}$ *]* $+\boldsymbol{D}_{Li}$ *[*α_{it} $+$ $\boldsymbol{\beta_{11}}$ ***Extent Derivative*** $_{it}$ $+$ β_{12} *Leverage* $_{it}$ $+$ β_{13}*Size*$_{it}$ $+\beta_{14}$*IG* $_{it}$ $+$ β_{15} *Liquidity* $_{it}$ $+$ β_{16} *Managerial Discretion* $_{it}$ $+\beta_{17}$ *Dividend Yield* $_{it}$ $+\beta_{18}$ *Industrial Diversification* $_{it.}$ $+$ β_{19} *Geographical Diversification* $_{it}$ $+$ β_{20} *Profitability* $_{it}$ *]* $+$ ε_{it}. (17)

As per the portfolio analysis results, the optimal portfolios will be the ones with the highest level of firm value. The extent of derivative use in these two portfolios will be the two thresholds. The first threshold will be the extent of derivative use of the portfolio that has the highest Tobin's Q. The second threshold will be the extent of derivative use of the portfolio that has the second highest Tobin's Q. Two dummy variables have been calculated and put into equation 17. The first dummy variable D_{Si} is set to one if the extent of derivative use is the optimal level or less and zero if otherwise. The second dummy variable D_{Li} is set to one if the extent of derivative usage is the optimal level or higher and zero if otherwise. β_1 and β_{11} will be of primary essence in this test. This process is repeated for the second threshold to check for sensitivity in results when the threshold changes. In addition, regressions are run where non-derivative users are included and when they are excluded.

According to Nguyen and Faff, (2010b) results firms with the extent of derivative use at optimal threshold or less will experience the best enhancement of value and therefore a positive sign for β_1 is expected. The converse is expected for β_{11} as high derivative users are expected to experience a decrease in firm risk and therefore the coefficient is expected to be a negative value.

3.4.3.5 Interaction regressions

This dissertation tries to examine specific groups within the sample that have a higher probability of having significant exposure to specific financial risks compared to others. Firms with a high level of geographical diversification (foreign turnover to total turnover) might be more prone to foreign currency risk. Firms with a high level of leverage might be more prone to interest rate risk. The use of derivatives by a firm is likely to be more value enhancing and risk reducing if firms use derivatives in a manner aligned to the type of exposure that the firm faces.

3.4.3.5.1 Foreign currency derivatives

Equation 18 is therefore run allowing the geographical diversification (foreign turnover to total turnover) variable to be applied interactively with variables proxy for corporate use of foreign currency derivatives. It is expected that firms with higher foreign sales will have more inherent exposure to fluctuations in exchange rate. Therefore, the use of foreign currency derivatives should be more value enhancing and risk reducing for these firms.

Firm value $_{it}$ $=$ α $+$ $\boldsymbol{\beta_1}$***FCD use*** $_{it}$ $+$ $\boldsymbol{\beta_2}$***FCD use * Geographical Diversification*** $_{it}$ $+\beta_3$*Size*$_{it}$ $+\beta_4$*Investment Growth* $_{it}$ $+$ β_5 *Liquidity* $_{it}$ $+$ β_6 *Managerial Discretion* $_{it}$ $+\beta_7$ *Dividend Yield* $_{it}$ $+\beta_8$*Industrial Diversification* $_{it}$$+\beta_9$*Geographical Diversification* $_{it}$$+$ β_{10}*Profitability* $_{it}$$+$ $\varepsilon_{it.}$ (18)

Firm value $_{it}$ $=$ α $+$ $\boldsymbol{\beta_1}$***FCD use*** $_{it}$ $+$ $\boldsymbol{\beta_2}$ ***Extent FCD use * Geographical Diversification*** $_{it}$ $+\beta_3$ *Size* $_{it}$ $+\beta_4$ *Investment Growth*

$_{it} + \beta_5$ *Liquidity* $_{it} + \beta_6$ *Managerial Discretion* $_{it} + \beta_7$ *Dividend Yield* $_{it} + \beta_8 ID_{it} + \beta_9 Fsts_{it} + \beta_{10} ROA_{it} + \varepsilon_{it.}$ (19)

3.4.3.5.2 Interest rate derivatives

Similarly, for firms that have interest rate exposure the use of interest rate derivatives will be more value enhancing and risk reduction for them. The interactive variable in this case will be *IRDUse * leverage* and the *extentIRD*Leverage*.

$$\textbf{Firm value}_{it} = \alpha + \beta_1 \textbf{IRD use}_{it} + \beta_2 \textbf{IRD use * Leverage}_{it} + \beta_3 Size_{it} + \beta_4 Investment\ Growth_{it} + \beta_5 Liquidity_{it} + \beta_6 Managerial\ Discretion_{it} + \beta_7 Dividend\ Yield_{it} + \beta_8 Industrial\ Diversification_{it} + \beta_9 Geographical\ Diversification_{it} + \beta_{10} Profitability_{it} + \varepsilon_{it.} \quad (20)$$

$$\textbf{Firm value}_{it} = \alpha + \beta_1 \textbf{Extent IRD use}_{it} + \beta_2 \textbf{Extent IRD use * Leverage}_{it} + \beta_3 Size_{it} + \beta_4 Investment\ Growth_{it} + \beta_5 Liquidity_{it} + \beta_6 Managerial\ Discretion_{it} + \beta_7 Dividend\ Yield_{it} + \beta_8 Industrial\ Diversification_{it} + \beta_9 Geographical\ Diversification_{it} + \beta_{10} Profitability_{it} + \varepsilon_{it} \quad (21)$$

3.5 Estimation methods

Ordinary least squares (OLS) methodology is the first estimation method used. Firm's data is pooled and the pooled OLS method is used. Heterogeneity is always present in panel data because it comprises of different cross-sections across periods of time (Baltagi, 1995). A simple pooled OLS regression creates biased estimations because it does not consider the individual heterogeneity. In other words, ordinary least square regressions have a problem of not correcting for firm fixed effects. The fixed effects method and the random effects method are the two different techniques that are used to control for unobserved individual specific effects. In order to test which empirical model is most suitable statistically a Hausman specification test (Hausman, 1978) was conducted.

The models could not control for industry effects, as these variables remained the same during the period 2012 over to 2016. The variable for industrial diversification for firms did not change that much from the year 2012 to 2016. A firm that derived income from more than one industry sectors in 2012 still derived income from more than one industry sectors in 2016 hence the dummy variable for this firm remained to be 1 throughout 2012 to 2016.

This dissertation uses year dummies to control for time-fixed effects for 2012-2016. In order to control for industry sector effects this dissertation controls for industry sector-fixed effects through industry indicator variables based on Bloomberg industry classification standards (BICS).This dissertation used values ranging from 1-9 to represent the firms' industrial codes. The different industrial sectors may be

affected differently by macroeconomic factors, and therefore we expect them to have different risks and value.

4 Chapter 4 Empirical findings

The objective of this chapter is to evaluate how South African non-financial firms use derivatives. The descriptive statistics of the sample firms used in this dissertation are presented in this chapter. Moreover, included in this chapter is the frequency distribution of derivative use among the sample firms in this study. Equally important the results on the effect of derivative use on firm risk and firm value are presented. This chapter is organised as follows: Part 4.1 presents the descriptive statistics. Part 4.2 presents the empirical results. Part 4.3 draws the conclusion.

4.1 Descriptive Statistics

This part provides a summary statistics analysis of risk and value measure, control variables, the extent of derivative use, the use of derivatives variables and the Pearson correlation coefficients for derivatives, firm value, firm risk and control variables.

4.1.1 Summary statistics

Table 4-1 presents the descriptive statistics for the firm risk measures, firm value measure and the control variables. The tables details the mean, median, standard deviation, minimum value, maximum value and the number of observations.

Table 4-1Descriptive statistics for the Control and the Dependent Variable

	Mean	**Median**	**Standard Deviation**	**Min**	**Max**	**N**
Control Variables						
Profitability	7.963065	6.963349	10.15139	-48.8961	120.8124	455
Investment Growth	9.02181	4.890814	13.55777	0.001213	132.6595	455
Liquidity	1.688729	1.439815	0.954554	0	6.81764	455
Management discretion	1.503293	0.107614	5.10776	0	56.14603	455
Dividend 12 Month Yield	0.250577	0.02925	2.235695	0	38.57423	455
Market to Book	3.174979	2.127416	2.916973	-6.21677	23.52725	455
Size	83471.4	17782	246750.5	604.014	1989821	455
Leverage	0.308	0.195647	1.417608	-26.4853	10.2045	455
Log of total assets	4.303106	4.249981	0.658005	2.781047	6.298814	455
Geographical Diversification	0.30988	0.187844	0.322056	0	1.038328	455
Industrial diversification	0.461538	0	0.499067	0	1	455
Firm risk measures						
Total risk	0.307044	0.273383	0.132052	0.148318	1.459648	455
Systematic Risk	0.099376	0.080463	0.076627	4.21E-05	0.718012	455
Unsystematic risk	0.283286	0.251726	0.12605	0.124354	1.413847	455
Firm Value measures						
Tobin's Q	1.915984	1.514064	1.159744	0.388768	8.836012	455

Table 4-1 shows that the firms used in this study have a mean (median) total risk of 30.70% (27.34%). The average South African firm listed in FTSE/JSE Africa All Share Index on the JSE has a low total risk relative to other countries. Bartram, Brown and Conrad, (2011) show an average total risk of 56% for a sample of firms across 47 countries. In the United Kingdom, the mean (median) total risk for the

sample firms listed on the London Stock Exchange is 42.98%(37.06%) (Finavker, 2014). In the US, firms have a median of 33.8% (Guay, 1999).

The mean systematic risk is 9.9% (8%), and the mean (median) unsystematic risk in this study is 28.33% (25.17%). These figures are still lower than the results presented in other countries. In the UK, the mean unsystematic risk is 39.19% (Finavker, 2014). Guay (1999) reports a 32.07% median unsystematic risk for US firms. Bartram, Brown and Conrad, (2011) report a 38.5%and 28.3% unsystematic risk for US and UK firms respectively.

The mean (median) Tobin's Q is 1.92 (1.51). In the UK the non-financial firms had a mean (median) Tobin's Q of 0.407 (0.330) (Ahmed, Azevedo and Guney, 2014). Lel and Miller, (2009) analyse a sample of 39 countries, and they report a mean (median) Tobin's Q of 2.213 (1.499). In Australia, the mean (median) Tobin's Q is 1.513 (1.1904) (Nguyen and Faff, 2010). Bartram, Brown and Conrad, (2011) reported that their sample firms across 47 countries had an average Tobin's Q of 2.33.

The average leverage ratio is 30.8%.The average profitability is 7.963.The average investment growth is 9.02. The average liquidity is 1.688.The average managerial discretion is 1.503.The average dividend 12-month yield is 25%.The average market to book ratio is 3.1749.The average log of total assets is 4.303.The average geographical diversification is 30.988%.The average industrial diversification is 46.15%.

4.1.2 The usage of derivatives use by our sample.

Table 4-2 provides the data on the use of derivatives by sample firms used in this study.

4.1.2.1 Firms using derivatives in South Africa

Table 4-2Presents the percentage of firms using derivative in South Africa

Row Labels	Number of firms using derivatives	Total number of firms	Percentage of derivative use
2012	56	91	62%
2013	55	91	60%
2014	55	91	60%
2015	59	91	65%
2016	59	91	65%
Grand Total	284	455	62%

Table 4.2 shows that 62% of firms in this study use at least one type of derivative while 38% of firms do not use any derivative. In appendix B table 6.2 shows that the average market capitalisation of the firms in this study was 10.67 trillion Rand, the minimum market capitalisation was 262.99 billion Rand, and the maximum market capitalisation was 153.87 trillion rand. These firms constitute the top 99% of the total pre-free float market capitalisation of all listed firms on the Johannesburg Stock Exchange. Similar studies have been conducted in South Africa and involve large firms measured by Market Capitalisation. Correia, Holman and Jahreskog, (2012) surveyed derivative use on 98 large JSE- Listed

non-financial firms. In this study, 50 firms responded to their questionnaire, and 90% of these firms used derivatives. Bartram, Brown and Conrad, (2011) conducted a survey which had 55 large non-financial firms from South Africa. The authors reported that 89.1% of these firms used derivatives. The two studies recorded a rate much higher than this study, but both studies had a smaller sample.

This dissertation tries to make a comparison between countries. Bartram, Brown and Conrad, (2011) report that 60.5% of firms from a sample of 47 countries use derivatives. We compare derivative usage in South Africa to other open economies like New Zealand, the United Kingdom, Sweden and Germany. In Sweden, 86% of large firms use derivatives (Alkebäck, Hagelin and Pramborg, 2006). In Germany, 81% of large firms use derivatives (Bodnar and Gebhardt, 1998). In the UK Finavker, (2014) reports that in a sample of LSE listed firms 86.61% of the firms used derivatives. In the U.S. 83% of large firms use derivative (Bodnar, Hayt and Marston, 1998). Another study was done in the U.S. by Guay and Kothari, (2003) indicates that 56.7% of large non-financial firms in the U.S. use derivatives.

We also try to compare the rate derivative use in South Africa with that of middle-income economies. A study conducted by Bartram, Brown and Fehle, (2009), reported, countries that have middle-income economies, less liquid derivative markets and that lack develop capital markets have a lower percentage of derivative use. In the study, the authors stated that countries regarded as non- OECD (Organisation for Economic Cooperation and development) had only 39.6% of firms using derivatives. Concerning this, a later study done by (Bartram, Brown and Conrad, 2011) showed that other countries with similar economic characteristics to South Africa had lower percentages of derivative use. For instance, Greece had 21.1%, Malaysia had 20.1%, and the Czech Republic had 26.1%. In the same study, South Africa that was represented by 55 firms reported a rate of derivative use of 89.1% amongst those firms. This rate was much higher.

The above analysis has illustrated that there is a high percentage of South African firms using derivatives. Correia, Holman and Jahreskog, (2012) find it surprising that South Africa has a high usage of derivatives despite it being a developing economy that is subject to exchange controls. The authors argue that the high percentage of firms using derivatives in South Africa is due to its role as a developing economy that is subject to exchange controls. The authors also add that the Rand volatile nature may induce firms to enter into forward contracts. According to the authors, the existence of exchange controls may have a positive effect on derivative use because firms will undertake forward sales of foreign currency receipts.

4.1.2.2 Types of risks being hedged by South African Firms

Table 4.3 provides the broad categories of the risks being hedged by the firms in this sample.

Table 4-3 Presents the type of risks being hedged by firms

Row Labels	Sum of Foreign currency Derivatives	Sum of Commodity price derivatives	Sum of Interest rate derivatives	Sum of Other derivatives
2012	45	12	25	14
2013	46	13	26	14
2014	44	12	25	11
2015	49	12	28	16
2016	44	13	26	14
Grand Total	228	62	130	69
	80.3%	21.8%	46%	24.3%

According to table 4.3, currency risk is the most hedged risk in South Africa. 80.3% of firms that use derivatives hedge currency risk. Interest rate risk hedging comes second with 46% of firms in the sample hedging it. Other risks like equity risk come third with 24.3% of firms hedging them. Commodity price risk comes 4th with 21.8% of firms hedging it. Almost all prior studies on this topic find a similar pattern. Foreign currency derivatives take the lion's share, followed by interest rate derivative and then commodity price derivatives. Prior studies that report similar results are in Sweden, Khediri, (2010) in France, Bartram, Brown and Conrad, (2011) in 47 countries, Kamphuis, (2013) in the USA, and Lau, (2016) in Malaysia.

4.1.2.3 The number of risks being hedged by Firms

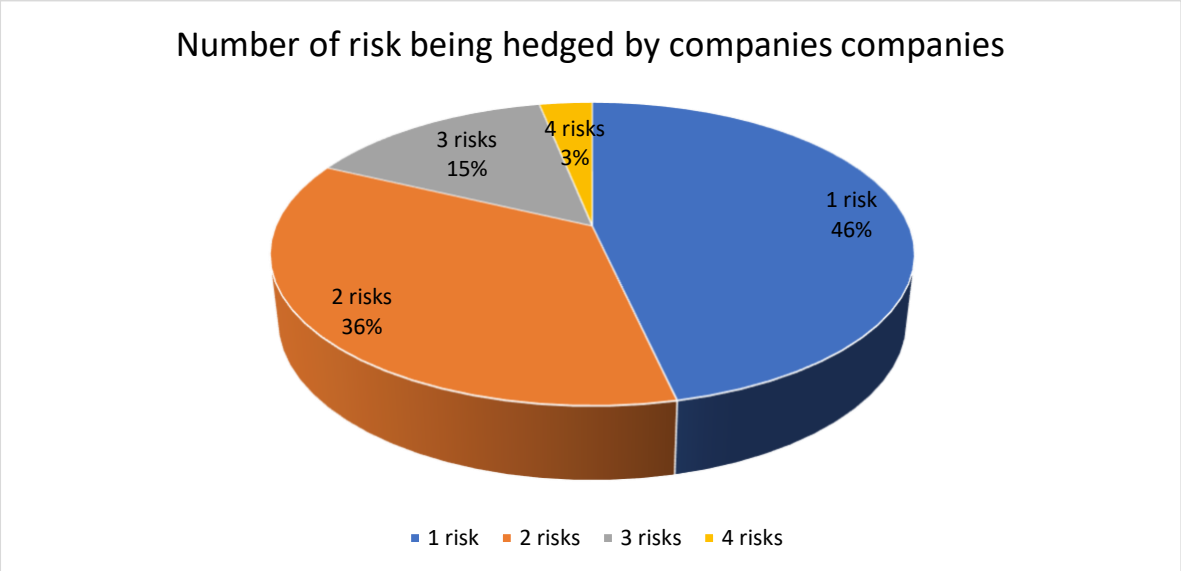

Figure 4-1Presents the number of risks being hedged by firms

Figure 4.1 presents an analysis of the number of risks being hedged by firms ;46% of them hedge one type of risk,36% of them hedge two types of risk ,15% of them hedge three types of risk and 3% of

them hedge four types of risk. A study done by Holman *et al.*, (2013) shows that for South African firms 69.6% hedge one type of risk, 29.6% hedge two types of risk ,8% hedge three types of risk and 0.5% hedge all the four types of risk.

4.1.2.4 The type of derivative instruments being used by sample firms

Table 4-4 Presents the type of derivative instruments being used

Row Labels	swaps	OTC forwards	futures	OTC & exchange option contracts
2012	24	45	10	17
2013	26	46	9	15
2014	26	45	8	14
2015	30	47	9	15
2016	29	44	7	15
Grand Total	135	227	43	76
	28%	47%	9%	16%

According to table 4.4 OTC forwards are most common amongst firms as 47% of firms use them. Twenty eight percent of firms use swaps, 16% of firms use options, and 9% of firms use futures. The higher use of forwards, options and swaps is consistent amongst prior studies. For instance with Correia, Holman and Jahreskog, (2012) in South Africa. Yakup and Asli, (2010) in Turkey and Kamphius (2013) in the US.

4.1.2.5 Derivative instruments used for each type of risk

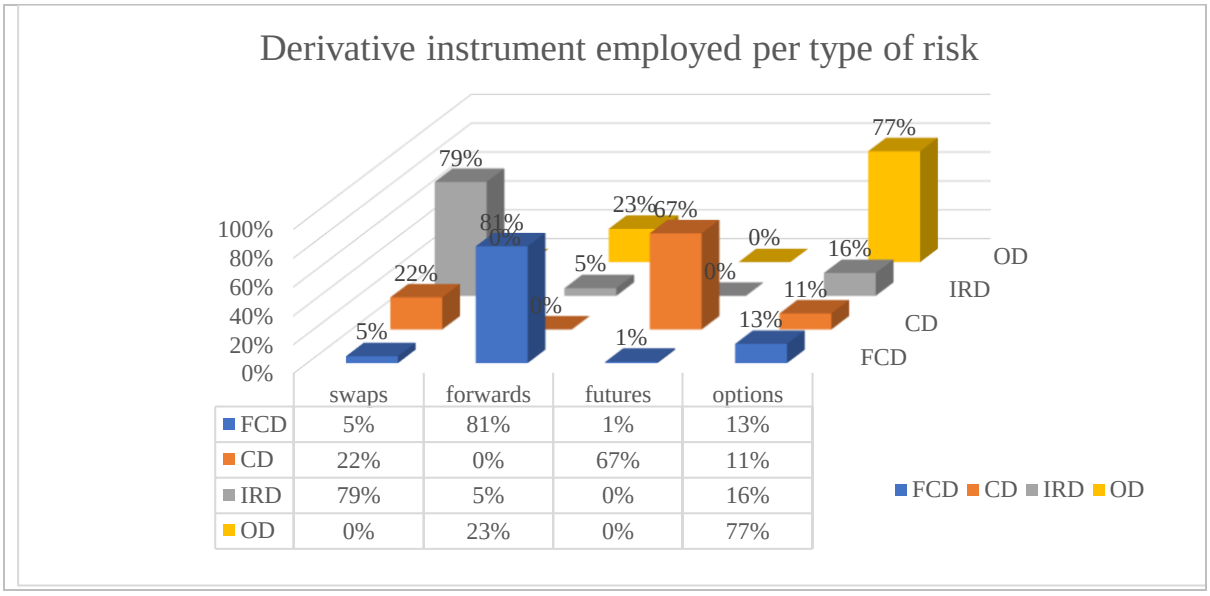

Figure 4-2Presents derivative instruments used for each type of exposure

Figure 4.2 shows that for the derivatives used to hedge foreign currency risk, 81% of them are forwards, 13% are options, 5% are swaps, and only 1% are futures. To hedge interest rate risk 79% of the derivatives used are swaps, 16% are options, and 5% are forwards. To hedge commodity price risk 67%

of derivatives used are futures, 22% are swaps, and 11% are options. To hedge other risks 77% of risks used are options and 23% are forwards.

Most studies done inside and outside of South Africa establish that forwards are mostly used to hedge foreign currency risk. Similarly, swaps are mostly used to hedge interest rate risk. There is a trend of firms using futures and forwards to manage commodity price risk. There was no distinct particular order of the instruments used to hedge other risks. Studies done in South Africa that illustrated this were (Bartram, Brown and Conrad, 2011; Correia, Holman and Jahreskog, 2012).Studies done out of South Africa included: African countries (Holman *et al.*, 2013). UK (Nova, Cerqueira and Brandão, 2015).Sweden (Alkebäck, Hagelin and Pramborg, 2006) .The US (Kamphuis, 2013).

4.1.3 Correlation Analysis

Table 4-5Correlation Analysis provides a Pearson correlation for the entire variable used in the analysis

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Derivative use	1.000													
2	Ln Tobin's Q	0.143	1.000												
3	Systematic risk	0.195	-0.116	1.000											
4	Unsystematic risk	-0.226	-0.402	0.273	1.000										
5	Total risk	-0.168	-0.394	0.485	0.968	1.000									
6	Profitability	0.057	0.629	-0.125	-0.369	-0.362	1.000								
7	Liquidity	-0.174	-0.014	0.007	0.076	0.070	0.162	1.000							
8	Managerial discretion	-0.190	0.005	-0.053	-0.054	-0.043	0.032	-0.056	1.000						
9	Dividend 12 Month Yield	0.070	0.042	0.042	-0.045	-0.032	0.025	0.149	-0.008	1.000					
10	Market to Book	0.161	0.791	-0.073	-0.298	-0.295	0.425	-0.163	-0.042	-0.021	1.000				
11	Leverage	0.007	-0.014	0.025	0.034	0.035	0.015	-0.054	-0.018	-0.016	-0.287	1.000			
12	Size	0.440	-0.261	0.555	-0.039	0.086	-0.247	-0.115	-0.094	0.161	-0.132	0.071	1.000		
13	Geographical diversification	0.245	-0.186	0.420	0.053	0.136	-0.210	-0.085	-0.053	0.080	-0.137	0.034	0.627	1.000	
14	Industrial diversification	0.136	-0.106	0.136	-0.048	-0.014	0.050	-0.076	0.051	-0.079	-0.119	-0.014	0.173	0.025	1.000

Table 4.5 presents the correlation coefficients for derivative variables, firm risk variables, firm value variable and control variables. As expected, there is a positive correlation between derivative use and firm value. There is a negative correlation between derivative use and total risk and unsystematic risk. There is a positive correlation between derivative use and systematic risk. These results are evidence that firms are using derivatives productively to reduce risk and increase firm value.

The correlations with control variables state the following. Profitability is positively correlated with derivative use and firm value and negatively correlated with all measures of risk. This is in line with expectations as profitable firms have a lower financial risk and higher firm value. Managerial discretion is negatively correlated with derivative use and all measures of firm risk but positively correlated with firm value. Dividend 12-month yield is positively correlated with derivative use, firm value and systematic risk and negatively correlated with total risk and unsystematic risk. Market to book ratio is positively correlated with derivative use and firm value and negatively correlated with all measures of firm risk. Leverage has a positive correlation with derivative use and all measures of risk and a negative correlation with firm value. Size has a positive correlation with derivative use, systematic risk and total risk and a negative correlation with firm value and unsystematic risk. Geographical diversification has a positive correlation with derivative use and all measures of risk and a negative correlation with firm value. Industrial diversification is positively correlated with derivative use and systematic risk and negatively correlated with firm value, unsystematic risk and total risk. This preliminary evidence supports the motives behind the use of derivatives by South African non-Financial Firms.

4.2 Empirical Analysis

In this section, the results of the univariate and the multivariate analysis examining the effects of derivative use on firm risk measures and firm value measure are presented.

4.2.1 Univariate analysis

This section presents the means, median, number of observations (N) and mean difference of the firms used in this study. We compare the simple means of firms risk and value measures and the sample characteristics by derivative use. We use the mean difference test based on the parametric t-test to measure the significance between firms that use derivatives and non-users. Table 4.6 presents results for all derivative users. Table 4.7 presents results for interest rate derivative users. Table 4.8 presents results for foreign currency derivative users. Table 4.9 presents results for commodity price derivatives users. *** indicates significance at 1% ** at 5% and *at 10% level.

Table 4-6 Presents the mean, median and mean differences for All derivative user of firm risk and value and the control variables

Variable	Mean Users	Mean Non-users	Number of users	Number of non-users	Standard deviation users	Standard deviation non-users	Median Users	Median non-users	P-value for mean difference	Mean difference	Significance
Profitability	8.407947863	7.224196339	284	171	10.18474216	10.08205482	6.814027	7.181976	0.227697001	-1.18375152	
Liquidity	1.560315933	1.902000977	284	171	0.837677321	1.091758787	1.3409785	1.694667	0.000507278	0.34168504	***
Management discretion	0.752534835	2.750165912	284	171	3.405086391	6.918560349	0.077771	0.293458	0.000510868	1.99763108	***
Dividend 12 Month Yield	0.371718313	0.049383632	284	171	2.822182442	0.156038591	0.031122	0.026738	0.055863978	-0.32233468	*
Market to Book	3.539247731	2.569994632	284	171	3.055417602	2.567584991	2.411053	1.624999	0.000323582	-0.96925268	***
Leverage	0.315337766	0.295812353	284	171	1.666338778	0.862694792	0.308970956	0.090801065	0.869598985	-0.01952541	
Size	4.527574779	3.930303099	284	171	0.640054293	0.500333016	4.431918555	3.861319301	3.20745E-25	-0.59727168	***
Geographical Diversification	0.371075315	0.208246604	284	171	0.325784108	0.289246378	0.268358106	0.068702478	5.47766E-08	-0.16282871	***
Industrial diversification	0.514084507	0.374269006	284	171	0.500683385	0.485354835	1	0	0.00348056	-0.13981 55	***
Total risk	0.289804267	0.335676345	284	171	0.098106799	0.170954163	0.267998827	0.292561142	0.001533006	0.04587208	***
Systematic Risk	0.110937398	0.080175276	284	171	0.068886637	0.08477681	0.101314 13	0.053458553	7.53592E-05	-0.03076212	***
Unsystematic risk	0.261158811	0.320034176	284	171	0.092612051	0.161175599	0.241509431	0.277042278	1.91253E-05	0.05887537	***
Tobin's Q	1.985377644	1.800733596	284	171	1.05461918	1.311117588	1.616581	1.35309	1.91253E-05	-0.18464405	***

Table 4-7 Presents the mean, median and mean differences for Interest Rate Derivative Users of firm risk and value and the control variables

Variable	Mean Users	Mean Non-users	Number of users	Number of non-users	Standard deviation users	Standard deviation non-users	Median Users	Median non-users	P-value for mean difference	Mean difference	Significance
Total risk	0.287123215	0.315012458	130	325	0.093957113	0.143863469	0.268718913	0.279315 76	0.015536659	0.02788924	**
Systematic Risk	0.130175473	0.087056559	130	325	0.071768719	0.075126653	0.120551463	0.066395582	3.18886E-08	-0.04311891	**
Unsystematic risk	0.250033233	0.296586543	130	325	0.082817391	0.137520297	0.233809279	0.261997927	1.28785E-05	0.04655331	**
Tobin's Q	2.003010308	1.881173403	130	325	1.088699936	1.18680337	1.640397 5	1.454765	0.294471934	-0.12183 69	

Table 4-8 Presents the mean, median and mean differences for Foreign Currency Derivative users of firm risk and value and the control variables

Variable	Mean Users	Mean Non-users	Number of users	Number of non-users	Standard deviation users	Standard deviation non-users	Median Users	Median non-users	P-value for mean difference	Mean difference	Significance
Total risk	0.284594648	0.329592454	228	227	0.090225773	0.160729843	0.266359324	0.285183472	0.000561281	0.04499781	***
Systematic Risk	0.110764861	0.087937467	228	227	0.067343347	0.083533777	0.101293014	0.060294122	9.2294E-07	-0.02282739	***
Unsystematic risk	0.25567373	0.311019102	228	227	0.084334394	0.15242193	0.238128916	0.270636813	1.1865E-06	0.05534537	***
Tobin's Q	1.980818145	1.850864137	228	227	1.071221259	1.24129843	1.58827	1.43819	0.053332853	-0.12995401	**

Table 4-9Presents the mean, median and mean differences for Commodity Derivatives of firm risk and value and the control variables

Variable	Mean Users	Mean Non-users	Number of users	Number of non-users	Standard deviation users	Standard deviation NON-USERS	Median Users	Median NON-USERS	P-value for mean difference	Mean difference	Significance
Total risk	0.300688125	0.308046827	16.88001177	393	0.125015877	0.133252986	0.262996029	0.274379874	0.508683563	0.0073587	
Systematic Risk	0.1150732	0.096899885	17.88001177	393	0.076452308	0.076457308	0.102611683	0.077574834	0.019221059	-0.01817332	**
Unsystematic risk	0.269390722	0.285477664	18.88001177	393	0.122100584	0.126674188	0.241184517	0.253480028	0.165102518	0.01608694	
Tobin's Q	1.587043419	1.967877873	19.88001177	393	0.782770479	1.201072298	1.319776	1.536758	0.010569438	0.38083445	**

This study compares the simple averages of firm risk measures, firm value, and the sample characteristics by derivative use. A parametric T-test is used to measure the significance of the differences in mean between the derivative user and non-user firms. The study uses several measures of derivative use. These are interest rate derivatives, foreign currency derivatives and commodity price derivatives.

In table 4.6, the results for all derivative users and nonusers' firms are presented. The mean difference test shows that firms that use derivatives have 4.8% lower total risk compared to non-user firms. This is statistically significant at 1% level. Authors that have found similar results where the total risk of derivative users is significantly lower than that of non-users include (Guay, 1999; Hentschel and Kothari, 2001; Bartram, Brown and Conrad, 2011; Finavker, 2014; Bartram, 2019).

Table 4.6 shows that derivative users have a 3.865% higher systematic risk compared to non-derivative users. This is statistically significant at a 5% level. Similarly, Hentschel and Kothari, (2001) reports that derivative users have a 0.12% higher systematic risk than that of non-users. On the contrary Finavker, (2014) shows that there is no significant difference in systematic risk between derivatives users and non-users among the sample of UK non-financial firms. Bartram, Brown and Conrad, (2011)

reports that the median systematic risk for firms that use derivatives is 13.3% lower to that of non-users firms. The authors find that the systematic risk is within 15% to 31% lower for derivative users' firms than for non-user firms.

Table 4.6 reports that firms that use derivatives have an unsystematic risk mean that is 5.88% lower than non-derivative users. This is statistically significant at a 1% level. Guay, (1999), Hentschel and Kothari, (2001) and Finavker, (2014) find similar results.

Table 4.6 reports that the Tobin's Q for derivative users is higher than that of non-users. The average Tobin's Q for users of derivatives is 1.99 while that of non-users is 1.8. This is statistically significant at a 5% level. The results suggest that derivative use is value enhancing for South African firms.

Table 4.6 reports that derivative users have lower levels of liquidity than non-users. Derivative users have a lower level of managerial discretion than non-users. Derivative users have a higher dividend 12-month yield than non-users. Derivative users have a higher market to book ratio than non-users. Derivative users are larger than non-users. Derivative users are more geographically diversified than non-users. Finally, this study shows that Derivative users are more industrially diversified than non-users. The results of interest rate derivative users and non-users in table 4.7, foreign currency derivative users and non-users in table 4.8 and commodity derivative users and non-users in table 4.9 are qualitatively similar. More analysis has been presented in the appendix C.

These results point to the fact that firms that use derivative have a higher firm value and systematic risk than nonusers and lower total risk and unsystematic risk than non-users. This provides some evidence to show that firms are using derivatives to reduce risk and increase value. We employ multivariate analysis to further investigate the effect of derivative use on firm value and firm risk. This is because other firm characteristics cannot be controlled by univariate analysis.

4.2.2 Multivariate analysis

In this section, the study presents the results of multivariate regression models that examine whether derivative use has an effect on firm risk and firm value. The study regresses the measure of firm value and the different measures of risk first, on dummy variables for derivatives use and second on a continuous variable, which is the extent of derivative use.

4.2.2.1 The effect of derivative use on firm risk measures.

In table 4.10, the results of the effect of derivative use on various measures of firm risk (total risk, systematic risk and unsystematic risk) are presented. Equations 4, 6 and 8 have been used to provide these results. Derivative use is measured using a dummy variable of one if a firm uses derivatives and zero if a firm does not use derivatives. The results presented are those of the effect of derivative use, foreign currency derivatives use, interest rate derivatives use and commodity price derivatives use. In addition, results are presented on the effect of using derivative instruments (swaps, options, futures and

forwards). Several estimation methods like OLS, RE and FE models have been used. Various tests have been employed to select the best model amongst the OLS, RE and FE models. The results discussed only relate to the best model.

Table 4-10 Presents the Effect of derivative use on Firm Risk with Control Variables

Fixed effects model

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	Total Risk	Total Risk	Total Risk	Systematic Risk	Systematic Risk	Systematic Risk	Unsystematic Risk	Unsystematic Risk	Unsystematic Risk
Derivative use	-0.0473*			-0.00931			-0.0485**		
	(0.0249)			(0.0138)			(0.0239)		
Usage FCD		-0.00452			0.00749			-0.0106	
		(0.0220)			(0.0121)			(0.0212)	
Usage IRD		-0.0240			-0.00486			-0.0223	
		(0.0221)			(0.0122)			(0.0213)	
Usage CD		-0.0405			-0.0262*			-0.0306	
		(0.0277)			(0.0153)			(0.0267)	
Usage of swaps			-0.0223			0.00480			-0.0236
			(0.0209)			(0.0116)			(0.0201)
Usage of forwards			0.00462			0.0110			-0.00221
			(0.0223)			(0.0123)			(0.0215)
Usage of futures			-0.0539*			-0.0229			-0.0468*
			(0.0281)			(0.0155)			(0.0271)
Usage of option contracts			-0.0195			-0.0139			-0.0136
			(0.0198)			(0.0110)			(0.0191)
Leverage	-0.00592	-0.00588	-0.00702	0.000880	0.00116	0.000607	-0.00669	-0.00689	-0.00778*
	(0.00456)	(0.00471)	(0.00472)	(0.00253)	(0.00260)	(0.00261)	(0.00439)	(0.00454)	(0.00456)
Size	-1.41e-07	-1.49e-07*	-1.47e-07*	2.73e-08	2.47e-08	2.95e-08	-1.60e-07*	-1.68e-07**	-1.68e-07**
	(8.62e-08)	(8.80e-08)	(8.76e-08)	(4.78e-08)	(4.86e-08)	(4.85e-08)	(8.30e-08)	(8.48e-08)	(8.45e-08)
Market to Book	-0.0103**	-0.01000**	-0.0112***	-0.000834	-0.000767	-0.00115	-0.0106***	-0.0104**	-0.0115***
	(0.00412)	(0.00417)	(0.00417)	(0.00229)	(0.00230)	(0.00231)	(0.00397)	(0.00402)	(0.00402)
Liquidity	-0.0171**	-0.0160*	-0.0155*	-0.00321	-0.00280	-0.00281	-0.0156*	-0.0146*	-0.0141*
	(0.00831)	(0.00833)	(0.00835)	(0.00461)	(0.00460)	(0.00462)	(0.00800)	(0.00803)	(0.00805)
Managerial Discretion	-0.00293**	-0.00250*	-0.00251*	0.000336	0.000501	0.000497	-0.00300**	-0.00262*	-0.00262*
	(0.00138)	(0.00139)	(0.00139)	(0.000765)	(0.000765)	(0.000767)	(0.00133)	(0.00134)	(0.00134)
Dividend 12 Month Yield	-0.00654*	-0.00606*	-0.00666*	-0.00344*	-0.00333*	-0.00395*	-0.00523	-0.00479	-0.00515
	(0.00358)	(0.00362)	(0.00365)	(0.00198)	(0.00200)	(0.00202)	(0.00344)	(0.00349)	(0.00352)
Geographical Diversification	-0.0914**	-0.0904**	-0.0896**	0.00294	0.00361	0.00215	-0.0987**	-0.0982**	-0.0968**
	(0.0425)	(0.0427)	(0.0426)	(0.0236)	(0.0236)	(0.0236)	(0.0409)	(0.0412)	(0.0411)
Profitability	-0.00247***	-0.00253***	-0.00255***	-0.000178	-0.000215	-0.000201	-0.00256***	-0.00261***	-0.00263***
	(0.000654)	(0.000658)	(0.000657)	(0.000363)	(0.000363)	(0.000364)	(0.000630)	(0.000634)	(0.000634)
Industrial diversification									
Year2013	0.0315**	0.0336**	0.0323**	0.0247***	0.0253***	0.0241***	0.0248*	0.0268**	0.0260**

	(0.0131)	(0.0132)	(0.0131)	(0.00727)	(0.00726)	(0.00727)	(0.0126)	(0.0127)	(0.0127)
Year2014	0.0278**	0.0293**	0.0282**	0.0121	0.0125*	0.0114	0.0253**	0.0267**	0.0260**
	(0.0133)	(0.0133)	(0.0133)	(0.00736)	(0.00734)	(0.00736)	(0.0128)	(0.0128)	(0.0128)
Year2015	0.118***	0.119***	0.118***	0.0522***	0.0520***	0.0510***	0.103***	0.104***	0.104***
	(0.0137)	(0.0138)	(0.0138)	(0.00759)	(0.00761)	(0.00763)	(0.0132)	(0.0133)	(0.0133)
Year2016	0.143***	0.143***	0.141***	0.0700***	0.0704***	0.0688***	0.126***	0.126***	0.124***
	(0.0138)	(0.0138)	(0.0139)	(0.00763)	(0.00762)	(0.00767)	(0.0132)	(0.0133)	(0.0134)
Constant	0.402***	0.383***	0.386***	0.0797***	0.0740***	0.0730***	0.390***	0.373***	0.375***
	(0.0320)	(0.0310)	(0.0312)	(0.0177)	(0.0171)	(0.0173)	(0.0308)	(0.0299)	(0.0301)
Observations	455	455	455	455	455	455	455	455	455
R-squared	0.414	0.413	0.417	0.284	0.290	0.291	0.387	0.384	0.388
Number of Company I. D	91	91	91	91	91	91	91	91	91
R sq. within	0.414	0.413	0.417	0.284	0.290	0.291	0.387	0.384	0.388
R sq. between	0.0387	0.0222	0.0206	0.0264	0.0199	0.0507	0.112	0.0895	0.0850
R sq. overall	0.171	0.151	0.148	0.135	0.133	0.153	0.205	0.188	0.183
Model 1=FE; 2=RE	1	1	1	1	1	1	1	1	1
Hausman Chi2	40.03	43.65	46.38	30.69	33.06	31.75	35.20	38.14	41.37
Hausman p	0%	0%	0%	0%	0%	0%	0%	0%	0%
Breusch Pagan Lagrangian multiplier chi2	74.26	72.24	71.71	140.1	132.8	135.8	72.94	70.02	68.63
Breusch&Pagan Lagrangian multiplier p	0	0	0	0	0	0	0	0	0

*Table 4.10 is divided into three sections. Column 2, 3 and 4 represent total risk. Column 5, 6 and 7 represent systematic risk and column 8, 9 and 10 represent unsystematic risk. Each section shows the effects of all derivative use, foreign currency derivative use, interest rate derivative use, commodity price derivatives use and derivative instrument use (forwards, options, swaps and futures) on firm risk measures. This table presents the results of derivative use on firm risk controlled by the variables; leverage, size, market to book ,liquidity ,managerial discretion, dividend 12-month yield, geographical diversification, industrial diversification and profitability. The explanations of these variables can be found in chapter 3 section 3.3 control variables. Derivative use is a dummy variable equal to '1' if a firm uses derivatives and '0' if a firm does not use derivatives. Usage FCD is a dummy variable of '1' if a firm uses foreign currency derivatives and '0' if a firm does not use foreign currency derivatives. Usage IRD is a dummy variable of '1' if a firm uses interest rate derivatives and '0' if a firm does not use interest rate derivatives. Usage CD is a dummy variable of '1' if a firm uses commodity price derivatives and '0' if a firm does not use commodity price derivatives. . The figures in the brackets are t statistics adjusted for heteroscedasticity using the white (1980) method*** indicates significance at 1%, ** at 5% and *at 10% level.*

4.2.2.1.1 Total risk

The results in column 2 of table 4.10 show that derivative use reduces total risk. This is statistically significant at a 10% level. The variable of derivative use has a coefficient of -0.0473. These results suggest that firms that use derivatives will have a 4.73% lower total risk. The reduction in total risk for all derivative represents 15% of the average total risk in our sample. Therefore, the reduction is

economically significant. Guay, (1999) conducted a study in the US and reported that there is a decrease in stock return volatility of 5% for firms that use derivatives for the first time compared to non-users of derivatives. Bartram, Brown and Conrad, (2011) report that firms using derivative have 5%-10% lower total risk compared to non-users. A study done in the UK by Finavker ,(2014) show that derivative users have a 3.62% to 4.82% significantly lower total risk than non-users.

In column 3, we show the results of the effect of foreign currency derivative use, interest rate derivative use and commodity price derivative use on total risk. The results show that the coefficient on all them are negative, but they are all not statistically significant. This means that only firms that hedge a combination of all the financial risks are able to reduce total risk effectively. Bartram show that foreign currency derivatives have a positive but insignificant effect on total risk and that interest rate derivatives have a negative and significant effect on total risk. A study done in the UK by Finavker, (2014) show that interest rate derivatives are more effective in reducing unsystematic risk and total risk when compared to foreign currency derivatives. Allayannis and Ofek, (2001) reports that there is a significant negative relationship between the use of foreign currency derivatives and the exchange rate exposure faced by those firms.

The results on the effect of derivative instruments from swaps, forwards, futures and options on firm risk are presented in column 4. The coefficient on swaps and options are negative but not statistically significant. The coefficient on forwards is positive but not statistically significant. The coefficient on futures is negative and statistically significant at a 10% level. This implies that firms that use futures have a 5.39% lower total risk than firms that do not use futures. This reduction is economically significant as it represents 17% of the mean total risk.

4.2.2.1.2 Systematic risk

In column 5 of table 4.10 derivative use has a negative coefficient with systematic risk. This is not statistically significant. In column 6 of table 4.10, foreign currency derivative users have a coefficient that is positive but not statistically significant. For interest rate derivative users, the coefficient is negative but not statistically significant. For commodity derivatives users the coefficient is negative and statistically significant at a 10% level. This means that commodity derivative users have a 2.62% lower systematic risk than non-users. In column 7 the results show that for users of derivative instruments like swaps and forwards the coefficients are positive but not statistically significant. The coefficients that relate to futures and options are negative but not statistically significant.

4.2.2.1.3 Unsystematic risk

In column 8 derivative use has a negative coefficient that is statistically significant at a 5% level. This means that firms using derivatives have a 4.85% lower unsystematic risk than non-users. In column 9 the results of foreign currency derivative use, interest rate derivative use and commodity price

derivative use are shown .All the risks have negative coefficients, but none are statistically significant. In column, 10 the results for derivative instruments (swaps, options, futures and forwards) used all had a negative coefficient. They were all not statistically significant. A study done in the UK by Finavker, (2014) show that derivative users have 1.84% to 2.55% significantly lower unsystematic risk than non-users.

4.2.2.1.4 Control Variables

The results in table 4.10 show that total risk is a function of; market to book, liquidity, managerial discretion, dividend 12-month yield, geographical diversification and profitability. This study's results show that when other factors are kept constant, an increase in the market to book ratio will lead to a significant decrease in total risk of 1.03%.Our results show there is a significant negative relationship between total risk and liquidity. A one per cent increase in liquidity decreases total risk by 1.71%. This study's results show that managerial discretion has a negative and significant relationship with total risk. A one per cent increase in managerial discretion decreases total risk by 0.293%. This study's results show that dividend 12-month yield and total risk has a significant negative relationship. Our results show that geographical diversification has a significant negative relationship with total risk. A one per cent increase in geographical diversification decreases total risk by 9.14%. These results show that for South African firms, operational hedging reduces firm risk. Our results show a significant negative relationship between profitability and total risk. A one per cent increase in profitability decreases total risk by 0.247 %. These results regarding control variables are consistent with our expectations.

4.2.2.2 The effect of the extent of derivative use on firm risk measures.

In this part, the study presents the results of the effect of the extent of derivative use on total risk, systematic risk and unsystematic risk using equation 5, 7 and 9. Extent of derivatives use is the total fair values of derivatives divided by total asset. Table 4.11 presents the results of the OLS robust regression model. We choose to present the OLS results based on statistical measures and following examples of other authors who presented this specific results using OLS model. Other authors that report this kind of results using the OLS model are (Hentschel and Kothari, 2001; Bartram, 2009; Nguyen and Faff, 2010).

Table 4-11 Presents the Effect of the Extent of Derivative Use on Firm Risk Measures with Control Variables

Ordinary least square model

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	Total Risk	Total Risk	Total Risk	Systematic Risk	Systematic Risk	Systematic Risk	Unsystematic Risk	Unsystematic Risk	Unsystematic Risk

Extent of derivative use	0.0335			0.0947			0.0123		
	(0.671)			(0.267)			(0.650)		
Extent FCD		-0.0845**			-0.0354***			-0.0734**	
		(0.0360)			(0.0133)			(0.0347)	
Extent IRD		-0.109			-0.0208			-0.0992	
		(0.176)			(0.134)			(0.131)	
Extent CD		0.2975***			0.626			3.141***	
		(0.712)			(0.444)			(0.567)	
Extent of swaps			-0.0616			2.57e-05			-0.0582
			(0.223)			(0.153)			(0.172)
Extent of forwards			-0.0878**			-0.0377***			-0.0761**
			(0.0378)			(0.0142)			(0.0363)
Extent of futures			3.630**			0.547			4.025**
			(1.827)			(0.885)			(1.599)
Extent of option contracts			-0.497			-0.691**			-0.236
			(0.460)			(0.327)			(0.453)
Leverage	-0.00131	-0.00178	-0.00186	0.00153	0.000825	0.000778	-0.00121	-0.00149	-0.00155
	(0.00467)	(0.00312)	(0.00311)	(0.00250)	(0.00186)	(0.00188)	(0.00439)	(0.00280)	(0.00278)
Size	-4.73e-08	-7.18e-08***	-8.15e-08***	4.01e-08***	3.74e-08***	3.74e-08**	-7.73e-08***	-1.04e-07***	-1.16e-07***
	(3.01e-08)	(2.35e-08)	(2.95e-08)	(1.39e-08)	(1.39e-08)	(1.60e-08)	(2.96e-08)	(2.13e-08)	(2.64e-08)
Market to Book	-0.00272	-0.00244	-0.00243	0.00215	0.00239*	0.00246*	-0.00282	-0.00260	-0.00261
	(0.00343)	(0.00322)	(0.00316)	(0.00144)	(0.00143)	(0.00141)	(0.00332)	(0.00313)	(0.00308)
Liquidity	0.0143**	0.0137**	0.0141**	0.0101***	0.0102***	0.0104***	0.0116*	0.0107*	0.0112*
	(0.00659)	(0.00658)	(0.00652)	(0.00316)	(0.00319)	(0.00318)	(0.00626)	(0.00626)	(0.00621)
Managerial Discretion	0.000685	0.000200	0.000157	-0.000394	-0.000488	-0.000442	0.000600	8.76e-05	3.02e-06
	(0.000741)	(0.000731)	(0.000770)	(0.000845)	(0.000849)	(0.000867)	(0.000534)	(0.000525)	(0.000565)
Dividend 12 Month Yield	-0.00277***	-0.00262***	-0.00265***	4.33e-05	2.54e-05	-4.64e-05	-0.00280***	-0.00262***	-0.00262***
	(0.000812)	(0.000832)	(0.000865)	(0.000533)	(0.000542)	(0.000556)	(0.000767)	(0.000790)	(0.000825)
Geographical Diversification	0.00396	0.00268	0.00543	0.0652***	0.0654***	0.0661***	-0.0177	-0.0193	-0.0164
	(0.0199)	(0.0193)	(0.0195)	(0.0114)	(0.0114)	(0.0115)	(0.0191)	(0.0185)	(0.0187)
Profitability	-0.00330*	-0.00338*	-0.00333*	-0.000424	-0.000460	-0.000428	-0.00338*	-0.00347*	-0.00342*
Industrial diversification									
Year2013	0.0382***	0.0381***	0.0385***	0.0256***	0.0257***	0.0261***	0.0309***	0.0308***	0.0310***
	(0.00991)	(0.00982)	(0.00986)	(0.00646)	(0.00645)	(0.00649)	(0.00954)	(0.00942)	(0.00946)
Year2014	0.0331**	0.0334**	0.0336**	0.0115*	0.0118*	0.0121**	0.0302**	0.0303**	0.0304**

	(0.0133)	(0.0134)	(0.0135)	(0.00607)	(0.00612)	(0.00613)	(0.0135)	(0.0135)	(0.0136)
Year2015	0.119***	0.119***	0.119***	0.0498***	0.0498***	0.0505***	0.104***	0.104***	0.104***
	(0.0150)	(0.0151)	(0.0152)	(0.0112)	(0.0113)	(0.0113)	(0.0139)	(0.0140)	(0.0140)
Year2016	0.148***	0.144***	0.146***	0.0685***	0.0687***	0.0702***	0.131***	0.127***	0.128***
	(0.0154)	(0.0154)	(0.0156)	(0.00933)	(0.00944)	(0.00959)	(0.0146)	(0.0146)	(0.0148)
Constant	0.242***	0.248***	0.246***	-0.0183	-0.0175	-0.0192	0.255***	0.262***	0.261***
	(0.0365)	(0.0363)	(0.0365)	(0.0155)	(0.0154)	(0.0155)	(0.0380)	(0.0379)	(0.0380)
Observations	455	454	454	455	454	454	455	454	454
R-squared	0.394	0.411	0.407	0.409	0.411	0.412	0.382	0.402	0.397

*Table 4.11 is divided into three sections. Column 2, 3 and 4 represent total risk. Column 5, 6 and 7 represent systematic risk and column 8, 9 and 10 represent unsystematic risk. Each section shows the effects of all derivative use, foreign currency derivative use, interest rate derivative use, commodity price derivative use and derivative instrument use (forwards, options, swaps and futures) on firm risk measures. This table shows results of the extent of all derivative use on firm risk measures using the Ordinary Least Squares regression. Extent of derivative use is the total fair values of derivatives divided by total assets; Extent of (FCD) foreign currency derivatives is the total fair values of foreign currency derivatives divided by total assets; Extent of (IRD) interest rate derivatives is the total fair values of interest rate derivatives divided by total assets. Extent of (CD) commodity price derivatives is the total fair values of commodity price derivatives divided by total assets. The control variables are: leverage, size, market to book, liquidity, managerial discretion, dividend 12-month yield, geographical diversification, industrial diversification and profitability. The explanations of these variables can be found in chapter 3 section 3.3 control variables. The figures in the brackets are t statistics adjusted for heteroscedasticity using the white (1980) method. *** indicates significance at1%, ** at 5% and *at 10% level.*

4.2.2.2.1 Total risk

In Table 4.11, column one presents the results for the extent of derivative use. According to the results, the extent of derivative use leads to an increase in total risk. However, this is not statistically significant. In column 2, the results of the effect of the extent of foreign currency derivatives, interest rate derivatives, and commodity price derivatives on total risk are presented. There is a significant negative effect of the extent of foreign currency derivative use on total risk. The use of foreign currency derivatives reduces total risk by 8.45%. This reduction in total risk is large compared to the reduction experienced in other studies. For instance, Nguyen and Faff, (2010) report that the extent of foreign currency derivative use has a weak effect on total risk. Their results show that stock return volatility decreases only by 0.88% for a 10% increase in the extent of foreign currency derivative use. According to Bodnar and Gebhardt, (1998) foreign currency derivatives with maturities of less than 90 days were used by 84% of firms, and only 30% of firms use foreign currency derivatives with maturities of greater than three years. Therefore, the author argues that firms use foreign currency derivatives to hedge short-

term risk. Because the risk being hedged is short term, it is expected that the effect on total risk will not be as large.

Similarly, Guay and Kothari, (2003) stated that foreign currency derivatives' contribution to cash flow volatility was about 25% more than interest rate derivatives. However, the author stated that on average the maturity for interest rate derivatives is longer than that of foreign currency derivatives hence the contribution of interest rate derivatives to market value sensitivity is about 25% greater when compared to that of foreign currency derivatives. Other studies like Finavker, (2014) have found a negative but insignificant effect of the extent of foreign currency derivative use on total risk.

The effect of extent of interest rate derivative use on firm risk is presented in column 2 of table 4.11. The results show that interest rate derivatives reduces total risk, but this is not statistically significant. This is not per expectations. This is because according to the results presented by Bodnar and Gebhardt, (1998)73% of the firms use interest rate derivatives and majority (83%) of this interest rate derivative users use interest rate swaps. The author argues that interest rate swaps are long-term derivative instruments and therefore they are expected to have a more significant effect on total risk. Finavker, (2014) conducts a study on UK firms and finds that interest rate derivatives have a significant negative effect on total risk. Similarly, Nguyen and Faff, (2010) report that total risk for Australian firms decreases by 3.51% as a result of a 1% increase in the extent of interest rate derivative use.

This study's results show that the extent of commodity derivatives use increases the total risk by 2.975%. This is statistically significant at a 1% significance level. This is in contrast to our expectations. This is because, amongst industries, the cost of primary product outputs and material inputs are subject to fluctuations in commodity prices. Therefore, any significant volatility on commodity price can have severe effects on firms' sales and cost of sales affecting gross margins and operational incomes. Risk management strategies in most firms, therefore, hedge against commodity price volatility risk. They can offer competitive and consistent prices and thus reduce firm risk.

Column 3 presents the results of the derivative instruments. Swaps and options reduce total risk. However, this is not statistically significant. Forwards reduce total risk. This is statistically significant. Futures increase firm risk, and this is statistically significant. The control variables that significantly affect total risk are liquidity, dividend 12-month yield and profitability. Their relationship with total risk has been discussed in the previous section 4.2.2.1.4.

4.2.2.2.2 Systematic risk

In column 4 of table 4.11, the extent of derivative use has a positive effect on systematic risk. However, this effect is not statistically significant. On the contrary, other authors like Bartram, (2019) and Nguyen and Faff, (2007) find that derivative use has a negative but insignificant relationship with systematic risk. Guay, (1999) established that the use of derivatives for risk management reduces market risk.

In column 5 of table 4.11, the effect of the extent of foreign currency derivatives on systematic risk shows that foreign currency derivatives reduce systematic risk. This is statistically significant at a 1% level. A 1% increase in the extent of foreign currency derivative use reduces systematic risk by 3.54%. Similarly, Bartram, (2019) who conducted a study with firms across 47 countries reports that foreign currency derivatives have a significant negative effect on systematic risk.

This study's results show that the extent of interest rate derivatives has a negative effect on systematic risk. However, this is not statistically significant. These results are similar to those of Nguyen and Faff, (2010).On the contrary, Bartram, Brown and Conrad, (2011) show that interest rate derivatives have a significant negative effect on systematic risk.

This study's results shows that the extent of commodity price derivatives use has a positive effect on total risk. However, this is not statistically significant. On the contrary Jin and Jorion, (2006) reported that firms in the oil and gas industry that used commodity price derivatives experienced a reduction in the firm’s stock price sensitivity to oil and gas prices.

In column, 6 of table 4.11 results of the effect of the extent of derivative instrument use on systematic risk are presented. Swaps and futures have a positive effect on systematic risk. However, this is not statistically significant. Forwards have a significant and negative effect on systematic risk. An increase of 1% in the extent of forwards use reduces systematic risk by 3.77%. Option contracts also have a significant and negative effect on systematic risk. An increase of 1% in the extent of options use reduces systematic risk by 6.91%.

4.2.2.2.3 Unsystematic risk

In column, 7 of table 4.11 results of the effect of the extent of derivative use on unsystematic risk are presented. The extent of derivative use has a positive effect on unsystematic risk. However, this is not statistically significant. On the contrary Nguyen and Faff, (2010) report that the effect of the extent of derivative use has a negative and an insignificant relationship with unsystematic risk. A study done on UK non-financial firms establishes that the effect of the extent of derivative use on unsystematic risk is negative and significant (Finavker, 2014).

In column 8 of table 4.11 results of the effect of the extent of foreign currency derivative use has a negative and significant effect on unsystematic risk. A 1% increase in the extent of foreign currency derivative use will lead to a 7.34% decrease in unsystematic risk. Similarly, Finavker, (2014) finds that the effect of foreign currency derivative use on unsystematic risk is negative but not significant. Nguyen and Faff, (2010) do not report a significant effect of foreign currency derivative use on unsystematic risk.

The effect of the extent of interest rate derivatives on unsystematic risk is negative. However, it is not significant. These results are consistent with (Nguyen and Faff, 2010). On the contrary, Finavker,

(2014) finds that interest rate derivatives have a significantly negative effect on unsystematic risk. The effect of the extent of commodity derivatives on unsystematic risk is positive and significant.

In column, 9 results of the effect of the extent of derivative instrument use on unsystematic risk are reported. The extent of use of swaps and options contracts have a negative effect on unsystematic risk. However, this is insignificant. The extent of use of forwards has a significantly negative effect on unsystematic risk. A 1% increase in the extent of use of forwards decreases unsystematic risk by 0.0761%. The extent of use of futures has a significant positive effect on unsystematic risk. One percent increase in the extent of futures leads to a 4.025% increase in unsystematic risk.

4.2.2.3 Portfolio analysis

In this section, the results of the test for non-linearity in the use of derivatives are presented. The analysis is done using equation 10.All derivative users have been divided into ten portfolios according to the extent of derivative use (measured by the total fair value of all derivative contracts divided by total assets). Portfolio 0 has all the non-users. Portfolio 1 has the least intensive derivative users, and portfolio 10 has the most intensive derivative users. We expected that portfolio 1 (portfolio 10) would have the highest (lowest) total risk if the total risk is a linear function of derivative use.

Table 4-12 Portfolio Analysis between Risk and Derivative Usage

Portfolio	Average Extent of derivative use	Total risk		Profitability	Investment Growth	Liquidity	Managerial discretion	Dividend 12 Month Yield	Market to book	Leverage	Size	Geographical diversification	Industrial diversification
0	0.00%	33.57%	11	7.22	10.81	1.90	2.75	0.05	2.57	0.30	3.93	0.21	0.37
1	0.02%	29.10%	6	7.80	9.89	1.42	0.35	0.03	3.75	0.27	4.37	0.35	0.39
2	0.05%	28.69%	4	6.21	7.32	1.15	0.38	0.03	3.17	0.32	4.51	0.28	0.61
3	0.09%	26.80%	2	7.52	6.49	1.38	0.22	0.03	3.09	0.31	4.36	0.34	0.57
4	0.13%	26.72%	1	9.20	4.66	1.62	0.16	0.04	3.64	0.36	4.34	0.25	0.54
5	0.19%	28.05%	3	11.65	7.50	1.79	0.18	0.06	2.36	0.37	4.36	0.35	0.50
6	0.31%	29.05%	5	7.88	6.29	1.53	1.16	0.05	3.17	0.41	4.44	0.33	0.59
7	0.54%	29.28%	8	8.14	9.70	1.73	0.54	1.93	3.13	0.29	4.40	0.24	0.39
8	0.97%	30.65%	9	8.35	7.58	1.66	0.24	1.09	3.78	0.56	4.65	0.43	0.43
9	1.65%	29.12%	7	9.70	10.26	1.54	0.21	0.29	4.56	0.67	4.76	0.50	0.43
10	5.44%	32.68%	10	7.29	9.61	1.77	4.14	0.21	4.73	-0.39	5.12	0.63	0.54

Table 4.12 shows the portfolio based on the extent of derivatives usage where portfolio 0 contains 171 non-users and portfolio 1 (28 users just like all other portfolios apart from portfolio 7-10 that have 29 users) has the least intensive derivative users and portfolio 10 has the most intensive derivative users.

The results in table 4.12 show that firm risk is a nonlinear function of derivative use. Risk reduction is evident for all firms that use derivatives that is all firms in portfolio 1-10. However, there is no apparent

relationship to show total risk reduces as the extent of derivative use increases. The non-users of derivatives have the highest level of total risk with 33.57% per annum. The user portfolios (1-10) have a lower total risk than the non-user portfolio. These results are in line with our univariate results.

The decrease in total risk when moving from portfolio 0 to portfolio 1 (when a firm changes status from being a non-user of derivatives to a user) is 4.65% per annum. This reduction in risk also turns out to be the most economical marginal risk reduction. Firms that move from portfolio 0 to portfolio 1 experience the most risk reduction than any movement between other portfolios. The portfolio with the least amount of total risk is portfolio 4 with 26.72% per annum. The second lowest total risk comes from portfolio 3 with 26.80% per annum. The reduction in risk for portfolio 4 is 6.85% per annum compared to firms that do not make use of derivatives. Considering the mean total risk of the sample firms is 30.704% per annum, this risk reduction if substantial in economic terms as it represents 22% of the mean total risk. The extent of derivative use of 0.13% is, therefore, the optimal level for firms that want to achieve risk reduction from the use of derivatives in the current sample. The second most optimal extent of derivative use is 0.09%, which is portfolio 4. Thus, the two thresholds used in the regressions were 0.09% and 0.13%.

Interestingly firms that use more derivatives than the level that is deemed optimal start to have a higher total risk. Portfolio 7, 8, 9 and 10 are the most intensive users of derivatives, and yet they have the highest levels of risk. Taking note of portfolio ten, which has the highest amount of total risk amongst all the portfolios of derivative users.

Comparing to the paper of Nguyen and Faff, (2010) who does this test on Australian firms and uses the notional amount of derivatives instead of the fair value of derivative the results differ somehow but not entirely. The author reports that total risk reduces by 1.13% per annum when an Australian firm changes status from a non-user of derivatives to a user of derivatives. The author states that in their sample economic marginal risk reduction was most significant between portfolio 1 and 2 where the extent of derivative use was 0.23% and 2.09% respectively. The authors report that their most substantial risk reduction was in portfolio 6 with an optimal extent of derivative use of 19.55%. Similarly, in their sample, the authors reported that the firm risk of portfolio 7, 8, 9 and 10 increases as a function of derivative use intensity. The author uses a threshold of 20%, which is the extent of derivative use of their optimal portfolio, and the second threshold of 40%. The author states that their choice of 40% was based on Tufano, (1996) selection of a moderate user of derivatives. Even though the results differ per sample, the fact that both studies identified that derivative use has an optimal level shows that the relationship between derivative use and firm risk is non-linear.

Some financial characteristics may explain why portfolio 0 has the highest risk. The firms in portfolio 0 have the highest liquidity. The firms in portfolio 0 are the smallest/least in terms of size, geographical diversification and industrial diversification. Other authors that have observed a negative relationship

between firm size and total risk are (Hentschel and Kothari, 2001; Nguyen and Faff, 2010). Finavker, (2014) state that larger firms are considered to be less risky than smaller firms because they usually are well diversified in terms of products and geographical diversification.

Table 4.13 and table 4.14 present the results of the regression model for the non-linear relationship between derivative use and firm risk. Equation 10 is employed in the regression. The Hausman test specified that the best model for the results where "non-users are included "is the fixed effect model while the best model for the results where "non-users are excluded" is the random effects model. Hence, table 4.13 reports the results of the fixed effects model while table 4.14 reports the results of the random effects model.

Table 4-13 Non-linear relationship between derivative use and Firm Risk (Fixed effects model where non-users are included)

Fixed effects

	(1)	**(1)**
VARIABLES	0.09% non-users included	0.13% non-users included
Low derivative users		
Constant	0.357***	0.350***
	(0.0418)	(0.0421)
.Extent of derivative use	-0.861	-0.981*
	(0.524)	(0.536)
.Leverage	-0.00245	9.73e-06
	(0.00610)	(0.00624)
.Size	-1.20e-07	-1.40e-07
	(1.01e-07)	(1.02e-07)
.Market to Book	-0.0151***	-0.0136***
	(0.00431)	(0.00435)
.Liquidity	-0.0113	-0.0109
	(0.0129)	(0.0136)
.Managerial Discretion	-0.00411	-0.00439
	(0.00289)	(0.00292)
.Dividend 12 Month Yield	-0.00511	-0.00571
	(0.00352)	(0.00361)
.Industrial diversification	-0.0412	-0.0275
	(0.0315)	(0.0289)
.Geographical Diversification	-0.0694	-0.0918*
	(0.0514)	(0.0547)
.Profitability	3.63e-05	-0.000286
	(0.000724)	(0.000756)
High derivative users		
constant	-41.24	-10.49
	(37.94)	(22.93)
.Extent of derivative use	0.0705	0.0762

	(0.0515)	(0.0496)
.Leverage	-0.0119	-0.0147
	(0.0116)	(0.0115)
.Size	-6.37e-07*	-7.28e-07**
	(3.29e-07)	(3.03e-07)
.Market to Book	-0.00386	-0.00784
	(0.00575)	(0.00541)
.Liquidity	-0.0192**	-0.0186*
	(0.00952)	(0.00946)
.Managerial Discretion	-0.00284**	-0.00263*
	(0.00138)	(0.00139)
.Dividend 12 Month Yield	-0.118	-0.113
	(0.0784)	(0.0794)
.Geographical Diversification	-0.0503	-0.0341
	(0.0440)	(0.0432)
.Profitability	-0.00861***	-0.00751***
	(0.00109)	(0.00106)
Industrial diversification		
Year2013	0.0305**	0.0320**
	(0.0124)	(0.0126)
Year2014	0.0227*	0.0258**
	(0.0127)	(0.0129)
Year2015	0.107***	0.109***
	(0.0134)	(0.0137)
Year2016	0.126***	0.130***
	(0.0138)	(0.0141)
Constant	0.357***	0.350***
	(0.0418)	(0.0421)
Observations	455	455
R-squared	0.503	0.488
Number of Company I.D	91	91
Model 1=FE; 2=RE	1	1
Hausman Chi2	53.74	47.80
Hausman p	0%	0%
Breusch&Pagan Lagrangian multiplier chi2	76.46	72.77
Breusch&Pagan Lagrangian multiplier p	0	0
R sq within	0.503	0.488
R sq between	0.0701	0.0670
R sq overall	0.243	0.226

Table 4-14 Non-linear relationship between derivative use and Firm Risk (Random effects model where non-users are excluded)

Random effects

	(2)	(2)
VARIABLES	0.09% non-users excluded	0.13% non-users excluded
Constant	0.255***	0.252***
	(0.0312)	(0.0324)
Low derivative users		
Extent of derivative use	-0.943*	-1.004**
	(0.488)	(0.499)
Leverage	0.00155	0.00276
	(0.00533)	(0.00543)
Size	-1.89e-08	-1.78e-08
	(3.59e-08)	(3.65e-08)
Market to Book	-0.0105***	-0.0101***
	(0.00318)	(0.00325)
Liquidity	-0.00211	-0.00138
	(0.00991)	(0.0102)
Managerial discretion	-0.000919	-0.000827
	(0.00198)	(0.00201)
Dividend 12 Month Yield	-0.00284	-0.00288
	(0.00259)	(0.00262)
Geographical diversification	0.0178	0.0109
	(0.0313)	(0.0334)
Profitability	1.77e-05	-0.000125
	(0.000677)	(0.000701)
High derivative users		
Constant	-61.82*	-26.16
	(33.47)	(19.20)
.Extent of derivative use	0.0895**	0.0878**
	(0.0388)	(0.0386)
.Leverage	-0.0181*	-0.0187**
	(0.00951)	(0.00946)
.Size	-1.76e-07	-2.78e-07
	(2.35e-07)	(2.14e-07)
.Market to Book	-0.00316	-0.00499
	(0.00402)	(0.00376)
.Liquidity	0.00132	0.00191
	(0.00809)	(0.00799)
.Managerial discretion	-0.00148	-0.00134
	(0.00121)	(0.00122)
.Dividend 12 Month Yield	-0.00493	-0.00351
	(0.0609)	(0.0612)
Geographical diversification	0.00644	0.0259
	(0.0304)	(0.0291)
.Profitability	-0.00806***	-0.00722***
	(0.000984)	(0.000947)
industrial diversification		
Year2013	0.0334***	0.0332***

	(0.0126)	(0.0127)
Year2014	0.0221*	0.0234*
	(0.0127)	(0.0129)
Year2015	0.105***	0.106***
	(0.0131)	(0.0133)
Year2016	0.127***	0.128***
	(0.0134)	(0.0136)
Observations	284	284
Number of CompId	64	64
R sq within	0.479	0.464
R sq between	0.306	0.316
R sq overall	0.403	0.399

*Table 4.13 and 4.16 reports the effects of derivatives use on total risk where the sample is split between low derivative users and high derivative users with a threshold of 0.09% and 0.13%. The control variables are leverage, size, market to book, liquidity, managerial discretion, dividend 12-month yield, geographical diversification, industrial diversification and profitability. The explanations of these variables can be found in chapter 3 section 3.3 control variables. The figures in the brackets are t statistics adjusted for heteroscedasticity using the white (1980) method. *** indicates significance at 1%, ** at 5% and *at 10% level.*

The results that have been presented so far paint a picture that the relationship between firm risk and derivative use is non-linear. There may be a plethora of factors that may cause the absence of a linear relationship. However, results from the portfolio analysis indicate that the lack of a direct relationship is due to non-linearity. According to Guay, (1999) one of the major causes of an insignificant coefficient is the lack of a linear relationship between derivative usage and firm risk.

4.2.2.3.1 Low derivative users

The coefficient on the extent of derivative use where the threshold is 0.09% or less (portfolio 3) is negative but not statistically significant. As we expected, the coefficient on the extent of derivative use where the threshold is 0.13% or less (portfolio 4 -the optimal portfolio) is negative and statistically significant at a 10% level. In table 4.14, the results where "non-users are excluded" are presented. For the 0.09% threshold, the coefficient is negative and significant at a 10% level. For the 0.13% threshold level, the coefficient is negative and significant at a 1% level. These results suggest that the usage of derivative of less than 0.13% is linked to a reduction in the firm risk.

4.2.2.3.2 High derivative users

On the other hand, where "non-users are included" the coefficient where the extent of derivative usage is 0.09% and 0.13% or higher is positive but not significant. Where "non-users are excluded" in the coefficients presented in table 4.14 show that they are positive and significant at a 5% level. These results suggest that the extent of the use of derivatives over the 0.13% threshold increases firm risk.

This study has identified that using derivatives has a significant relationship with a firm's total risk. Besides, the condition of that relationship is determined by the extent of derivative usage in a firm.

Comparison to the paper of Nguyen and Faff, (2010a) shows similar conclusion. The author finds that the coefficient on the extent of derivative use to be statistically significantly negative for firms whose extent of derivative usage was equal or less than the optimal level of 20%. Similarly, the author reported that the extent of derivative use that is less than 20% is linked to a reduction in firm risk. The author also showed that firms that had an extent of derivative use higher than the optimal threshold of 20% experienced an increase in firm risk. The author reported that these extensive users demonstrated a pattern of derivative use more consistent with speculation.

The increase in the threshold from 0.09% to 0.13% seems to give better results. The coefficient increases in size and the strength of its statistical significance increases. For instance, in table 4.13 the coefficient β_1 changes from -0.861 to -0.981 for regressions of low derivative users "including non-derivative users". In table 4.14, the coefficient β_{11} increases from 0.943 to 1.004. The significance also increases from 10% to 5%.

4.2.3 The effect of derivative use on Firm Value

In table 4.15, the results of the effect of derivative use on firm value are presented. We estimate this effect using equation 16, 18 and 20.Derivative use is measured using a dummy variable of one if a firm uses derivatives and zero if a firm does not use derivatives. The results presented are those of the effect of derivative use, foreign currency derivative use, interest rate derivative use and commodity price derivative use. In addition, results are presented on the effect of using derivative products (swaps, options, futures and forwards). Several estimation methods like OLS, RE and FE models have been used. Various tests have been employed to select the best model amongst the OLS, RE and FE models. The results discussed only relate to the best model.

Table 4-15 the effects of derivative use on Firm Value

Fixed effects

	(2)	(3)	(4)
VARIABLES	Lntobinq	Lntobinq	Lntobinq
Derivative use	0.0554		

	(0.0399)		
Usage FCD		0.0556	
		(0.0352)	
Usage IRD		-0.00126	
		(0.0353)	
Usage CD		0.0229	
		(0.0444)	
Usage of swaps			-0.0276
			(0.0336)
Usage of forwards			0.0253
			(0.0358)
Usage of futures			0.0274
			(0.0451)
Usage of option contracts			0.0250
			(0.0319)
Leverage	0.0885***	0.0911***	0.0906***
	(0.00732)	(0.00753)	(0.00760)
Size	-1.83e-07	-1.56e-07	-1.78e-07
	(1.38e-07)	(1.41e-07)	(1.41e-07)
Investment growth	0.115***	0.116***	0.115***
	(0.00661)	(0.00667)	(0.00671)
Liquidity	0.0132	0.0130	0.0134
	(0.0133)	(0.0133)	(0.0134)
Managerial Discretion	-0.00142	-0.00126	-0.00161
	(0.00221)	(0.00222)	(0.00223)
Dividend 12 Month Yield	0.000773	0.000592	0.00195
	(0.00573)	(0.00579)	(0.00588)
Geographical Diversification	0.116*	0.117*	0.121*
	(0.0682)	(0.0684)	(0.0686)
Profitability	0.00637***	0.00632***	0.00632***
	(0.00105)	(0.00105)	(0.00106)
Industrial diversification			
Year2013	0.0171	0.0146	0.0165
	(0.0210)	(0.0211)	(0.0211)
Year2014	-0.00226	-0.00358	-0.00237
	(0.0213)	(0.0213)	(0.0214)
Year2015	-0.0518**	-0.0542**	-0.0499**
	(0.0219)	(0.0221)	(0.0222)
Year2016	-0.0428*	-0.0420*	-0.0393*
	(0.0221)	(0.0221)	(0.0223)
Constant	0.00455	0.00427	0.0228
	(0.0513)	(0.0497)	(0.0502)
Observations	455	455	455
R-squared	0.576	0.577	0.576

Number of Company I.D	91	91	91
R sq within	0.576	0.577	0.576
R sq between	0.750	0.747	0.758
R sq overall	0.723	0.721	0.730
Model 1=FE; 2=RE	1	1	1
Hausman Chi2	46.22	47.89	50.33
Hausman p	0%	0%	0%
Breusch&Pagan Lagrangian multiplier chi2	311.4	308.5	292.8
Breusch&Pagan Lagrangian multiplier p	0	0	0

*Table 4.15 shows the effects of all derivative use, foreign currency derivative use, interest rate derivative use, commodity price derivatives use, and derivative instrument use (forwards, options ,swaps and futures) on firm value measure. The control variables are; leverage, size, market to book, liquidity, managerial discretion, dividend 12-month yield, geographical diversification, industrial diversification and profitability. The explanations of these variables can be found in chapter 3 section 3.3 control variables. Derivative use is a dummy variable equal to '1' if a firm uses derivatives and '0' if a firm does not use derivatives. Usage FCD is a dummy variable of '1' if a firm uses foreign currency derivatives and '0' if a firm does not use foreign currency derivatives. Usage IRD is a dummy variable of '1' if a firm uses interest rate derivatives and '0' if a firm does not use interest rate derivatives. Usage CD is a dummy variable of '1' if a firm uses commodity price derivatives and '0' if a firm does not use commodity price derivatives. The figures in the brackets are t statistics adjusted for heteroscedasticity using the white (1980) method. *** indicates significance at 1%, ** at 5% and *at 10% level.*

4.2.3.1.1 Tobin's Q

The results in column 1 of table 4.15 show that derivative use increases firm value by 5.54%. However, this is not statistically significant. This indicates that on average hedging adds value; however, the magnitude of the value addition is not substantial. Bartram, Brown and Fehle, (2009) report that derivative user firms from around the world have a 0.29% to 1.7% higher firm value than non-derivative users. Bartram, Brown and Conrad, (2011) reported that hedging firms from around the world had a 1% to 7% higher Tobin's Q than matching non-hedging firms. On the contrary Khediri, (2010) said that French firms that use derivatives had a 2.5% insignificant lower firm value than non-derivative users. Nguyen and Faff, (2007) also report that derivative use in Australia reduces Tobin's Q by a magnitude of 0.27.

In column 2, the results of the effect of foreign currency derivative use, interest rate derivative use and commodity price derivative use on firm value are presented. The results show that the coefficient on the use of foreign currency derivatives is positive, but it is not statistically significant. Studies from other parts of the world have different results. Allayannis and Weston, (2001) report that in their sample of 720 U.S. firms, the use of foreign currency derivatives creates a hedging premium of 4.8%. Allayannis, Lel and Miller, (2009) report that hedging foreign currency risk adds value in firms from 39 countries. The authors found a substantial magnitude of hedging premium. The authors reported that

firms that used foreign currency derivatives had a 14.5% higher value than firms that did not manage this risk.

The coefficient on the use of commodity price derivatives is positive but not statistically significant. Similarly, Carter, Rogers and Simkins, (2004) report a hedging premium of 12-16% for US airlines that use commodity derivative to hedge fuel. On the contrary Lookman, (2004) said that for undiversified exploration and production (E&P) for firms that had commodity price risk as a primary risk the use of derivatives to hedge was linked to lower firm value. The author added that for diversified firms with an E&P segment the use of derivatives increased firm value. The author concluded that in general, the use of derivatives did not increase firm value. Jin and Jorion, (2006) also report that for firms in the Oil and gas industry based in the U.S. that use derivatives to manage commodity price risk do not experience a value premium compared to firms that don't hedge.

The coefficient on the use of interest rate derivative is negative however not statistically significant. On the contrary, Khediri, (2010) reports that French firms that use interest rate derivatives increases their firm value by 8.3%. The authors add that this value premium is however negligible. Similarly, Nguyen and Faff, (2010) report that interest rate derivatives contribute the most to the hedging premium experienced by Australian firms. The author reports that interest rate derivatives increase Tobin's Q by 0.3117.

The results of the use of derivative instruments from swaps, forwards, futures and options are presented in column 4. The coefficient on swaps is negative but not statistically significant. The coefficient on forwards, futures and options are positive but not statistically significant.

4.2.3.1.2 Control variables

Our results show that when other factors are kept constant, an increase in the investment growth will lead to a significant increase in firm value. A one per cent increase in investment growth will increase firm value by 11.5%. Our results show there is a significant positive relationship between firm value and leverage. This is in contradiction to our expectations. A one per cent increase in leverage will increase firm value by 8.85 %. Our results show that geographical diversification has a positive and significant relationship with firm value. A one per cent increase in geographical diversification will increase firm value by 11.6 % **.**Our results show a significant positive relationship between profitability and firm value. A one per cent increase in profitability will increase firm value by 6.37%.

4.2.4 The effect of the extent of derivative use on firm value.

In this part, the study presents the results of the effect of the extent of derivative use on firm value using equation 12, 14 and 16. Extent of Derivatives is the total fair values of Derivatives divided by total asset.

Table 4-16 the effect of the extent of Derivatives use on firm value

Fixed effects

	(2)	(3)	(4)
VARIABLES	Lntobinq	Lntobinq	Lntobinq
Extent of derivative use	-0.840		
	(0.798)		
Extent FCD		-0.0180	
		(0.145)	
Extent IRD		0.00320	
		(0.493)	
Extent CD		-0.821	
		(1.525)	
Extent of swaps			0.0313
			(0.491)
Extent of forwards			-0.0197
			(0.145)
Extent of futures			-1.163
			(2.709)
Extent of option contracts			-1.679
			(1.903)
Leverage	0.0820***	0.0886***	0.0891***
	(0.00948)	(0.00746)	(0.00748)
Size	-1.89e-07	-1.87e-07	-1.90e-07
	(1.38e-07)	(1.39e-07)	(1.42e-07)
Investment growth	0.115***	0.115***	0.116***
	(0.00661)	(0.00674)	(0.00676)
Liquidity	0.0126	0.0103	0.00956
	(0.0133)	(0.0135)	(0.0135)
Managerial Discretion	-0.00225	-0.00224	-0.00244
	(0.00215)	(0.00215)	(0.00216)
Dividend 12 Month Yield	0.000910	0.000996	0.000862
	(0.00574)	(0.00574)	(0.00575)
Geographical Diversification	0.128*	0.121*	0.122*
	(0.0686)	(0.0683)	(0.0683)
Profitability	0.00635***	0.00639***	0.00639***
	(0.00105)	(0.00105)	(0.00105)
Industrial diversification			
Year2013	0.0164	0.0151	0.0156
	(0.0210)	(0.0210)	(0.0211)
Year2014	-0.00336	-0.00417	-0.00403
	(0.0213)	(0.0214)	(0.0214)
Year2015	-0.0501**	-0.0517**	-0.0510**
	(0.0220)	(0.0221)	(0.0221)
Year2016	-0.0373*	-0.0446**	-0.0426*
	(0.0225)	(0.0222)	(0.0224)

Constant	0.0447	0.0440	0.0441
	(0.0433)	(0.0435)	(0.0435)
Observations	455	454	454
R-squared	0.575	0.578	0.579
Number of Company I.D	91	91	91
R sq within	0.575	0.578	0.579
R sq between	0.752	0.749	0.743
R sq overall	0.723	0.721	0.716
Model 1=FE; 2=RE	1	1	1
Hausman Chi2	47.15	50.02	54.66
Hausman p	0%	0%	0%
Breusch&Pagan Lagrangian multiplier chi2	310.3	306.9	291.6
Breusch&Pagan Lagrangian multiplier p	0	0	0

*Table 4.16 shows the effects of all derivative use, foreign currency derivative use, interest rate derivative use, commodity price derivatives use, and derivative instrument use (forwards, options ,swaps and futures) on firm value measure. The table shows results of the extent of all derivative use on firm risk measures .The extent of All derivatives is the total fair values of all derivatives divided by total assets; Extent of foreign currency derivatives is the total fair values of foreign currency derivatives divided by total assets; Extent of interest rate derivatives is the total fair values of interest rate derivatives divided by total assets; Extent of commodity price derivatives is the total fair values of commodity price derivatives divided by total assets. The control variables are: leverage, size, market to book, liquidity, managerial discretion, dividend 12-month yield, geographical diversification, industrial diversification and profitability. The explanations of these variables can be found in chapter 3 section 3.3 control variables. The figures in the brackets are t statistics adjusted for heteroscedasticity using the white (1980) method. *** indicates significance at 1%, ** at 5% and *at 10% level.*

4.2.4.1.1 Tobin's Q

According to the results, the use of derivative is associated with a decrease in firm value. However, this is not statistically significant. Similarly, Naito and Laux, (2011) reported that for UK firms derivative usage as proxied by fair value has a negative and significant relationship with firm value. On the other hand, the author reported results of the extent of derivative use proxied by notional value of firms' derivative contracts. The author's results showed that derivative use has a positive relationship with firm value. However, the author reports the results are not statistically significant.

In column 2 of table 4.16, the results of the effect of the extent of foreign currency derivatives, interest rate derivatives, and commodity price derivatives on firm value are presented. The extent of foreign currency derivatives and commodity price derivatives decrease the firm value, but this is not statistically significant. The extent of interest rate derivative use in column 2 shows that interest rate derivatives increase firm value, but this is not statistically significant.

The results of the use of derivative instruments from swaps, forwards, futures and options are presented in column 4. The coefficient on swaps is positive but not statistically significant. The coefficient on forwards, futures and options are negative but not statistically significant. The same control variable that was significant in table 4.15 are the same ones that are significant in table 4.16. Hence, the same explanation applies.

4.2.5 Interaction terms

The interaction term results examined using equation 18 to 20 are according to expectations. Firms that are specifically prone to interest rate risk and that hedge that risk with interest rate derivatives experience an enhancement in firm value. Firms that are also prone to foreign currency risk and that hedge that risk with foreign currency derivatives experience an insignificant enhancement in firm value. In order to conserve space more details regarding this interaction term results have been included in appendix D.

4.2.6 Portfolio analysis

In this section, the test results for non-linearity in the use of derivatives and firm value are presented. The analysis is done using equation 17.All derivative users have been divided into ten portfolios according to the extent of derivative use as measured by the total fair value of all derivative contracts divided by firm size (total assets). Portfolio 0 has all the non-users. Portfolio 1 has the least intensive derivative users, and portfolio 10 has the most intensive derivative users. We expected that portfolio 10 (portfolio 1) would have the highest (lowest) firm value if firm value is a linear function of derivative use.

Table 4-19 Portfolio Analysis between Firm Value and Derivative Usage

	Extent of derivative use	**Tobin's Q**		**Profitability**	**Liquidity**	**Managerial discretion**	**Dividend 12 Month Yield**	**Market to book**	**Leverage**	**Size**	**Geographical diversification**	**Industrial diversification**
0	0.00%	1.801	3	7.224	1.902	2.750	0.049	2.570	0.296	3.930	0.208	37.4%
1	0.02%	2.077	7	7.799	1.421	0.345	0.030	3.754	0.265	4.371	0.354	50.0%
2	0.05%	1.662	2	6.206	1.146	0.379	0.030	3.169	0.316	4.514	0.285	60.7%
3	0.09%	1.878	5	7.524	1.380	0.222	0.030	3.094	0.310	4.360	0.344	57.1%
4	0.13%	2.002	6	9.201	1.617	0.164	0.040	3.635	0.364	4.341	0.254	53.6%
5	0.19%	1.589	1	11.647	1.785	0.183	0.059	2.365	0.369	4.358	0.347	50.0%
6	0.31%	1.847	4	7.880	1.530	1.157	0.051	3.167	0.407	4.439	0.330	58.6%
7	0.54%	2.118	8	8.141	1.732	0.537	1.935	3.130	0.294	4.400	0.241	39.3%
8	0.97%	2.241	10	8.352	1.663	0.243	1.087	3.784	0.562	4.648	0.429	42.9%
9	1.65%	2.293	11	9.695	1.537	0.214	0.290	4.555	0.672	4.765	0.505	42.9%
10	5.44%	2.127	9	7.293	1.768	4.137	0.212	4.729	-0.387	5.121	0.629	53.6%

The results in table 4.17 show that firm value is a nonlinear function of derivative use. The non-users of derivatives have the third lowest Tobin's Q. We cannot establish any pattern that gives a general observation that firms that use derivatives have the highest firm value. That being said the three portfolios with the highest extent of derivative use also have the highest Tobin's Q. Portfolio 9 has the highest Tobin's Q followed by portfolio 8. The extent of derivative use of 1.65% is, therefore, the optimal level for firms that want to achieve the maximum firm value from the use of derivatives in our sample. The second most optimal extent of derivative use is 0.97%, which is portfolio 8. Thus, the two thresholds used in the regressions are therefore 0.97% and 1.65%.In Australia Nguyen and Faff, (2010b) results show that the non-derivative user portfolio has the highest Tobin's Q. The author's general observation is that firms are not rewarded with a value premium as their intensity of derivative use increases.

Some financial characteristics that are worth mentioning. Firms in portfolio 0 have the highest liquidity. The firms in portfolio 0 are the smallest/least regarding size, geographical diversification and industrial diversification. Nguyen and Faff, (2010b) reported that non-derivative users in portfolio 0 had some financial characteristics that were similar to the non-derivative users in this study. According to the authors, non-derivative user firms were the smallest, had the lowest degree of leverage, were the least profitable, the least industrially diversified but they had the highest managerial discretion, and they were the second most liquid.

Table 4-20 Non-linear relationship between derivative use and Firm Value

Fixed effects

	(1)	(1)	(2)	(2)
VARIABLES	0.97% non-users included	1.65% non-users included	0.97% non-users excluded	1.65% non-users excluded
Low derivative users				
Extent of derivative use	-0.492	0.825	0.290	0.610
	(0.985)	(1.424)	(0.846)	(1.200)
Leverage	0.0633***	0.0681***	0.0589***	0.0512***
	(0.0119)	(0.0157)	(0.0101)	(0.0134)
Size	-1.50e-07	-2.20e-07	-1.70e-07	-1.43e-07
	(2.08e-07)	(2.06e-07)	(1.79e-07)	(1.84e-07)
Investment growth	0.0966***	0.0828***	0.0872***	0.0683***
	(0.00931)	(0.0121)	(0.00824)	(0.0105)
Liquidity	-0.00770	-0.0611	-0.00572	-0.0559
	(0.0243)	(0.0523)	(0.0228)	(0.0462)
Managerial Discretion	-0.00242	-0.00395	-0.00200	-0.00160
	(0.00620)	(0.00608)	(0.00534)	(0.00538)
Dividend 12 Month Yield	-0.00247	-0.0309	-0.00591	-0.0303
	(0.00621)	(0.0674)	(0.00559)	(0.0562)

Industrial diversification	0.0440	0.226***	0.173***	0.311***
	(0.0568)	(0.0872)	(0.0547)	(0.0754)
Geographical Diversification	-0.0117	0.0337	-0.128	-0.0601
	(0.101)	(0.138)	(0.107)	(0.131)
Profitability	0.0129***	0.00745	0.0143***	0.0132**
	(0.00291)	(0.00552)	(0.00262)	(0.00517)
Extent of derivative use	12.22	-3.549	1.933	-6.758**
	(8.934)	(3.312)	(8.922)	(3.426)
High derivative users				
Constant	12.22	-3.549	1.933	-6.758**
	(8.934)	(3.312)	(8.922)	(3.426)
Extent of derivative use	-0.126	-0.172	0.0650	-0.0908
	(0.0842)	(0.133)	(0.0781)	(0.112)
Leverage	0.125***	0.114***	-0.115***	-0.120***
	(0.0181)	(0.0175)	(0.0433)	(0.0368)
Size	2.51e-07	-5.21e-08	4.03e-07	4.35e-08
	(3.96e-07)	(2.27e-07)	(3.47e-07)	(1.98e-07)
Investment growth	0.130***	0.129***	0.132***	0.138***
	(0.00801)	(0.00731)	(0.00875)	(0.00750)
Liquidity	0.00985	0.00768	-0.0104	-0.00888
	(0.0139)	(0.0133)	(0.0205)	(0.0194)
Managerial Discretion	-0.000889	-0.00156	-0.00816	-0.00635
	(0.00227)	(0.00225)	(0.00734)	(0.00714)
Dividend 12 Month Yield	-0.204*	0.000423	-0.836***	0.000434
	(0.122)	(0.00573)	(0.282)	(0.00524)
co.Dsi05#cIndustrial diversification	0	0	0	0
	(0)	(0)	(0)	(0)
Geographical Diversification	0.143**	0.135**	0.192**	0.149*
	(0.0689)	(0.0682)	(0.0940)	(0.0894)
Profitability	0.00553***	0.00588***	0.00319***	0.00351***
	(0.00108)	(0.00104)	(0.00108)	(0.00103)
Industrial diversification				
Year2013	0.0166	0.00994	0.0252	0.0115
	(0.0206)	(0.0209)	(0.0223)	(0.0225)
Year2014	-0.00180	-0.0113	0.00494	-0.00427
	(0.0210)	(0.0211)	(0.0233)	(0.0233)
Year2015	-0.0453**	-0.0541**	-0.0170	-0.0395
	(0.0220)	(0.0218)	(0.0247)	(0.0239)
Year2016	-0.0385*	-0.0383*	-0.0405	-0.0462*
	(0.0227)	(0.0227)	(0.0259)	(0.0258)
Constant	0.108	0.178	0.0802	0.209*
	(0.0833)	(0.134)	(0.0798)	(0.117)
Observations	455	455	284	284

R-squared	0.609	0.608	0.748	0.748
Number of Company I.D	91	91	64	64
Model 1=FE; 2=RE	1	1	1	1
Hausman Chi2	50.80	58.10	39.04	35.73
Hausman p	0%	0%	1%	2%
Breusch Pagan Lagrangian multiplier chi2	268.6	252.4	173.9	175.4
Breusch&Pagan Lagrangian multiplier p	0	0	0	0
R sq within	0.609	0.608	0.748	0.748
R sq between	0.749	0.762	0.715	0.776
R sq overall	0.727	0.737	0.702	0.756

*Table 4.18 reports the effects of derivatives use on firm value where the sample is split between low derivative users and high derivative users with a threshold of 0.05% and 0.19%. The control variables are: leverage, size, market to book, liquidity, managerial discretion, dividend 12-month yield, geographical diversification, industrial diversification and profitability. The explanations of these variables can be found in chapter 3 section 3.3 control variables. The figures in the brackets are t statistics adjusted for heteroscedasticity using the white (1980) method. *** indicates significance at 1%, ** at 5% and *at 10% level.*

As explained in chapter 3 we use equation 17 to test the nonlinear relationship between derivative usage and firm value. The results are presented in table 4.18. The left two columns are where non-users are included, and the right two columns are where non-users are excluded.

4.2.6.1.1 Low derivative users

The coefficient on the extent of derivative where the threshold is 0.97% or less (portfolio 8) is negative but not statistically significant. The coefficient on the extent of derivative use where the threshold is 1.65% or less (portfolio 9 -the optimal portfolio) is positive but not statistically significant at a 10% level. The results where "non-users are excluded" are presented. For the 0.97% threshold, the coefficient is positive but not statistically significant. For the 1.65% threshold, the coefficient is positive but not statistically significant. This results are not within our expectations. Nguyen and Faff, (2010b) reported that Australian firms that were low derivative users (Portfolio 1 and 2) did not experience any effect in value from using derivatives.

4.2.6.1.2 High derivative users

On the other hand, where non-users are included the coefficient on both thresholds are negative but not significant. Where "non-users are excluded" the coefficients for the 0.97% threshold is positive but not statistically significant. The coefficient on the 1.65% threshold is negative but not statistically significant. We have established that the use of derivatives has no significant relationship with the firm value. The increase in the threshold from 0.97% to 1.65% does not seem to give better results. The coefficient increases in size but the strength of its statistical significance does not improve. Nguyen and Faff, (2010b) report that high derivative use is value destructive for firms. According to the author firms

belonging to portfolio, 3 to 10 (high intensity derivative users) had a statistically lower Tobin's Q than that of firms in portfolio 0 (non-derivative users).

4.2.7 Fair value as a measure of extent of derivative use

The results show that there are issues with using the fair value of derivative use as a measure of extent of derivative use. The results of the extent of derivative use measured by (total fair value of derivatives divided by total assets) present a different picture from the results of usage of derivatives measured by (a variable equals one if a firm uses derivatives and zero if a firm does not use derivatives). The fair value of derivative use was used as a proxy to measure the extent/magnitude of derivative use in a firm. The reasoning behind this was that the fair value of derivative use would be able to capture volume of derivative use. The results however show that this assumption does not hold. These conclusions are similar to those of Naito and Laux, (2011) who state that fair value of derivative instruments can only be used as a proxy for the position of the derivative contracts in a firm as it is based from the difference in value between the underlying asset and the face value of the contract. The author states that the fair value is a proxy for the outcomes of a firm's risk exposure. Firms with high gross fair values divided by total assets are more exposed to risk that provide extreme outcomes. The prices of the underlying assets of the firm's derivative contracts deviated from what was expected. The market therefore penalises a firm's value for risk exposures that result in extreme outcomes.

5 Conclusion

This dissertation has examined the extent of derivative use and the effect of derivative use on firm value and firm risk for 91 non-financial firms listed on the FTSE/JSE Africa All share index in the JSE. The study used a balanced panel data over the period 2012 to 2016. As per chapter 1 the following questions have been answered.

5.1.1 Research question 1

What percentage of non-financial firms listed in FTSE/JSE Africa All Shares Index are using derivatives?

On the usage of derivatives, the study finds on average 62% of the firms are using derivatives. The rate of derivative use was at 62% in 2012 and it increased to 65% in 2016. Compared to prior studies focusing on South Africa (e.g. Bartram, Brown and Conrad, 2011; Correia, Holman and Jahreskog, 2012) these results show that fewer firms are using derivatives. However, it should be noted that the sample used by Correia, Holman and Jahreskog, (2012) and Bartram, Brown and Conrad, (2011) had fewer firms. Foreign currency risk is still the most hedged financial risk followed by interest rate risk then commodity price risk. Foreign currency risk was mostly hedged using forwards, interest rate risk was mostly hedged using swaps and commodity price risk was mostly hedged using futures.

5.1.2 Research question 2

Does the usage of derivatives by non-financial firms listed in FTSE/JSE Africa All Shares Index on the Johannesburg stock exchange reduce firm risk significantly?

Overall, this dissertation finds the use of derivatives significantly reduces total risk. However, on examining the different types of derivatives separately (foreign currency derivatives, interest rate derivatives, and commodity price derivatives), the dissertation finds that none of them has a significant effect on firm risk. This is despite the fact that on categorising the derivatives types and examining their effect on firm risk, the dissertation finds that foreign currency derivatives, interest rate derivatives and commodity price derivatives all reduce total risk. However, none of them has a reduction that is statistically significant. This means that firms that use derivatives to solely hedge foreign exchange rate risk, interest rate risk or commodity price risk will not experience a statistically significant reduction in total risk. Therefore, firms must hedge a combination of all of these risks in order to experience a significant reduction in total risk. Of the various types of derivative instruments and how they affect firm risk, the dissertation finds that futures are the only derivative instruments that can reduce firm risk significantly. Swaps and options reduce total risk, however, this reduction is not significant. After breaking down the risks into their various forms, we find that the overall effect of derivatives on firm risk is only significant for unsystematic risk, it is not significant for systematic risk. The effect of

derivatives in reducing systematic risk is only significant when hedging commodity price risk. None of the derivative types (future, swaps and options) has an effect on systematic and non-systematic risk separately.

This dissertation establishes, through portfolio analysis that the relationship between derivative use and total risk is non-linear. Therefore, an increase in the extent of derivative use does not necessarily mean that there will be a reduction in total risk. The results show that there is an optimal level of the extent of derivative use for firms that want to minimise their risk. This optimal level is 0.13% (fair value of derivatives divided by total assets). Firms with the extent of derivative use equal to or less than 0.13% experienced a reduction in total risk and vice versa.

5.1.3 Research question 3

Does the usage of derivatives by non-financial firms listed in FTSE/JSE Africa All Shares Index on the Johannesburg stock exchange enhance firm value significantly?

On the effect of derivative use on firm value, we find that they do not have a significant effect. The results are persistent even after analysis of the different derivatives types (foreign currency derivatives, interest rate derivatives and commodity price derivatives) and derivative instruments (futures, options, swaps and forwards).The results show that using derivatives does not affect firm value.

This dissertation establishes through portfolio analysis that the relationship between derivative use and firm value is non-linear. This means that increasing the extent of derivative use in a firm will not necessarily increase firm value. The results show that there is an optimal level of the extent of derivative use for firms that want to maximise their firm value. This optimal level is 1.65 % (fair value of derivatives divided by total assets). Firms that exceed this level of derivative use will experience a reduction in firm risk.

5.1.4 Limitations and recommendation for further studies

This dissertation suffered certain limitations that are important to highlight. The first limitation is the assumption that the South African market is strong form efficient. This dissertation has assumed that the market and all its participants are rational and that the market prices are an indication of all publicly available information.

The second limitation was data regarding derivative use amongst South African firms. The data of derivative use was collected manually from annual financial statements. There was an absence of uniformity concerning financial statement disclosures, and therefore different firm disclosed the information on derivative use differently. Consequently, there was a possibility that firms could be classified incorrectly. However, the incorrect classification would not result in a significant bias. According to Finavker, (2014) the misclassification of firms that use derivatives and those that do not would have a similar occurrence. In addition, Due to unavailability of data concerning the notional

value of derivative use this dissertation could not have concise investigations on the intensity of derivative use. Instead, this dissertation opted to use fair value amounts, which were reported for most of the firms that used derivatives.

The final limitation is that this dissertation dissects derivative use into three types of derivatives according to the risk being hedged: foreign currency derivatives, interest rate derivatives and commodity price derivative. In reality, there are more risks that firms hedge using derivatives. This dissertation goes a step further to investigate derivative instruments namely: futures, options and swaps. This dissertation did not, however, investigate these derivative instruments under the broad categories of foreign currency derivatives, interest rate derivatives and commodity price derivative. The derivatives instruments were investigated on their own and this dissertation did not make a distinction of whether the instruments fell under the broad categories of foreign currency derivatives, interest rate derivatives or commodity price derivatives. This dissertation assumes that the effect from the use of these categories of derivatives is uniform.

This dissertation gives further recommendations on further research based on the limitations mentioned in the previous paragraph. Further research could be done based on detailed data on the types of derivative instruments under the broad categories of foreign currency risk, interest rate risk and commodity price risk. This will provide a detailed explanation on which type of derivative instruments are most effective in value enhancement and risk reduction under each broad category (foreign currency derivatives, interest rate derivatives and commodity price derivatives). This dissertation makes use of market variables to measure risk and value. More research could also be done using a different measure of firm risk and firm value. For instance, the use of other variables like cash flow volatility, to represent the firm risk and the use of market to book ratio to represent firm value.

Overall, this paper has some important implications on how different stakeholders assess the use of derivatives by firms. It suggests that derivative use is done for hedging purposes. Even though the use of derivatives does not yield a significant valuation premium for the firms, it provides a sound economic reduction in firm risk.

List of References

Adelegan, O.J., 2009. The derivatives market in South Africa: Lessons for sub-Saharan African countries (No. 9-196). International Monetary Fund.

Ahmed, H., Azevedo, A. and Guney, Y., 2014. The effect of hedging on firm value and performance: Evidence from the nonfinancial UK firms. European Financial Management Association, 44.

Alam, A. and Afza, T., 2017. Impact of derivative usage on firm's risk and value: A comparative analysis of Pakistan and Malaysia. Argumenta Oeconomica, 1(38), pp.221-242.

Alkebäck, P., Hagelin, N. and Pramborg, B., 2006. Derivative usage by non-financial firms in Sweden 1996 and 2003: what has changed?. Managerial Finance, 32(2), pp.101-114.

Allayannis, G. and Ofek, E., 2001. Exchange rate exposure, hedging, and the use of foreign currency derivatives. Journal of international money and finance, 20(2), pp.273-296.

Allayannis, G. and Weston, J.P., 2001. The use of foreign currency derivatives and firm market value. The review of financial studies, 14(1), pp.243-276.

Allayannis, G., Lel, U. and Miller, D.P., 2012. The use of foreign currency derivatives, corporate governance, and firm value around the world. Journal of International Economics, 87(1), pp.65-79.

Allayannis, G., Lel, U., andMiller, D. P., 2009. Corporate governance and the hedging premium around the world. In Working paper, No. 03-10, Darden Business School.

Allayannis, G., Weston, J., 2003. Earning volatility, cash flow volatility and firm value. Working Paper,University of Virginia.

Ameer, R., 2009. Value-relevance of foreign-exchange and interest-rate derivatives disclosure: The case of Malaysian firms. The Journal of Risk Finance, 10(1), pp.78-90.

Baltagi, B.H., 1995. Econometric analysis of panel data (Vol. 2). New York: Wiley.

Bartram, S.M., 2019. Corporate hedging and speculation with derivatives. Journal of Corporate Finance, 57, pp.9-34.

Bartram, S.M., Brown, G.W. and Conrad, J., 2011. The effects of derivatives on firm risk and value. Journal of Financial and Quantitative Analysis, 46(4), pp.967-999.

Bartram, S.M., Brown, G.W. and Fehle, F.R., 2009. International evidence on financial derivatives usage. Financial management, 38(1), pp.185-206.

Baxter, R., 2009. The global economic crisis and its effect on South Africa and the country's mining industry. Challenges for monetary policy-makers in emerging markets, pp.105-116.

Bessembinder, H., 1991. Forward contracts and firm value: Investment incentive and contracting effects. Journal of Financial and quantitative Analysis, 26(4), pp.519-532.

Bloomberg.2018. Bloomberg - Are you a robot? [Online] Available at: https://www.bloomberg.com/quote/JALSH:IND [Accessed 29 April. 2018].

Bodnar, G.M. and Gebhardt, G., 1998. Derivatives usage in risk management by US and German non-financial firms: a comparative survey. Journal of International Financial Management & Accounting, 10(3), pp.153-187.

Bodnar, G.M., Hayt, G.S. and Marston, R.C., 1998. 1998 Wharton survey of financial risk management by US non-financial firms. Financial management, pp.70-91.

Bodnar, G.M., Hayt, G.S., Marston, R.C. and Smithson, C.W., 1995. Wharton survey of derivatives usage by US non-financial firms. Financial management, 24(2), pp.104-114.

Buffett, W., 2003. Warren Buffett's Letters to Berkshire Shareholders 1977–2002. (February 21, Available at http://www.berkshirehathaway.com/letters/2002.html. (Accessed 4 June 2018)).

Callahan, M., 2002. To Hedge or Not to Hedge… That Is the Question Empirical Evidence from the North American Gold Mining Industry 1996–2000. Financial Markets, Institutions & Instruments, 11(4), pp.271-288.

Campbell, J.Y., Hilscher, J. and Szilagyi, J., 2008. In search of distress risk. The Journal of Finance, 63(6), pp.2899-2939.

Carter, D., Pantzalis, C. and Simkins, B.J., 2001. Firm wide risk management of foreign exchange exposure by US multinational corporations. Oklahoma State University working paper.

Carter, D., Rogers, D.A. and Simkins, B.J., 2004. Does fuel hedging make economic sense? The case of the US airline industry. The Case of the Us Airline Industry (September 16, 2002). AFA.

Chung, K.H. and Pruitt, S.W., 1994. A simple approximation of Tobin's q. financial management, pp.70-74.

Correia, C., Holman, G. and Jahreskog, A., 2012. The corporate use of derivatives: a survey of South Africa's large listed non-financial firms. South African Journal of Accounting Research, 26(1), pp.67-94.

Daves, P.R., Ehrhardt, M.C. and Kunkel, R.A., 2000. Estimating systematic risk: the choice of return interval and estimation period. journal of Financial and Strategic Decisions, 13(1), pp.7-13.

DeMarzo, P.M. and Duffie, D., 1995. Corporate incentives for hedging and hedge accounting. The review of financial studies, 8(3), pp.743-771.

Errunza, V.R. and Senbet, L.W., 1981. The effects of international operations on the market value of the firm: Theory and evidence. The Journal of Finance, 36(2), pp.401-417.

Fama, E.F. and French, K.R., 1998. Taxes, financing decisions, and firm value. The Journal of Finance, 53(3), pp.819-843.

Finavker, V., 2014. The effects of derivatives on firm financial risk: an analysis of UK non-financial firms(Doctoral dissertation, Middlesex University).

Froot, K.A., Scharfstein, D.S. and Stein, J.C., 1993. Risk management: Coordinating corporate investment and financing policies. the Journal of Finance, 48(5), pp.1629-1658.

Geczy, C., Minton, B.A. and Schrand, C., 1997. Why firms use currency derivatives. the Journal of Finance, 52(4), pp.1323-1354.

Graham, J.R. and Rogers, D.A., 2002. Do firms hedge in response to tax incentives?. The Journal of finance, 57(2), pp.815-839.

Guay, W. and Kothari, S.P., 2003. How much do firms hedge with derivatives?. Journal of Financial Economics, 70(3), pp.423-461.

Guay, W.R., 1999. The effect of derivatives on firm risk: An empirical examination of new derivative users1. Journal of Accounting and Economics, 26(1-3), pp.319-351.

Hann, R.N., Ogneva, M. and Ozbas, O., 2013. Corporate diversification and the cost of capital. The journal of finance, 68(5), pp.1961-1999.

Hausman, J.A., 1978. Specification tests in econometrics. Econometrica: Journal of the econometric society, pp.1251-1271.

Hawawini, G., 1983. Why beta shifts as the return interval changes. Financial analysts journal, pp.73-77.

Hentschel, L. and Kothari, S.P., 2001. Are corporations reducing or taking risks with derivatives?. Journal of Financial and Quantitative Analysis, 36(1), pp.93-118.

Hirsch, B.T. and Seaks, T.G., 1993. Functional form in regression models of Tobin's q. The Review of Economics and Statistics, pp.381-385.

Holman, G., Correia, C., Pitt, L., & Majoni, A.,2013. The corporate use of derivatives by listed non-financial firms in Africa. Corporate Ownership & Control, 11(1-7), 671-690.

Hsiao, C., 2003. Analysis of panel data, 2nd. Cambridge: Cambridge University Press. Kose, Ma, Es Prasad, & Me Terrones (2003), Financial integration and macroeconomic volatility, Imf Staff Papers, 50, pp.119-142.

Jacobs, A., 2011. An investigation into the use of derivatives by the 2nd 100 largest listed companies in South Africa (Doctoral dissertation, University of Cape Town).

Jafarinejad, M., Ngo, T. and Escobari, D., 2018. Disentangling the impacts of industrial and global diversification on firm risk. Global Finance Journal, 37, pp.39-56.

Jensen, M.C. and Meckling, W.H., 1976. Theory of the firm: Managerial behaviour, agency costs and ownership structure. Journal of financial economics, 3(4), pp.305-360.

Jensen, M.C., 1986. Agency costs of free cash flow, corporate finance, and takeovers. The American economic review, 76(2), pp.323-329.

Jin, Y. and Jorion, P., 2006. Firm value and hedging: Evidence from US oil and gas producers. The Journal of Finance, 61(2), pp.893-919.

Jse.co.za. 2018. The reporting of financial results – Johannesburg Stock Exchange (JSE). [online] Available at: https://www.jse.co.za/grow-my-wealth/results [Accessed 21 May 2018].

Júnior, J.L.R., 2007. The use of currency derivatives by Brazilian companies: an empirical investigation. Brazilian Review of Finance, 5(2), pp.205-232.

Kamphius, R.,2013. What are the effects of derivatives on firm risk? An empirical study on S&P 500 manufacturing firms for the years 2007-2009 (Masters dissertation. Tilburg university).

Khediri, K.B., 2010. Do investors really value derivatives use? Empirical evidence from France. The Journal of Risk Finance.

Kogut, B. and Kulatilaka, N., 1994. Operating flexibility, global manufacturing, and the option value of a multinational network. Management science, 40(1), pp.123-139.

Lang, L.H. and Stulz, R.M., 1994. Tobin's q, corporate diversification, and firm performance. Journal of political economy, 102(6), pp.1248-1280.

Lantara, I.W.N., 2012. The Use of Derivatives as a Risk Management Instrument: Evidence from Indonesian Non-Financial Firms. International Journal of Business & Economics, 11(1).

Lau, C.K., 2016. How corporate derivatives use impact firm performance?. Pacific-Basin Finance Journal, 40, pp.102-114.

Leland, H.E., 1998. Agency costs, risk management, and capital structure. The Journal of Finance, 53(4), pp.1213-1243.

Lenox, M.J., Rockart, S.F. and Lewin, A.Y., 2010. Does interdependency affect firm and industry profitability? An empirical test. Strategic Management Journal, 31(2), pp.121-139.

Gómez-González, J.E., León Rincón, C.E. and Leiton Rodríguez, K.J., 2012. Does the use of foreign currency derivatives affect firms' market value? Evidence from Colombia. Emerging Markets Finance and Trade, 48(4), pp.50-66.

Lewellen, W.G., 1971. A pure financial rationale for the conglomerate merger. The journal of Finance, 26(2), pp.521-537.

Lin, R. and Chang, Y., 2009. Does hedging add value? Evidence from the global airline industry, Working Paper Series, National Chengchi University.

Lookman, A., 2004, September. Does hedging increase firm value? Evidence from oil and gas producing firms. In EFA 2004 Maastricht Meetings, Paper (No. 5174).

Marin, M., 2013. Can financial risk management help prevent bankruptcy?. Journal of Finance and Accountancy, 12, p.1.

Merton, R.C., 1974. On the pricing of corporate debt: The risk structure of interest rates. The Journal of finance, 29(2), pp.449-470.

Mlambo, C. and Biekpe, N., 2007. The efficient market hypodissertation: Evidence from ten African stock markets. Investment Analysts Journal, 36(66), pp.5-17.

Modack, G., 2011. " An investigation into the use of derivatives by the 100 largest companies listed on the main board of the JSE Securities Exchange, South Africa. *University of Cape Town*.

Modigliani, F. and Miller, M.H., 1958. The cost of capital, corporation finance and the theory of investment. The American economic review, 48(3), pp.261-297.

Morck, R. and Yeung, B., 1991. Why investors value multinationality. Journal of Business, pp.165-187.

Morck, R., Shleifer, A. and Vishny, R.W., 1988. Management ownership and market valuation: An empirical analysis. Journal of financial economics, 20, pp.293-315.

Myers, S.C., 1977. Determinants of corporate borrowing. Journal of financial economics, 5(2), pp.147-175.

Naito, J. and J. Laux., 2011. Derivatives Usage: Value-Adding or Destroying? Journal of Business & Economics Research, Volume 9, Number 11, 41-50.

Nance, D.R., Smith Jr, C.W. and Smithson, C.W., 1993. On the determinants of corporate hedging. The journal of Finance, 48(1), pp.267-284.

Nguyen, H. and Faff, R., 2007. Are Financial Derivates Really Value Enhancing? Australian Evidence (No. 2007_14). Deakin University, Faculty of Business and Law, School of Accounting, Economics and Finance.

Nguyen, H. and Faff, R., 2010. Does the type of derivative instrument used by companies effect firm value? Applied Economics Letters, 17(7), pp.681-683.

Nguyen, H. and Faff, R., 2010a. Are firms hedging or speculating? The relationship between financial derivatives and firm risk. Applied Financial Economics, 20(10), pp.827-843.

Nova, M., Cerqueira, A. and Brandão, E., 2015. Hedging With Derivatives and Firm Value: Evidence for the nonfinancial firms listed on the London Stock Exchange.

Pitt, L.J., 2011. An investigation into the use of derivative by 104 of the smallest companies on the main board of the JSE as well as those companies listed on the ALTX (Masters dissertation, University of Cape Town).

Pramborg, B., 2004. Derivatives hedging, geographical diversification, and firm market value. Journal of Multinational Financial Management, 14(2), pp.117-133.

Sharma, A., Branch, B.S., Chawla, C. and Qiu, L., 2013. Explaining Market to Book: The Relative Effect of Firm Performance, Growth, and Risk. Business Quest: http://www. westga. edu/~ bquest/2013/research2013.

Smith, C.W. and Stulz, R.M., 1985. The determinants of firms' hedging policies. Journal of financial and quantitative analysis, 20(4), pp.391-405.

Smithson, C. and Simkins, B.J., 2005. Does risk management add value? A survey of the evidence. Journal of Applied Corporate Finance, 17(3), pp.8-17.

Smith, G., Jefferis, K. and Ryoo, H.J., 2002. African stock markets: multiple variance ratio tests of random walks. Applied Financial Economics, 12(7), pp.475-484.

Stulz, R.M., 1984. Optimal hedging policies. Journal of Financial and Quantitative analysis, 19(2), pp.127-140.

Stulz, R.M., 1996. Rethinking risk management. Journal of applied corporate finance, 9(3), pp.8-25.
Titman, S. and Wessel, R., 1988. The Determinants of Capital Structure Choice: The Journal of Finance, Vol XLIII (1), March.

Stulz, R.M., 2004. Should we fear derivatives?. *Journal of Economic Perspectives*, *18*(3), pp.173-192.

Titman, S., 1992. Interest rate swaps and corporate financing choices. The Journal of Finance, 47(4), pp.1503-1516.

Tufano, P., 1996. Who manages risk? An empirical examination of risk management practices in the gold mining industry. the Journal of Finance, 51(4), pp.1097-1137.

Wernerfelt, B. and Montgomery, C.A., 1988. Tobin's q and the importance of focus in firm performance. The American Economic Review, pp.246-250.

Yakup, S. & Asli, T., 2010. Derivatives Usage in Risk Management by Turkish Non-Financial Firms and Banks: A Comparative Study. Annales Universitatis Apulensis Series Oeconomica,12, 2, 1-10.

Yücel, E. and Önal, Y.B., 2016. Industrial diversification and performance in an emerging market. Panoeconomicus, 63(4), pp.441-454.

Zhou, V.Y. and Wang, P., 2013. Managing foreign exchange risk with derivatives in UK non-financial firms. International Review of Financial Analysis, 29, pp.294-302.

Appendices

Appendix A

Table 0-1 Variable summary

Variable	Proxy	Expected Sign for Firm Risk	Expected Sign for Firm Value
Derivative Dummy	Dummy variable with value of one if the firm uses derivatives and 0 if a firm does not use derivatives	-	+
Extent Derivative use	Extent of derivative usage (Total value of derivative used divided by firm size.)	-	+
FCD	Foreign currency derivative	-	+
Extent of FCD	Extent of FCD usage (Total value of foreign currency derivative used divided by firm size (total assets)	-	+
IRD	Interest rate derivatives	-	+
Extent of IRD	Extent of IRD usage (Total value of IRD derivative used divided by firm size (total assets)	-	+
CD	Commodity derivatives	-	+
Extent of CD	Extent of CD usage (Total value of Commodity price derivatives used divided by firm size (total assets)	-	+
Forward	Forward derivative instrument	-	+
Extent of Forward	Extent of forward usage (Total value of forward derivative used divided by firm size (total assets)	-	+
Future	Future derivative instrument	-	+
Extent of future	Extent of futures usage (Total value of futures derivative used divided by firm size (total assets)	-	+
Swap	Swap derivative instrument	-	+
Extent of swap	Extent of swaps usage (Total value of swaps derivative used divided by firm size (total assets)	-	+
Option	Options derivative instrument	-	+
Extent of option	Extent of option usage (Total value of option derivative used divided by firm size (total assets)	-	+
Leverage	Leverage (total debt/ total equity)	-	-
Size	Size (log of total assets)	-	?
Market to Book	Market Capitalization / Book Value		+
Liquidity	Liquidity ratio/ current ratio calculated as: Current Assets / Current Liabilities	-	+
Managerial Discretion	Managerial discretion Executive stock ownership measured by Percentage Insider Shares Outstanding Percentage of outstanding shares currently held by insiders	-	+
Dividend Yield	Dividend yield (dividend yield/ price per share) Sum of dividend per share amounts that have gone ex-dividend over the prior 12 months, divided by the current stock price	-	+
Profitability	Return on assets (Ratio net income to total assets) Calculated as:	-	+

	(Trailing 12M Net Income / Average Total Assets) * 100		
Geographical Diversification	Ratio of Foreign sales to total sales	-	+
Industrial Diversification	Industrial diversification with a dummy variable that equals one for firms deriving revenue from more than one industry and zero for otherwise	-	+/-
D_{Si} Firm risk	Dummy variable equals one if derivative use is 0.09%/0.13% or less and zero if otherwise		
D_{Li} Firm risk	Dummy variable equals to one if derivative use is 0.97%/1.65% or more and zero if otherwise		
D_{Si} Firm value	Dummy variable equals one if derivative use is 0.97%/ 1.65% or less and zero if otherwise		
D_{Li} Firm Value	Dummy variable equals to one if derivative use is 0.97%/1.65% or more and zero if otherwise		
FR- Firm risk	The variation in market variables: standard deviation of share price returns and the standard deviation of the firm's volatility measured as a ratio of a firms share price returns standard deviation to the standard deviation of the returns of the FTSE/JSE Africa All Share Index. Total risk = systematic risk + unsystematic risk.		
FV-Fair value	Tobin's Q = (Equity market value + total debt book value + book value of preference shares)/ (total assets)		
Ln Tobin's Q	natural log of Tobin's Q		

Appendix B

Table 0-2 Presents a list of firms included in this study

	Name	Market Cap	Price:D-1	P/E	Total Return YTD	Revenue T12M	EPS T12M
	Investable Universe (101)	10.06T	14263.72	26.26	-0.99	7.56T	996.06
1	BHP BILLITON PLC	153.87T	27441	24.53	12.6	54.95T	1.17k
2	BRITISH AMERICAN TOBACCO PLC	152.45T	66468	2.28	-18.89	35.05T	29.97k
3	NASPERS LTD-N SHS	133.41T	303500	94.41	-12.05	8.36T	10.80k
4	GLENCORE PLC	88.51T	6136	12.23	-2.87	273.51T	537.29
5	FINANCIÈRE RICHEMONT-DEP REC	68.63T	11952	27.48	6.95	16.50T	4.32k
6	ANGLO AMERICAN PLC	38.29T	29628	9.62	18.49	34.95T	3.31k
7	SASOL LTD	29.28T	45300	11.95	7.11	17.57T	3.04k
8	VODACOM GROUP LTD	26.18T	15211	16.49	4.41	8.31T	706.65
9	MTN GROUP LTD	24.21T	12850	70.6	-2.35	13.28T	245.88
10	MONDI LTD	15.88T	32883	15.11	9.77	10.67T	2.08k
11	MONDI PLC	15.88T	32977	15.98	10.03	10.67T	2.08k
12	SHOPRITE HOLDINGS LTD	14.37T	24300	22.55	10.74	14.55T	1.06k
13	REMGRO LTD	12.54T	22199	15.94	-5.11	2.71T	1.30k

14	ASPEN PHARMACARE HOLDINGS LT	12.07T	26452	17.77	-4.68	4.33T	1.31k
15	DISCOVERY LTD	11.21T	17335	22.19	-6.28	5.56T	781.18
16	ANGLO AMERICAN PLATINUM LTD	9.41T	34895	23.29	-0.32	6.57T	741.13
17	KUMBA IRON ORE LTD	9.10T	28250	9.21	-22.05	4.64T	3.86k
18	BIDVEST GROUP LTD	8.12T	24082	20.74	11.69	7.49T	1.40k
19	MR PRICE GROUP LTD	7.36T	27253	27.41	11.3	1.91T	963.03
20	TIGER BRANDS LTD	7.08T	37279	17.26	-17.67	3.13T	1.91k
21	WOOLWORTHS HOLDINGS LTD	6.55T	6250	16.16	-2.59	6.85T	-284.26
22	CLICKS GROUP LTD	5.33T	21000	36.64	17.44	2.81T	579.29
23	THE FOSCHINI GROUP LTD	4.95T	20902	19.34	7.86	2.46T	1.09k
24	IMPERIAL HOLDINGS LTD	4.56T	22650	16.88	-12.48	12.37T	1.33k
25	SAPPI LIMITED	4.55T	8160	11.36	-6.84	7.08T	770.82
26	TRUWORTHS INTERNATIONAL LTD	4.50T	10180	15.83	10.57	1.81T	647.38
27	ANGLOGOLD ASHANTI LTD	4.50T	10900	442.85	-14.7	5.80T	-621.83
28	ASSORE LTD	4.45T	31900	6.13	-8.6	636.22B	5.09k
29	NETCARE LTD	4.45T	3024	27.53	22.93	3.41T	-40.25
30	LIFE HEALTHCARE GROUP HOLDING	4.22T	2880	37.33	5.52	2.08T	56.48
31	EXXARO RESOURCES LTD	4.18T	11650	18.86	-18.68	2.28T	1.93k
32	GOLD FIELDS LTD	3.99T	4852	14.88	-9.37	3.68T	-24.61
33	PICK N PAY STORES LTD	3.94T	8070	28.92	16.01	8.16T	274.86
34	SPAR GROUP LIMITED/THE	3.90T	20261	21.36	-0.35	9.55T	945.4
35	AVI LTD	3.86T	10984	20.88	0.94	1.34T	500.13
36	BARLOWORLD LTD	3.44T	16158	18.47	2.93	6.20T	779.69
37	MASSMART HOLDINGS LTD	3.43T	15801	22.99	15.1	9.37T	702.51
38	DISTELL GROUP LTD	3.02T	13573	19.95	-3.21	2.32T	630.32
39	TELKOM SA SOC LTD	2.89T	5646	8.14	17.33	4.08T	707.08
40	TSOGO SUN HOLDINGS LTD	2.68T	2331	10.36	-4.31	1.33T	276.03
41	PIONEER FOODS GROUP LTD	2.65T	11325	28.27	-15.74	1.96T	390.51
42	AFRICAN RAINBOW MINERALS LTD	2.29T	10442	5.79	-20.17	793.70B	1.78k
43	KAP INDUSTRIAL HOLDINGS LTD	2.29T	856	15.29	7.67	2.22T	53.63
44	NORTHAM PLATINUM LTD	2.07T	4057		-22.38	675.96B	-198.1
45	ITALTILE LTD	1.94T	1439	16.59	-0.94	442.00B	86.76
46	RCL FOODS LTD/SOUTH AFRICA	1.76T	1875	20.74	24.33	2.46T	99.13
47	IMPALA PLATINUM HOLDINGS LTD	1.57T	2142		-33.97	3.59T	-1.12k
48	REUNERT LTD	1.50T	8113	12.04	18.2	977.30B	678.05
49	AECI LTD	1.45T	11933	12.51	22.99	1.85T	900.69
50	PPC LTD	1.41T	886	72.92	27.12	967.30B	19.41

51	HOSKEN CONS INVESTMENTS LTD	1.36T	14700	10.73	5.76	2.38T	1.64k
52	ASTRAL FOODS LTD	1.35T	31545	16.61	21.68	1.24T	1.95k
53	SUPER GROUP LTD	1.35T	3631	12.49	-12.19	3.37T	294.21
54	CURRO HOLDINGS LTD	1.30T	3150	64.51	-25.71	209.81B	54.17
55	ADCOCK INGRAM HOLDINGS LTD	1.25T	7107	34.18	23.32	615.66B	356.52
56	OCEANA GROUP LTD	1.17T	8621	21.31	1.42	680.79B	401.26
57	HARMONY GOLD MINING CO LTD	1.16T	2602		14.68	1.60T	-889
58	BLUE LABEL TELECOMS LTD	1.15T	1220	6.04	-18.23	2.66T	203.63
59	TONGAAT HULETT LTD	1.13T	8397	9.77	-26.11	1.75T	927.88
60	FAMOUS BRANDS LTD	1.13T	11300	29.84	9.72	667.02B	194.08
61	GRINDROD LTD	1.13T	1478	19.41	8.28		-77.53
62	AFRICAN OXYGEN LTD	1.06T	3090	15.37	12.33	569.30B	203.61
63	WILSON BAYLY HOLMES-OVCON	1.01T	16057	9.52	4.3	3.46T	1.70k
64	OMNIA HOLDINGS LTD	1.01T	14693	15.27	0.71	1.60T	928.83
65	CASHBUILD LTD	1.01T	40350	21.24	-8.42	996.37B	1.95k
66	NAMPAK LTD	969.81B	1406	11.2	-13.32	1.88T	36.69
67	ADVTECH LTD	862.82B	1585	22.9	-4.84	408.69B	69.1
68	STEINHOFF INTERNATIONAL H NV	818.85B	190	0.42	-59.14	25.45T	489.22
69	CITY LODGE HOTELS LTD	714.61B	16400	21.85	15.3	151.62B	783.07
70	MURRAY & ROBERTS HOLDINGS	679.11B	1527	25.76	26.09	2.26T	55.12
71	TRENCOR LTD	672.86B	3800		-20.83	837.00B	-133.23
72	SUN INTERNATIONAL LTD	657.79B	6030		-0.26	1.56T	-248.23
73	EOH HOLDINGS LTD	587.66B	3850	5.49	-42.91	1.66T	435.05
74	DATATEC LTD	570.96B	2350		-29.3	6.62T	-180.82
75	HUDACO INDUSTRIES LTD	545.50B	15972	12.78	13.58	590.16B	1.25k
76	ALLIED ELECTRONICS COR-A SHR	538.77B	1350	12.62	11.75	1.31T	-37.49
77	INVICTA HOLDINGS LTD	495.71B	4569	9.66	-10.5	873.83B	489.68
78	ROYAL BAFOKENG PLATINUM LTD	476.68B	2375	39.91	-15.18	349.85B	-390.04
79	MPACT LTD	466.14B	2700	16.41	12.2	1.01T	161.78
80	METAIR INVESTMENTS LTD	447.52B	2249	8	8.67	951.67B	281.05
81	LEWIS GROUP LTD	432.78B	4550	11.97	77.82	550.49B	370.59
82	AFRIMAT LTD	414.46B	2893	14.22	-2.59	225.95B	200.85
83	RAUBEX GROUP LTD	390.76B	2150	9.71	7.82	854.22B	233.61
84	CAXTON AND CTP PUBLISHERS AN	380.60B	975	9.17	-18.41	626.79B	101.14
85	CLOVER INDUSTRIES LTD	356.67B	1869	28.95	44.94	914.39B	102.9

86	AFROCENTRIC INVESTMENT CORPO	321.54B	580	21.65	-9.38	401.26B	24.67
87	ARCELORMITTAL SOUTH AFRICA	318.66B	280		-27.65	3.90T	-468.66
88	BRIMSTONE INVESTMENT - N SHS	295.74B	1080	103.67	-0.64	278.34B	67.29
89	PAN AFRICAN RESOURCES PLC	288.27B	129	10	-46.25	253.83B	7.22
90	SPUR CORP LTD	282.16B	2601	21.09	-3.19	64.49B	122.84
91	LONMIN PLC	262.99B	930		-33.95	1.56T	-4.68k
	Average	10.67021T					
	Min	0.26299 T					
	Max	153.87 T					

Appendix C

Table 0-3 Presents the mean, median and mean differences for Interest Rate Derivative Users

Variable	Mean Users	Mean Non-users	Number of users	Number of non-users	Standard deviation users	Standard deviation non-users	Median Users	Median non-users	P-value for mean difference	Mean difference	Significance
Profitability	8.947615969	7.569245203	130	325	13.039288994	8.726926521	7.503159	6.850887	0.268534752	-1.37837077	
Liquidity	1.595918846	1.725853668	130	325	1.006732459	0.931880302	1.319001	1.510156	0.205428854	0.12993482	
Management discretion	1.0160018	1.698209323	130	325	4.682113963	5.2626459	0.0719145	0.125532	0.176878375	0.68220752	
Dividend 12 Month Yield	0.702420292	0.069839889	130	325	4.113026669	0.392025987	0.034465	0.027826	0.082408956	-0.6325804	*
Market to Book	3.685239638	2.970874354	130	325	3.462510525	2.646333598	2.555328	1.979805	0.035469425	-0.71436528	**
Leverage	0.325016123	0.301193052	130	325	2.435593882	0.67373075	0.370427939	0.148142661	0.912685538	-0.02382307	
Size	4.823366855	4.095001157	130	325	0.674926902	0.522764381	4.743074102	4.116142654	2.49269E-22	-0.7283657	***
Geographical Diversification	0.451393599	0.253275048	130	325	0.333847004	0.299519473	0.433359393	0.139680282	1.50034E-08	-0.19811855	***
Industrial diversification	0.438461538	0.470769231	130	325	0.498118104	0.499914523	0	0	0.532989591	0.03230769	
Total risk	0.287123215	0.315012458	130	325	0.093957113	0.143863469	0.268718913	0.279315 76	0.015536659	0.02788924	**
Systematic Risk	0.130175473	0.087056559	130	325	0.071768719	0.075126653	0.120551463	0.066395582	3.18886E-08	-0.04311891	**
Unsystematic risk	0.250033233	0.296586543	130	325	0.082817391	0.137520297	0.233809279	0.261997927	1.28785E-05	0.04655331	**
Tobin's Q	2.003010308	1.881173403	130	325	1.088699936	1.18680337	1.640397 5	1.454765	0.294471934	-0.1218369	

Table 0-4 Presents the mean, median and mean differences for Foreign Currency Derivative users

Variable	Mean Users	Mean Non-users	Number of users	Number of non-users	Standard deviation users	Standard deviation non-users	Median Users	Median non-users	P-value for mean difference	Mean difference	Significance
Profitability	8.825697197	7.096633507	228	227	11.02532149	9.133067398	7.3595795	6.850887	0.05030 1513	-1.72906369	**
Liquidity	1.546876654	1.831207115	228	227	0.885499908	1.001069109	1.3261015	1.654696	0.00105 8644	0.28433046	***
Management discretion	0.775133386	2.234660141	228	227	3.701303227	6.129997143	0.0772295	0.148133	0.00211 1964	1.45952676	***
Dividend 12 Month Yield	0.443391346	0.056913546	228	227	3.146284048	0.151045584	0.0300635	0.027972	0.06489 4253	-0.3864778	*
Market to Book	3.729904289	2.617608546	228	227	3.156429012	2.542228596	2.6833365	1.772821	3.11759 E-06	-1.11229574	***
Firm size	148823.6603	17831.23914	228	227	335639.8086	22835.20348	39969	8380.609	1.44275 E-08	-130992.421	***
Leverage	0.254247487	0.361988594	228	227	1.827415357	0.822764748	0.2992718 38	0.132661552	0.62178 6465	0.10774111	
size	4.635394658	3.969352798	228	227	0.621852281	0.508020448	4.601680 04	3.923275579	5.93854 E-31	-0.66604186	***
Geographical Diversification	0.393895191	0.225495396	228	227	0.337470965	0.282301718	0.3035004444	0.11911 094	6.86659 E-08	-0.1683998	***
Industrial diversification	0.513157895	0.40969 163	228	227	0.50092 657	0.492863578	1	0	0.06683 8421	-0.10346626	
Total risk	0.284594648	0.329592454	228	227	0.090225773	0.160729843	0.2663593 24	0.285183472	0.00056 1281	0.04499781	***
Systematic Risk	0.110764861	0.087937467	228	227	0.067343347	0.083533777	0.1012930 14	0.060294122	9.2294E-07	-0.02282739	***
Unsystematic risk	0.25567373	0.311019102	228	227	0.084334394	0.15242193	0.2381289 16	0.270636813	1.1865E-06	0.05534537	***
Tobin's Q	1.980818145	1.850864137	228	227	1.071221259	1.24129843	1.58827	1.43819	0.05333 2853	-0.12995401	**

Table 0-5 Presents the mean, median and mean differences for Commodity Derivatives

Variable	Mean Users	Mean Non-users	Number of users	Number of non-users	Standard deviation users	Standard deviation NON-USERS	Median Users	Median NON-USERS	P-value for mean difference	Mean difference	Significance
Profitability	6.259057 5	8.231891099	-0.119988235	393	6.422271677	10.60186093	5.5154155	7.295789	0.12876 7762	1.9728336	
Liquidity	1.665784839	1.692349191	4.880011765	393	0.741457394	0.984703586	1.5132455	1.435494	0.60912 7763	0.02656435	
Management discretion	1.899398823	1.440802893	5.880011765	393	6.744937566	4.807014058	0.1203336	0.098676	0.60682 8286	-0.45859593	
Dividend 12 Month Yield	0.110795177	0.272629265	6.880011765	393	0.390812276	2.400320698	0.029835	0.029167	0.37022 2551	0.16183409	
Market to Book	2.271484097	3.317514768	7.880011765	393	1.853244532	3.028294623	1.6491733	2.297705	0.00463 2186	1.0460306 7	***

Leverage	0.282756284	0.311982057	12.88001177	393	0.236503057	1.522707394	0.249752761	0.189919275	0.915715464	0.02922577	
Size	4.672090139	4.244894347	13.88001177	393	0.725003623	0.628271625	4.438803291	4.202052169	4.0621E-07	-0.42719579	***
Geographical Diversification	0.402981792	0.295192589	14.88001177	393	0.357955817	0.314004219	0.271302697	0.175283112	0.003538319	-0.1077892	***
Industrial diversification	0.629032258	0.435114504	15.88001177	393	0.487007287	0.496403956	1	0	0.007269153	-0.19391775	***
Total risk	0.300688125	0.308046827	16.88001177	393	0.125015877	0.133252986	0.262996029	0.274379874	0.508683563	0.0073587	
Systematic Risk	0.1150732	0.096899885	17.88001177	393	0.076452308	0.076457308	0.102611683	0.077574834	0.019221059	-0.01817332	**
Unsystematic risk	0.269390722	0.285477664	18.88001177	393	0.122100584	0.126674188	0.241184517	0.253480028	0.165102518	0.01608694	
Tobin's Q	1.587043419	1.967877873	19.88001177	393	0.782770479	1.201072298	1.319776	1.536758	0.010569438	0.38083445	**

Appendix D

Interaction terms: The effect of interest rate derivative and foreign currency derivative usage on Firm value.

In table 4.17 the extended analysis of the effect of derivative use on firm value. In this part, the interactions terms are examined using equation 18 and 20.

Table 0-6 The Effect of Interest rate derivative Use and Foreign currency derivative Use on Firm Value

Fixed effect

	(2)	**(3)**
VARIABLES	Lntobinq	Lntobinq
Usage IRD	0.00599	
	(0.0356)	
c.Usage IRD #c.Leverage	-0.0268	
	(0.0180)	
Usage FCD		0.0364
		(0.0467)
c.Usage FCD#c.Geographical Diversification		0.0516
		(0.0813)
Leverage	0.113***	0.0903***
	(0.0184)	(0.00756)
Size	-1.97e-07	-1.60e-07
	(1.38e-07)	(1.40e-07)
Investment Growth	0.116***	0.115***
	(0.00672)	(0.00674)
Liquidity	0.0108	0.0135
	(0.0133)	(0.0133)
Managerial Discretion	-0.00208	-0.00143

	(0.00215)	(0.00222)
Dividend 12 Month Yield	0.00105	0.00154
	(0.00578)	(0.00590)
Geographical Diversification	0.122*	0.0986
	(0.0683)	(0.0745)
Profitability	0.00657***	0.00638***
	(0.00105)	(0.00106)
Year2013	0.0163	0.0152
	(0.0210)	(0.0210)
Year2014	-0.00383	-0.00301
	(0.0213)	(0.0212)
Year2015	-0.0509**	-0.0536**
	(0.0220)	(0.0220)
Year2016	-0.0436**	-0.0409*
	(0.0221)	(0.0221)
Constant	0.0313	0.0152
	(0.0446)	(0.0500)
Observations	455	455
R-squared	0.577	0.578
Number of Company I.D	91	91
R sq within	0.577	0.578
R sq between	0.746	0.749
R sq overall	0.719	0.722
Model 1=FE; 2=RE	1	1
Hausman Chi2	49.04	47.08
Hausman p	0%	0%
Breusch&Pagan Lagrangian multiplier chi2	304.3	312.3
Breusch&Pagan Lagrangian multiplier p	0	0

*Table 4.17 shows the effects of, foreign currency derivative use, IRD derivative on Firm value measures. This table presents the results of interest rate derivative use on firm value for firms that have a greater inherent interest rate exposure and foreign currency derivatives for firms that have high geographical diversification. The interactive variables are interest rate derivative USE*Leverage and foreign currency derivatives and geographical diversification. The control variables are, size, market to book, liquidity, managerial discretion, dividend 12-month yield, industrial diversification and profitability. The explanations of these variables can be found in chapter 3 section 3.3 control variables. Derivative use is a dummy variable equal to '1' if a firm uses derivatives and '0' if a firm does not use derivatives. Usage FCD is a dummy variable of '1' if a firm uses foreign currency derivatives and '0' if a firm does not use foreign currency derivatives. Usage IRD is a dummy variable of '1' if a firm uses interest rate derivatives and '0' if a firm does not use interest rate derivatives. Usage CD is a dummy variable of '1' if a firm uses commodity price derivatives and '0' if a firm does not use commodity price derivatives. . The figures in the brackets are t statistics adjusted for heteroscedasticity using the white (1980) method*** indicates significance at 1%, ** at 5% and *at 10% level.*

Column 1 presents the results for the interest rate derivatives interaction terms. According to the results, the use of interest rate derivatives is associated with an increase in firm value for firms with higher leverage. However, this is not statistically significant. The coefficient of the interactive variable is negative. However, this is not statistically significant. Comparing to the Australian study of Nguyen and Faff, (2010b) we find slightly different results. The use of interest rate derivatives amongst firms with higher leverage is associated with a valuation penalty. The interactive variable was also not statistically or economically significant.

Column 2 presents the results for the foreign currency derivatives interaction terms. According to the results, the use of foreign currency derivatives is associated with an increase in firm value for firms with higher geographic diversification. However, this is not significant. The coefficient of the interactive variable is positive. However, this is not statistically significant. Comparing to the Australian study of Nguyen and Faff, (2010b) we find slightly different results. The use of foreign currency derivatives did not exhibit any statistical relationship with firm value. Similarly, the author reported that the interactive variable was neither statistically nor economically significant.

Interaction terms: The effect of the extent of interest rate and foreign currency derivatives use on firm value

In table 4.18 the extended analysis of the effect of derivative use on firm value. In this part, the interactions terms are examined using equation 20 and 21.

Table 0-7 The Effect of the Extent of Interest rate derivative Use and the Extent of Foreign currency derivatives on Firm Value Measures

Extent fixed effect

	(2)	**(3)**
VARIABLES	Lntobinq	Lntobinq
Extent IRD	4.964***	
	(1.135)	
c.Extent IRD #c.Leverage	-13.60***	
	(2.839)	
Extent FCD		-0.557
		(1.774)
c.Extent FCD#c.Geographical Diversification		1.708
		(5.588)
Leverage	0.110***	0.0902***
	(0.00836)	(0.00834)
Size	-2.31e-08	-2.02e-07
	(1.39e-07)	(1.39e-07)
Investment Growth	0.127***	0.116***

	(0.00688)	(0.00664)
Liquidity	0.00968	0.00957
	(0.0130)	(0.0134)
Managerial Discretion	-0.00146	-0.00222
	(0.00208)	(0.00215)
Dividend 12 Month Yield	0.000728	0.00137
	(0.00556)	(0.00582)
Industrial diversification	-	-
Geographical Diversification	0.140**	0.118*
	(0.0662)	(0.0687)
Profitability	0.00611***	0.00642***
	(0.00102)	(0.00105)
Year2013	0.0141	0.0156
	(0.0204)	(0.0210)
Year2014	-0.00978	-0.00404
	(0.0206)	(0.0213)
Year2015	-0.0532**	-0.0514**
	(0.0213)	(0.0219)
Year2016	-0.0463**	-0.0452**
	(0.0214)	(0.0221)
Constant	-0.00831	0.0440
	(0.0434)	(0.0433)
Observations	454	454
R-squared	0.604	0.578
Number of Company I.D	91	91
R sq within	0.604	0.578
R sq between	0.772	0.748
R sq overall	0.746	0.721
Model 1=FE; 2=RE	1	1
Hausman Chi2	50.10	47.17
Hausman p	0%	0%
Breusch&Pagan Lagrangian multiplier chi2	292.6	301.9
Breusch&Pagan Lagrangian multiplier p	0	0

*Table 4.18 shows the effects of, foreign currency derivative use, IRD derivative on Firm value measures. This table presents the results of interest rate derivative use on firm value for firms that have a greater inherent interest rate exposure and foreign currency derivatives for firms that have high geographical diversification. The interactive variables are the extent of interest rate derivative USE*Leverage and the extent of foreign currency derivatives and geographical diversification. The control variables are, size, market to book, liquidity, managerial discretion, dividend 12-month yield, industrial diversification and profitability. The explanations of these variables can be found in chapter 3 section 3.3 control variables. Extent of interest rate derivatives is the total fair values of interest rate derivatives divided by total assets; Extent of commodity price derivatives is the total*

*fair values of commodity price derivatives divided by total assets. The figures in the brackets are t statistics adjusted for heteroscedasticity using the white (1980) method*** indicates significance at 1%, ** at 5% and *at 10% level.*

This study incorporates a continuous variable (the extent of derivative use).The results in table 4.23 show that the use of interest rate derivatives has a positive effect on firm value. An increase in interest rate derivatives will lead to an increase in the firm value of 4.964%. This is statistically significant at a 1% level. The coefficient of the interactive variable is negative. It is statistically significant at a 1% level. The use of interest rate derivatives by firms with higher leverage seems to attract a valuation premium from the market. Nguyen and Faff, (2010b) also report that for Australian firms the use of interest rate derivatives is not value enhancing.

When the continuous variable for the extent of use of foreign currency derivatives is used, the results show that foreign currency derivatives reduce firm value. However, this is not statistically significant. The coefficient of the interactive variable is positive. However, this is not statistically significant. Nguyen and Faff, (2010b) report that when the continuous variable is used the results exhibit no statistical relationship with firm value. The author conclude the use of foreign currency derivatives by firms in Australia have no effect on firm value. Firms that exceeded this level of extent of derivative use experienced an increase in risk as they increased their intensity of derivative use.