THE IMPACT OF SINGLE STOCK FUTURES ON THE SOUTH AFRICAN EQUITY MARKET

by

JOHANNES SCHEEPERS DE BEER

submitted in fulfilment of the requirements for the degree of

MASTER OF COMMERCE

in the subject

BUSINESS MANAGEMENT

at the

UNIVERSITY OF SOUTH AFRICA

Supervisor: **PROF J MARX**

NOVEMBER 2008

DECLARATION

Student number: **3449-635-1**

I declare that **THE IMPACT OF SINGLE STOCK FUTURES ON THE SOUTH AFRICAN EQUITY MARKET** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Signature
(JS De Beer)

Date

ACKNOWLEDGEMENTS

I acknowledge the contribution of the following people:

Professor Johan Marx, my supervisor, for his guidance and support that enabled me to complete this study.

Ms Karabelo Pooe and the late Ms Faeza Sallie at the JSE Limted (Safex), providing me with the data on single stock futures.

Ms Cecilia du Plessis for her assistance with a literature search on the various library databases.

Ms Sandra Mills for the editing of my dissertation.

SUMMARY

The introduction of single stock futures to a market presents the opportunity to assess an individual company's response to futures trading directly, in contrast to the market-wide impact obtained from index futures studies. Thirty-eight South African companies were evaluated in terms of a possible price, volume, and volatility effect due to the initial trading of their respective single stock futures contracts. An event study revealed that SSF trading had little impact on the underlying share prices. A normalised volume comparison pre to post SSF trading showed a general increase in spot market trading volumes. The volatility effect was the main focus of this study with a GARCH(1,1) model establishing a volatility structure (pattern of behaviour) per company. Results showed a reduction in the level and changes in the structure of spot market volatility. In addition, a dummy variable regression could find no evidence of an altered company-market relationship (systematic risk) post futures.

Key terms:

Equity shares; event study; futures trading; GARCH model; price effect; single stock futures; spot market; volatility effect; volatility level; volatility structure; volume effect

OPSOMMING

Die instel van enkel-aandeeltermynkontrakte in ‘n mark bied die geleentheid om ‘n individuele maatskappy se reaksie op termynverhandeling regstreeks te beoordeel, in teenstelling met die mark-wye impak wat deur indeks-termynkontrakstudies verkry word. Agt en dertig Suid-Afrikaanse maatskappye is beoordeel in terme van ‘n moontlike prys-, volume- en volatiliteiteffek op grond van die aanvanklike verhandeling van hul onderskeie enkel-aandeeltermynkontrakte. ‘n Gebeurtenisstudie het getoon dat EAT-verhandeling ‘n geringe impak op die onderliggende aandeelpryse gehad het. ‘n Genormaliseerde volumevergelyking voor en ná EAT-verhandeling het ‘n algemene toename in kontantmarkverhandelingsvolumes getoon. Die volatiliteiteffek was die hooffokus van hierdie studie. ‘n GARCH(1,1)-model is toegepas, en dit het ‘n volatiliteitstruktuur (gedragspatroon) per maatskappy daargestel. Resultate toon ‘n afname in die vlak van en veranderinge in die struktuur van kontantmarkvolatiliteit. Daarbenewens het ‘n fopveranderlikeregressie geen bewys van ‘n veranderde maatskappy-tot-mark-verhouding (sistematiese risiko) ná termynverhandeling gevind nie.

Sleutelterme:

Ekwiteitsaandele; enkel-aandeeltermynkontrakte; GARCH-model; gebeurtenisstudie; kontantmark; pryseffek; termynverhandeling; volatiliteiteffek; volatiliteitstruktuur; volatiliteitvlak; volume-effek

TABLE OF CONTENTS

CHAPTER 6 SUMMARY AND RECOMMENDATIONS

MISCELLANEOUS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Background

A single stock futures (SSF) contract is an exchange-traded future commitment to buy or sell the shares of a particular listed company at a predetermined price.

The existence and value of futures contracts, categorised as derivative instruments, are contingent upon the existence of an underlying asset (often simply known as the "underlying"). Single stock futures, also known as individual equity futures,[1] are derived from and therefore reliant on the price of an ordinary share.

The link between the spot market and the futures market is established through the cost-of-carry concept. Strong (2005:246) defines the cost of carry as the net cost of carrying an asset forward in time, representing the carry charges (interest) and carry returns (dividends).[2] The fair value of a futures contract is therefore solely a function of the underlying asset's spot price and the cost of carry. However, the dynamics of financial markets are affected by divergent market perceptions, causing shifts in demand and supply, with the result that futures prices deviate from their fair values (JSE 2005a). The cost of carry relationship is maintained through cash and carry arbitrage.[3] This arbitrage strategy ensures that futures contracts trade within a narrow band of prices.

Having established this link, and on the assumption that the futures price is largely determined by the underlying spot price, it is conceivable that a reciprocal relationship exists between the underlying and its derivative. This raises the following question: to what extent does the derivative impact upon the underlying?

The impact of derivatives trading on an underlying asset is a recurring theme in empirical financial research, as stated by Kumar and Mukhopadhyay (2004:328), who base their contribution to this area of study on evidence from the Indian market. Similarly, Drimbetas,

---

[1] In South Africa these instruments are known interchangeably as single stock futures or individual equity futures and are also referred to as individual share futures (Australia), and universal stock futures (the United Kingdom). This study will refer to the more generic term "single stock futures" as used in the United States of America.
[2] All cost of carry models arise from a single formula ($F_t=S_0e^{cT}$). Characteristics unique to the specific asset and interest calculation methods account for the diverse formulas found in the literature (Chance 2006).
[3] Cash and carry arbitrage applies when the actual futures price exceeds the theoretical price ($F_0>S_0e^{cT}$), while reverse cash and carry arbitrage comes into play when the actual price is lower than the calculated price ($F_0<S_0e^{cT}$).

Sariannidis and Porfiris (2007) investigated the Greek stock market in an attempt to address this question. Their work represents some of the most recent research done on this topic with an underlying share index as the asset under investigation. Many previous studies that have produced conflicting results are quoted in these and subsequent papers.[4]

With the introduction of single stock futures, researchers were afforded the opportunity to revisit this contentious topic as single stock futures provide a more direct assessment of the possible impact on the behaviour of the underlying shares. Index futures contracts are useful in assessing market-wide impact (McKenzie, Brailsford & Faff 2000:240). The topics of volatility and to a lesser extent liquidity of the underlying cash market feature prominently in the studies done on single stock futures.[5]

The following section provides an overview of research findings on this topic. Attention will first be given to research done internationally, followed by research done in South Africa.

1.1.1 International research

Single stock futures are traded on relatively few exchanges, with the National Stock Exchange (NSE) of India and the Russian Trading System (RTS) Stock Exchange accounting for the majority of global volumes. A survey conducted by the World Federation of Exchanges recognised single stock futures as a strongly growing sector with exchanges that have adopted this product largely experiencing acceptance by investors and therefore good volume growth (WFE & Wells 2005).

The topic of single stock futures has been the subject of studies done in Australia, India, the United States of America, and the United Kingdom. Research on the effect on the underlying of the introduction of single stock futures has been confined to Australia and the United Kingdom.

1.1.1.1 Australia

The impact of the introduction of single stock futures on the trading behaviour of the underlying Australian equity market featured as the topic of research in a paper by Peat and McCorry (1997).[6] Using existing literature on the introduction of both options contracts and share index

---

[4] A useful summary can be found in Kumar and Mukhopadhyay (2004:328), who state that Figlewsky (1981a), Harris (1989), Brorsen (1991), Lee & Ohk (1992), Kamara et al (1992) and Antoniou & Holmes (1995) all reported that the inception of futures trading increased spot volatility, while Edwards (1988), Becketti & Roberts (1990), Hodgson & Nicholls (1991), Darrat & Rahman (1995) and Butterworth (2000) declared futures to have a beneficial effect on the underlying cash markets.

[5] Studies conducted in the United Kingdom and Australia. See, for example, Peat & McCorry (1997) and Lee & Tong (1998).

[6] In Australia these contracts are referred to as individual share futures.

futures, they developed and tested (within the Australian context) a number of hypotheses from models of market behaviour. They report their findings to be in contrast to those on the impact of options and share index futures where previous research indicated the following strong market completing effect: "Volume increased, there was a once-off price effect, and volatility decreased when options trading was introduced for a given stock" (Peat & McCorry 1997:10). The listing of SSF contracts was associated with a significant positive increase in trading volume in the underlying market, no significant change in the underlying price level and an increase in the underlying volatility.

The introduction of equity futures in the Australian market was also the focus of a study done by Lee and Tong (1998). They examined the effects on the volatility and volume of the underlying shares. Evidence of an increase in volume in conjunction with no increase in volatility led them to conclude the following: "the trading in stock futures offers many of the benefits associated with derivative trading without the spectre of raising volatility" (Lee & Tong 1998:300).

The overall evidence in an article entitled, "Share price volatility with the introduction of individual share futures on the Sydney Futures Exchange" suggests that the introduction of SSF trading impacted very little on cash market volatility. Cash market trading, according to Dennis and Sim (1999) has a bigger effect on cash market volatility than trading in the futures market.

McKenzie, Brailsford and Faff (2000) provided insights into the impact of single stock futures on the systematic risk and volatility of the underlying shares listed in Australia. Their findings revealed the following:

- a general reduction in the systematic risk[7] of the underlying shares
- evidence of a decline in unconditional volatility
- mixed evidence concerning the impact on conditional volatility[8]
- weak evidence to support a change in the asymmetric response[9] in individual share returns following futures listing and its impact on market dynamics

McKenzie et al (2000:238) reported the research evidence as unsupported by the control group used in the study, and as weak and difficult to interpret. Their conclusion was that the research outcome provided "new insights into the mixed results which are typical of existing studies".

[7] Also called market risk, or non-diversifiable risk, it is the risk common to an entire class of securities that cannot be eliminated through diversification as opposed to unique or firm-specific risk (diversifiable risk).
[8] The current volatility (measure of risk) is dependent or conditional upon the volatility in a previous (lagged) period. Conditional volatility models (e.g., GARCH models) capture time-varying volatility.
[9] An unequal response to opposing events of similar magnitude (e.g., positive and negative news events).

1.1.1.2 India

According to Mukherjee (2006), the National Stock Exchange (NSE) of India has entrenched itself as the category leader in single stock futures. Mukherjee attributes this success to the similarity between single stock futures trading and the carry-forward system[10] of speculation that existed in India. This futures-like practice, which allowed traders to carry forward large long or short net positions to the next settlement period, thereby accumulating sizeable positions and avoiding delivery for many months, was eliminated just before single stock futures were introduced. This familiarity with settlement periods and carry forwards was transformed into a demand for equity futures (Gorham, Thomas & Shah 2005:38).

A paper by Raul (2004) investigated the suitability of single stock futures in providing liquidity and initiating an efficient price discovery mechanism in the Indian futures market, thereby eliminating price risk and counterparty risk. The author also refers to the cessation of the carry-forward system, concluding that this wholly removed the price discovery mechanism. The study further found that index based futures, index options and options on individual shares have not generated much liquidity in the market. The introduction of equity futures, however, led to an increase in the volume of trade in the derivative segment, which translated into an increase in market depth.

1.1.1.3 United States of America

Paulden (2005) reported limited initial interest in singe stock futures with OneChicago - a joint venture between the Chicago Board Options Exchange (CBOE), Chicago Mercantile Exchange Inc (CME) and the Chicago Board of Trade – starting out with low volume and little activity, while Nasdaq Liffe Markets (NQLX) ceased operations.[11] Numerous articles have appeared in which the anticipation related to the eventual introduction of single stock futures in the US market,[12] the debate on the perceived advantages as well as the regulatory restrictions imposed were discussed.

Low volumes were identified as the major drawback in the US markets. Liquidity is the number one reason for the unpopularity of single stock futures; they are caught in the no-win situation of any new market – not being able to build liquidity without first having liquidity (Paulden

[10] An indigenous solution to a lack of liquidity in the secondary market (Bombay Stock Exchange), this process of buying shares with borrowed money, called "badla", was banned in 2001 (Rajeshwari 2004).
[11] Euronext.Liffe took ownership of NQLX, after Nasdaq relinquished its stake in the joint venture (Euronext 2003) and suspended trading in all of its security futures products in December 2004 (Euronext 2004).
[12] Trading of single stock futures allowed with the passing of the Commodity Futures Modernization Act of 2000 by the US Congress and launched November 8, 2002 (Salcedo 2003a:56).

2005:78). Single stock futures, in effect, compete with the cash market since they provide an alternative means of gaining direct exposure to listed equity shares, prompting concerns that, if successful, they could impair liquidity in the cash market (Lascelles 2002:10).[13]

A paper by Jones and Brooks (2005) presented an overview of how single stock futures have developed since their introduction in the United States. They advance a number of reasons why individual investor interest in single stock futures may not have reached its potential. Apart from reasons that are unique to the US market (tax laws and the regulatory structure such as margin requirements), this paper singles out the relative newness of the market, affirming the view that unfamiliarity with these products is a major reason why retail traders have not yet fully accepted single stock futures.

Based on the above, Ang and Cheng (2005) investigated whether financial innovation improves market efficiency. They applied a “specific news event” approach based on the reduction in the number of excessive unexplained price changes, to test for market efficiency. The evidence, according to them, is that SSF trading increases market efficiency, since it appears that there are fewer unexplained large share returns for SSF firms in the post-(SSF) listing period. This decline is positively related to the extent of trading activity in the single stock futures market. They declare their results to be consistent with a hypothesis that single stock futures, with lower trading costs and higher leverage, provide better relief to arbitrageurs than speculators (Ang & Cheng 2005:51). Innovations that facilitate arbitrage are considered to enhance market efficiency, while lower trading costs can have a stabilising effect on a market.

1.1.1.4 United Kingdom

Hung, Lee and So (2003) investigated whether foreign-listed single stock futures[14] would have any impact on their domestic underlying stock markets. Their results provide evidence that the trading of these foreign-listed derivatives has an escalating effect on the volatility of the respective underlying home spot markets. More specifically, it appeared that daily activity shocks of the foreign listed futures raised the conditional volatility of their home underlying shares, while predictable yet highly variable activity across days lessened the conditional volatility of these shares.

[13] Experience, however, shows that in practice the creation of a derivative on a security tends to increase liquidity for the reasons that it generates more trading activity and improves price discovery (Lascelles 2002:10).

[14] These contracts are referred to as universal stock futures and are traded on the London International Financial Futures and Options Exchange (LIFFE). The underlying securities are some of the world’s largest companies and not limited to shares traded on the London Stock Exchange (LSE).

In contrast, findings published by Chau, Holmes and Paudyal (2005) concerning the effect of domestic and cross-border single stock futures trading on the underlying market dynamics (volatility and the level of feedback trading), suggest a positive impact on the underlying markets, leading to a small reduction in feedback trading[15] and improved market efficiency. The results also suggest clear differences (although not futures induced) in the pattern of market dynamics between industries, and Chau et al (2005:28) advise further research, taking account of the industry in which the share is based. Concerning volatility, it was concluded that any change from the pre- to post-futures period was not futures related. The improvement in market efficiency relates to a reduction in the constant component of autocorrelation[16] incorporated in their statistical model. This coefficient was used to capture the autocorrelation induced by potential market frictions/inefficiency.

Internationally, research on the impact of SSF trading has been concentrated on the Australian market[17] with this market contributing the majority of research on the topic. The UK market dealt with the effect of foreign SSF listings and trading on domestic markets.[14] Although, the United States SSF market[12] is in its infancy and research is limited to the potential application and effect on current practices, this market should in time offer a wealth of research related to the introduction and trading of single stock futures.

The South African market,[17] like the Australian market, provides an opportunity to directly observe the effect of futures trading on the spot market. As will be shown in the next section, this opportunity has yet to be exploited to any extent, with past research being restricted to share index futures.

1.1.2 Research in South Africa

Abstracts from the following three dissertations typify the research carried out in South Africa on futures trading concerning the effect on the volatility and liquidity of the underlying spot market.[18] These studies focused solely on share index futures.

Nienaber (1994) investigated the question whether increased (share index) futures trading activity during the early 1990s was associated with greater equity volatility on the SA market. This study was based on research done in the United States by Bessembinder and Seguin (1992) on the S&P 500 share index that found a positive relationship between equity volatility and

[15] Feedback trading is a form of market timing that uses technical analysis or charts in an attempt to predict future prices from the time sequence of past prices.
[16] Correlation of the error terms from different observations of the same variable, also called serial correlation.
[17] Australian SSF trading data available since 1994 and the South African SSF market established in 1999.
[18] The spot market is also referred to as the cash market.

trading volumes in the spot market. In addition, the US study found a positive/negative association between unexpected/expected futures-trading volumes and spot volatility. Looking at the three main indices (All Share, Gold, and Industrial) on the JSE, positive correlations between equity volatility and expected and unexpected trading volumes for both the spot and futures markets were found. These findings differed from those of the US study and the author concluded that futures-trading volumes lead to greater volatility in the SA markets and that increasing volumes could possibly destabilise equity prices.[19]

A similar study by Oehley (1995) compared the volatility of the underlying index before and after the introduction of index futures trading. Once again, the JSE All Share Index, Industrial Index, and Gold Index were observed, with only the Industrial Index showing a significant change in volatility.

Swart (1998), in a dissertation entitled "The impact of share index futures trading on the volatility and liquidity of the underlying assets on the Johannesburg Stock Exchange", indicated significant positive relationships between futures trading activity and the volatility of the underlying assets for the Gold Index and the Industrial Index. Although no significant relationship was reported for the All Share Index, the author declares the results to support the hypothesis that index futures trading increases the volatility of the underlying assets. The author also maintains that the results of his research support the premise that the trading of index futures is associated with greater liquidity in the underlying assets.

In addition, Parsons (1998) and Kruger (2000) similarly examined the effect of index futures trading on cash market volatility. No conclusive evidence that links futures trading to an increase in general market volatility was found in either of these studies.

The diverse results reported by the limited number of studies carried out to date (UK and Australian markets) concerning the effects of single sock futures trading[20] on the underlying cash market, and the many studies featuring share index futures trading,[21] highlight the continued uncertainty surrounding the impact of futures trading on the spot market.

---

[19] Also refer to Smit and Nienaber (1997:59).
[20] See Peat & McCorry (1997), Lee & Tong (1998), Dennis & Sim (1999) and McKenzie et al (2000).
[21] See Kumar & Mukhopadhyay (2004) for a summary of the results.

1.2 Problem statement

Globally single stock futures represent a new type of derivative, and the impact of their introduction on the underlying domestic equity markets has not been evaluated extensively to any degree. Research on the effect of futures trading on the South African market is by no means exhaustive, and this is especially true for single stock futures, which cannot as yet be described as formally studied and analysed subject matter.

1.3 Purpose of the research

The purpose of this research is to determine what impact the introduction (initial trading) of single stock futures to the South African market had on the following three aspects of the underlying:

- Price (return) of the security, that is the price effect
- Trading volume of the security, that is the volume effect
- Volatility of the security, that is the volatility effect

Gaining an understanding of the usefulness of these instruments and their contribution to market efficiency, completeness and stability should result in a better understanding of security market behaviour and interaction in general.

1.4 Research methodology[22]

This research followed the methodology of a study carried out by Clarke, Gannon and Vinning (2007) on the impact of warrant introduction on the Australian market. In each instance, at least two methods were used to examine the impact SSF trading has had on the price, volume, and volatility of the underlying equity.

1.4.1 Price effect

Event study methodology was used to determine the impact of SSF trading on the price of the underlying equity. Employing the market model, an individual security's co-movement (beta) with the market in a period preceding the event was calculated. This established a "normal" return and generated a set of abnormal returns for the event period (number of days surrounding the event). An additional abnormal return per individual underlying security was generated for the actual first SSF trading day (day zero) via a dummy variable regression model.

[22] The research methodologies used are covered in detail in chapter 3.

1.4.2 Volume effect

The average normalised volume prior to the introduction of single stock futures was compared with the average normalised volume subsequent to the introduction of single stock futures. The significance of the result was established using a t-test for change in mean. Secondly, a dummy variable regression incorporating a trend coefficient was used to account for the general increase in trading volume over time.

1.4.3 Volatility effect

The ratio of pre-introduction variance to post-introduction variance was calculated to determine a change in unconditional variance and an F-test was applied to establish the significance.

Secondly, the Generalised Autoregressive Conditional Heteroskedasticity (GARCH) methodology was employed as a measure to detect changes in the conditional variance (structure of volatility) and unconditional variance of the error terms (level of volatility).

Finally, to determine whether SSF trading caused a change in systematic risk (beta), an ordinary least squares regression analysis was performed with the lognormal returns of the security and the lognormal returns of the market index. A dummy variable combination tested for an absolute shift in the constant term (intercept) and for a change in the slope (measure of co-movement).

1.5 Presentation structure of the study

The research is structured as follows:

Chapter 1 provides a brief overview of some previous studies on the impact of derivatives trading on the underlying market, the problem statement and the purpose of the research, as well as a short description of the research methodologies used.

Chapter 2 provides a literature review on single stock futures and similar single equity derivatives, theories on complete markets, and the expected contribution of futures trading to a more efficient market.

Chapter 3 provides a description of the methodologies used to perform the empirical research on the impact of introducing single stock futures to the South African market.[23]

Chapter 4 shows the statistical output and interpretations of the empirical research done on the impact of single stock futures on the underlying market.

Chapter 5 provides a synopsis of other similar (i.e., price and/or volume and/or volatility effects) studies on the impact of derivatives trading, thereby contrasting the results in terms of the instrument and underlying investigated, methodologies used, and final outcomes.

Chapter 6 summarises this study and contains the final conclusions reached on the market effects (price, volatility, and liquidity) of single stock futures trading, and recommendations for further research.

---

[23] Introduction or trading as it relates to this study refers in all instances to the initial or first-time trading of single stock futures and not the mere availability of a futures contract on a specific share.

CHAPTER 2

OVERVIEW OF SINGLE STOCK FUTURES AND RELATED CONCEPTS

2.1 Introduction

This overview describes the background to the research on the impact of single stock futures trading on the underlying spot market. The environment in which single stock futures and the underlying equity trade, the derivatives market framework, related terminology and concepts, theories regarding the possible impact on the market as well as the development of single stock futures and the distinctive way in which they function are covered. In addition, single stock futures are positioned among similar single equity derivative instruments, which are briefly discussed.

2.2 Trading environment

The Johannesburg Securities Exchange Limited (JSE Ltd) represents the formal exchange market for financial assets in South Africa and comprises the following divisions:[1]

Table 2.1

JSE Limited divisions

<table>
<tr><th colspan="4">JSE Limited</th></tr>
<tr><th>AltX</th><th colspan="2">Safex</th><th>YieldX</th></tr>
<tr><td rowspan="3">Alternative exchange - parallel market focused on quality small and medium sized high growth companies</td><td colspan="2">South African Futures Exchange</td><td rowspan="3">Environment for trading, clearing and settling of all interest rate products</td></tr>
<tr><td>Equity Derivatives</td><td>Agricultural Derivatives</td></tr>
<tr><td>Trading in derivative contracts (futures and options) based on financial products</td><td>Environment in which farmers, traders and processors manage risk and obtain insurance via derivative contracts (futures and options) on agricultural products</td></tr>
<tr><td colspan="4">Main Board: Trading of shares and warrants in listed companies complying to JSE Ltd requirements</td></tr>
</table>

Source: JSE Limited (2005)

The JSE Limited is ranked 19th by the World Federation of Exchanges in terms of market capitalisation (R7,4 billion) with 347 companies listed and an annual (2007) value traded of R6,5 billion (JSE 2008a:48). As shown in table 2.1, equity shares (underlying) trade on the Main Board of the JSE Ltd, while the financial futures and options contracts (derivatives) trade on the South African Futures Exchange (Safex).

[1] The Bond Exchange of South Africa Limited (BESA) is an independent exchange operating and regulating debt securities and interest-rate derivatives in the South African capital market.

2.3 Derivatives market

In the spot market (JSE Ltd Main Board), assets are traded for immediate payment and delivery (or payment and delivery within a short period of time). Share prices reflect the expectations of investors about the future prospects of companies. Originating from these share prices, equity derivative values and price movements are determined by the type or category of derivative product. This section presents the frame of reference when dealing with derivatives (adapted from Chance 2003:2-7):

Table 2.2

Classification of derivatives

Derivatives			
Forward Commitments		**Contingent Claims**	
Exchange-Traded	**Over-the-Counter**	**Exchange-Traded**	**Over-the-counter**
Futures contracts[1]	Forward contracts	Option contracts[3]	Option contracts
[Single stock futures]	Swaps	Equity warrants[4]	Interest rate options
	CFD[2]	Options on futures[5]	Convertible bonds
		Interest rate options	Exotic options
		Convertible bonds	Warrants

Notes:

[1] Single stock futures (refer to section 2.6), index futures, can-do futures (refer to section 2.7.2), and dividend futures all trade on Safex (Equity Derivatives). Currency futures trade on YieldX.

[2] Contracts for difference (refer to section 2.7.3).

[3] Can-do options (refer to section 2.7.2) and index options.

[4] Vanilla warrants, protected share investments, share instalments, barrier warrants (refer to section 2.7.1).

[5] Options on SSF contracts (refer to section 2.6.6).

Source: Adapted from Chance (2003:7)

Table 2.2 shows the two major categories, namely forward commitments and contingent claims. The four generic types of derivatives (i.e., forward, futures, options and swaps) are assigned to each and a distinction is drawn between exchange-traded and over-the-counter derivatives. Mattoo (1997:13-14) describes exchange-traded derivatives as commoditised instruments with fixed contract terms in order to facilitate trading. Over-the-counter derivatives, on the other hand, are negotiated instruments, also referred to as structured derivatives because they are "tailored" or "structured" to the requirements of individual investors or borrowers. A more detailed description of the generic types of derivatives follows the explanation of exchange-traded and over-the-counter trading.

■ Exchange-traded and over-the-counter derivatives

Derivative contracts are created on and traded in two distinct but related types of markets, namely exchange-traded and over-the-counter markets:

- **Exchange-traded contracts** have standard terms and features, and trade on an organised derivatives exchange facility referred to as a futures exchange. The following are some of the features of exchange-traded contracts:

- They are tradable financial instruments.
- Marked-to-market (settled daily).
- Performance guaranteed by the exchange's clearing house.
- Highly liquid (active secondary market) owing to the standardised nature of all contracts.

- **Over-the-counter contracts** are all customised transactions created by two parties through a telephone- and computer-linked network of dealers. The OTC market is larger than the exchange-traded market in terms of the total volume of trading. The following are some of the distinguishing features of over-the-counter contracts (compared to the characteristics of exchange-traded contracts listed above):

- Financial institutions often act as market makers for the more commonly traded instruments.
- Trades are typically much larger than trades in the exchange-traded market.
- There is usually some default risk in an over-the-counter trade.
- They are less liquid owing to the tailor-made structure of all the transactions.

Individual derivative instruments correspondingly trade either on an organised exchange or over the counter. The following subsection organises derivatives according to the rights and/or obligations attached to a particular contract.

■ Forward commitments and contingent claims

Derivative contracts can be classified into two general categories, namely forward commitments and contingent claims:

- **Forward commitments** are contracts in which the two parties enter into an agreement to engage in a transaction at a later date at a price established at the start. Within this category the two major classifications are exchange-traded contracts (futures) and over-the-counter contracts (forward contracts and swaps).

- A *forward contract* is an agreement between two parties in which one party, the buyer, agrees to buy from the other party, the seller, an underlying asset at a future date at a price established today. The contract is customised and each party is subject to the possibility that the other party will default.
- A f*utures contract* is a variation of a forward contract that has essentially the same basic definition, but some clearly distinguishable additional features, the most important being that it is not a private and customised transaction. It is a public, standardised transaction that takes place on a futures exchange.
- A s*wap* is a variation of a forward contract that is essentially equivalent to a series of forward contracts. It is an agreement between two parties to exchange a series of future cash flows. Typically at least one of the two series of cash flows is determined by a later variable outcome (e.g., floating interest rate based on LIBOR or JIBAR).[2]

- **Contingent claims** are contracts in which the payoffs occur if a specific event happens. Contracts of this kind are generally referred to as options, and confer the right but not the obligation to buy or sell an underlying asset from or to another party at a fixed price over a specific period of time.

- C*all options* grant the holder (long position) the opportunity to buy the underlying security at a price below the current market price, provided that the market price exceeds the call strike before[3] or at expiration (specified contingency).
- *Put options* grant the holder (long position) the opportunity to sell the underlying security at a price above the current market price, provided that the put strike exceeds the market price before or at[4] expiration (specified contingency).
- The option seller (short position) in both instances receives a payment (premium) compelling performance at the discretion of the holder.
- Combinations of options lead to different exposures and the incentive to contract either as the long or short holder centres on perceptions regarding market direction and expectations.

Single stock futures, according to this outline, feature as exchange-traded forward commitments. The focus in the following section is therefore the terminology and concepts related to this, the futures market.

[2] London Inter-Bank Offered Rate (LIBOR) – rate at which international banks borrow money from (lend money to) each other. In South Africa the equivalent rate is referred to as the Johannesburg Inter-Bank Agreed Rate (JIBAR).
[3] American style options allow exercise during the contract period – most options are American style.
[4] European style options permit exercise only upon expiry.

2.4 Terminology and concepts

A review of the different terminology used and concepts that apply to trading in the futures market follows. This provides a basis for the discussion on market efficiency, completeness, stability and interaction. Trading activities include arbitrage, hedging, speculation and short selling; open interest, volatility and leverage (gearing) are important basic futures market concepts, while the mark-to-market process deals with the valuation and administration of futures contracts.

2.4.1 Arbitrage, hedging and speculation

Arbitrage is the simultaneous purchase and sale of identical or equivalent financial assets in order to benefit from a discrepancy in their price relationship. The textbook (theoretical) version provided by Jarrow and Turnbull (2000:34-35) defines arbitrage as any trading strategy requiring no cash where there is some probability of making a profit without incurring the risk of a loss. The purchase of any security must be financed by borrowing or short selling another security. The worse possible outcome should result in a zero gain for the arbitrageur. Since the key characteristic is that there is no risk of a loss, all other possible outcomes should generate some profit. Miyazaki (2007:401-402) contests this assertion of risk-free trading, declaring actual arbitrage operations to be risky and different from the textbook version. The speculative nature of arbitrage necessitates the taking of some risk because of specific institutional factors (e.g., trading rules imposed by management) and technological factors (e.g., practical constraints on exploiting miss-pricings). If arbitrage is accepted as a low-risk trading strategy, there are obvious links to hedging (risk transference) as well as to speculation (risk acceptance).

Hedging is the practice of offsetting the price risk inherent in any spot market position by taking an equal[5] but opposite position in the futures market. Short (not owned) the intended purchase, a long hedge involves buying a futures contract to protect against a possible rise in the price of an asset, thereby locking in the price for future payment. Long (owning) an asset, the short hedge protects against a possible decline in the asset price by selling a futures contract and securing the selling price. Most derivatives markets came into being to reduce or eliminate the risk of asset ownership, according to Johnson (1999:24-26). The acquired derivative security will profit from the very same events that impose the losses on the underlying market. The opposite is also true (derivative loss resulting from a gain in the underlying) and this represents the only cost to

[5] Relative to and depending on the correlation between the derivative security and the underlying. In many instances a proxy (different underlying) is used to hedge an exposure, introducing basis risk (underlying and derivative prices not moving in tandem or unison).

entering into a futures contract – the forfeiture of any favourable spot price movements.[6] Risk is neutralised and transferred to someone for whom holding that particular risk would reduce an existing but opposite exposure. A counterparty without a pre-existing exposure (speculator) would accept the risk (long or short the derivative asset) to possibly benefit from an anticipated movement in price.

Speculation involves the buying, holding and selling of assets to profit from fluctuations in price over the short term, as opposed to buying for long-term gains (buy and hold) or income (dividends). Associated with day trading, it relies on market timing and implies a riskier proposition than investing. It may have a destabilising (increasing movements in asset prices) or stabilising (decreasing price fluctuations) effect on the market. Although, as stated earlier, futures markets arose from the desire to reduce risk (hedging activities), Eales and Choudhry (2003:126-127) see their greatest use as an aid to speculation. They cite the ease, speed, efficiency and low cost of transacting as abetting basic speculative strategies, essential to the determination of fair/true asset values.

In his study linking arbitrage to speculation, Miyazaki (2007:399-400) provided the following abridged version regarding hedgers, speculators and arbitrageurs. Hedgers enter derivative markets to reduce a pre-existing exposure to risk; speculators actively take risks and bet on the future direction of the market; arbitrageurs take positions in two or more economically related markets simultaneously to exploit theoretical/actual miss-pricings.

2.4.2 Short selling

Analogous to shorting an asset, selling an asset short is a legitimate trading strategy where a security is borrowed and sold by an investor with a commitment to purchase and replace it at a later stage. This complex and high-risk strategy of selling a security not owned is used to capitalise on an expected decline in price and can lead to substantial losses should the opposite occur (Rich 2006:8). A broker, as instructed by a client, will borrow shares from another client and sell them in the market. This short position can be maintained indefinitely, provided there are always shares for the broker to borrow. Running out of shares to borrow, the broker will be forced to close out immediately (short-squeezed). The investor is required to maintain a margin account with the broker as a guarantee that the short position will not be relinquished if the share price increases (Hull 2006:100). The percentage deposited as the initial margin represents a restriction on short selling as this limits the use of funds from the short sale (Kolb 2000:65).[7]

[6] Apart from the initial margin (refer to section 2.4.6).
[7] Refer to section 2.4.6 and also the discussion on complete/efficient markets (section 2.5).

2.4.3 Open interest

Open interest, used to measure liquidity, is the total number of options or futures contracts long or short in a delivery month or market that have been entered into and not yet liquidated by an offsetting transaction or fulfilled by delivery. Indicative of the level of commercial activity, a rise or fall in open interest shows that money is flowing into or out of a futures contract or option. While volume (number of contracts traded) indicates market activity, open interest indicates the depth (liquidity) of a market (Salcedo 2003b:60). The short interest is always equal to the long interest and "the amount of open interest reflects the intensity of the willingness of the participants to hold positions", according to Kleinman (2002:57). Rising open interest is considered good for the current trend and shows that those participants benefiting from a current move in the market (up or down) are prepared to enlarge their commitments and not cash out. A declining open interest is indicative that the losers are liquidating and the winners cashing in, with an insufficient number of new players moving in to replace them.

2.4.4 Volatility

Volatility is described as the degree of fluctuation (rate of change) in the price of a security and is mathematically expressed in terms of variance or standard deviation and beta. The greater the volatility, the wider the fluctuations between successive security prices over a given time period. The volatility of security returns is the measurement used to define risk. High volatility (severe changes in price) relays to high risk and an increased probability of either a loss or gain in a short period of time. Futures markets are traditionally more volatile than spot markets and the close relationship between these two markets creates the possibility of volatility transference (Kumar & Mukhopadhyay 2004).

2.4.5 Leverage

Derivatives are inherently leveraged and, in the context of futures contracts, leverage refers to margin trading or gearing. It is the relatively small amount of money (initial margin – a fraction of the maximum position size)[8] required to maintain an open position and control a larger investment. There is some relationship between leverage and risk, but they are not the same. Leverage is a tool used to either amplify or reduce risk levels and does not provide a measure of the risk taken, according to Norland, Quintana and Wilford (2000:8). When equated to risk, leverage is indicative of the exposure to a potentially large loss (maximum position size).

---

[8] See section 2.4.6, Mark to market.

2.4.6 Mark to market

The initial margin, as mentioned in the previous section, determines the level of gearing obtained from entering into a futures contract and forms part of marking a contract to market. This procedure revaluates a futures contract on a daily basis and adjusts the open position to reflect profits and losses resulting from price movements that occurred during the last trading session. Stulz (2003:32) describes it as "equivalent to closing the contract at the end of each day, settling gains and losses, and opening a new contract at a price such that the new contract has no value". The amount by which an account changes on any given day is referred to as the settlement variation and should this cause the account value to fall below the maintenance margin (minimum account balance), the investor receives a margin call and has to deposit an additional amount (variation margin) to bring the account balance to the initial margin. The mark-to-market process ensures that the counterparties all meet their obligations in terms of the futures contract. Failure to comply with a margin call will result in the close-out and financial settlement of the position (JSE 2007b:80).

2.5 Market efficiency, completeness, stability and interaction

A financial market is said to be efficient when the price of a traded security constantly changes as the market analyses and incorporates new information concerning the company. The market price should be an unbiased estimate of the true value of the security. The question is whether financial innovation (e.g., single stock futures) improves market efficiency, providing for a more complete market.

Figlewski and Webb (1993:776) define a complete market as one in which "for each possible state in the world, an investor can create a strategy that has a positive payoff in that state and zero in any other state". Aitken and Segara (2005:127) refer to several empirical studies that have supported the view that the introduction of derivatives made a positive contribution, enabling investors to achieve more efficient payoffs.[9] The introduction of derivatives, according to these studies, "makes an otherwise incomplete market more complete by expanding the investment opportunities set".

The futures market could potentially affect the stability of the spot market owing to the interaction between these two markets. Futures provide a mechanism for those who trade in the cash market to hedge against unfavourable price movements. Risk is transferred from the hedger in the spot market to the speculator in the futures market, reducing the need to incorporate and compensate

[9] Studies referred to by Aitken and Segara include Hakansson (1982), and Green & Jarrow (1987).

for risk and resulting in the improved functioning of the spot market (Figlewski 1981a:445). In addition, futures provide a mechanism for price discovery, that is, information regarding future spot prices is generated in the futures market. The convergence of the spot and futures market enforces the belief that futures prices move together with spot prices and that futures prices are able to provide information for predicting spot prices (Quan 1992:148). When highly related financial assets are traded on more than one market, the market that provides a combination of the greatest liquidity, lowest transaction costs and greatest leverage should dominate (Booth, So & Tse 1999:620). In accordance with this, Garbade and Silber (1983:297) found that, in general, futures markets dominate cash markets with price changes in the futures markets leading price changes in the cash markets.

It therefore appears probable that this apparent dominance by the futures market will have some effect on the dynamics of the underlying spot market. The outcome (positive or negative) of this effect, especially as it relates to the introduction of new derivative products (e.g., single stock futures), frequently features as the topic of debate and research given that the causal link between a derivative and its underlying could potentially stabilise or destabilise the spot market.

Robbani and Bhuyan (2005:248) distinguish between informed and uninformed investors (speculators) who carry out arbitraging or speculative activities.[10] An increasing number of informed investors attracted to the markets would increase the trading volume (liquidity) and thereby decrease the volatility of the spot market. This statement only holds good on the assumption that no trading is diverted from the underlying market to the corresponding derivative market, thereby decreasing spot liquidity and increasing price volatility (Sahlström 2001:20; Skinner 1989:61; Watt, Yadav & Draper 1992:486). The basic premise, according to Faff and Hillier (2005:1361), is that informed traders would be attracted by the offered leverage and lower transaction costs and would migrate from the underlying spot market to the derivatives market should a derivative product become available.[11] The reverse also applies, however, with market makers[12] in derivatives markets having to trade the underlying securities to hedge their positions, thereby improving liquidity in the spot market (Figlewski 1987:305; Mazouz 2004:696). In addition, the hedging function mentioned also gives investors the opportunity to invest in riskier shares, arguably leading to an increased demand for those shares.

On the other hand, more uninformed or irrational traders (speculators) in both markets focusing on short-term profits would increase equity market volatility. The migration of speculators, lured

[10] Refer to the discussion on arbitrage, hedging and speculation (section 2.4.1).
[11] Any price reaction caused by this influx of informed traders from the equity market to the futures market should occur around the time a new derivative security (e.g., a single stock future) is introduced (Faff & Hillier 2005:1361).
[12] Market makers facilitate trades for clients in the derivatives market by providing consistent buy and sell quotations on futures and options, thereby providing liquidity and the opportunity to transact under all market conditions.

from the underlying market, acts in the opposite direction to the migration of informed traders (Gorton & Pennacchi 1993:4; Mazouz 2004:696). In support of this view, Chau, Holmes and Paudyal (2005:5) suggest that derivatives facilitate speculation, leading to higher volatility in the equity market, which in turn changes the perception of risk in the market, thus potentially affecting the cost of equity and impacting on the economy at large.

Peat and McCorry (1997:5) summarised the opposing views in terms of the stabilisation/destabilisation discussion and (single stock) futures as follows: If markets move towards completion and stabilisation, a one-time increase in the share price and a lower required return, an increase in spot trading volume, and a decrease in the volatility of the underlying should result after the introduction of a single stock futures contract. If, however , the market is destabilised by the introduction, there should be a one-time decrease in the underlying share price with an increased required rate of return, decreasing spot trading volume (migration to the SSF market), and an increase in the volatility of the underlying share.

Another version of the preceding discussion on increased investor demand entails the restrictions on selling assets short. Short sale constraints cause the market to underweight negative information and are also responsible for an overvaluation (upward bias) of share prices (Figlewski 1981b:464). Derivatives allow investors to take short positions in equity, thereby making it possible for investors with a negative view on a particular share to trade on that information (Clarke, Gannon & Vinning 2007:6-7). Negative information gets impounded in the share price, improving efficiency by reducing the asymmetric response to information (Antoniou, Holmes & Priestley 1998:152). Greater short-selling activity would lead to an increase in trading volume (Faff & Hillier 2005:1365) and lower volatility (Ho 1996:377).

In support of and closely related to the theory on the reduction in short sale constraints, it is suggested that informed traders with negative information should be allowed to trade on and profit from their superior information (Clarke et al 2007:7). Puttonen (1993:661) confirms an earlier assertion, stating that "derivatives markets informationally dominate the cash market" and that restrictions on short selling in the underlying market increase the price discovery or informational role of derivatives markets.

These conceptual frameworks were described by Clarke et al (2007:6-7) as the complete markets theory, the diminishing short sales theory and the improved information environment (informed trading) hypotheses. All research done on the possible impact of derivatives trading/introduction on the underlying conforms to one or more of these theories.

2.6 Single stock futures

A single stock futures contract is a derivatives contract listed on the South African Futures Exchange (Safex). The underlying security is an individual equity share listed on the Johannesburg Securities Exchange Limited (JSE Ltd). When the futures contract expires, the holder in effect buys the actual share from the seller at the specified price.[13] The spot price, relative to the futures price, at expiration determines the gain or loss to the opposite parties. The contract can be terminated or closed-out at any time prior to expiration by taking an offsetting (reverse) position with the return determined by the difference between the initial and the prevailing futures price.

Since the introduction of SSF contracts to South Africa in 1999, these instruments have grown in popularity. The JSE Limited Annual Report (2006) states that SSF contracts appeal to a wide range of investors, from the conservative to the more speculative. The relatively low margin requirements allow investors of modest means access to high-priced shares, while more aggressive investors are attracted by the leverage inherent in these instruments (JSE 2007c:15).

Initially (1999) SSF contracts on the shares of six listed companies, namely Anglo American Corporation (AACQ), Comparex (CPXQ), Didata (DDTQ), Firstrand (FSRQ), Richemont (RCHQ) and South African Breweries (SABQ) were introduced. The total number of transactions concluded for 1999 only amounted to 80, increasing to almost 8000 in 2002. The following subsection graphically tracks the growth of single stock futures since 2002, with 56 SSF contracts listed and a total value traded exceeding R3,8 billion. The number of SSF contracts available on JSE Limited listed companies currently (2008) stands at 331 (see Annexure A), and the total number of trades and total value traded for the preceding year (2007) at around 600 000 and R350 billion respectively (JSE database). This growing interest in single stock futures is evidence of the need for research on the impact of SSF trading on the South African equity market. Young and Sidey (2003) contend that single stock futures contribute not only to the derivatives market, but to continued growth in the cash market as well. Their view ties in with the general discussion on market efficiency, stability, completeness and interaction (section 2.5) and provides the basis for any research on stock futures trading.

Subsequent subsections focus on the benefits from trading SSF contracts, contract specifications, contract pricing, and the mechanics of trading SSF contracts. Options on single stock futures (a fringe benefit of the introduction of single stock futures), provide for numerous trading strategies, and are covered briefly in the last subsection (2.6.6).

---

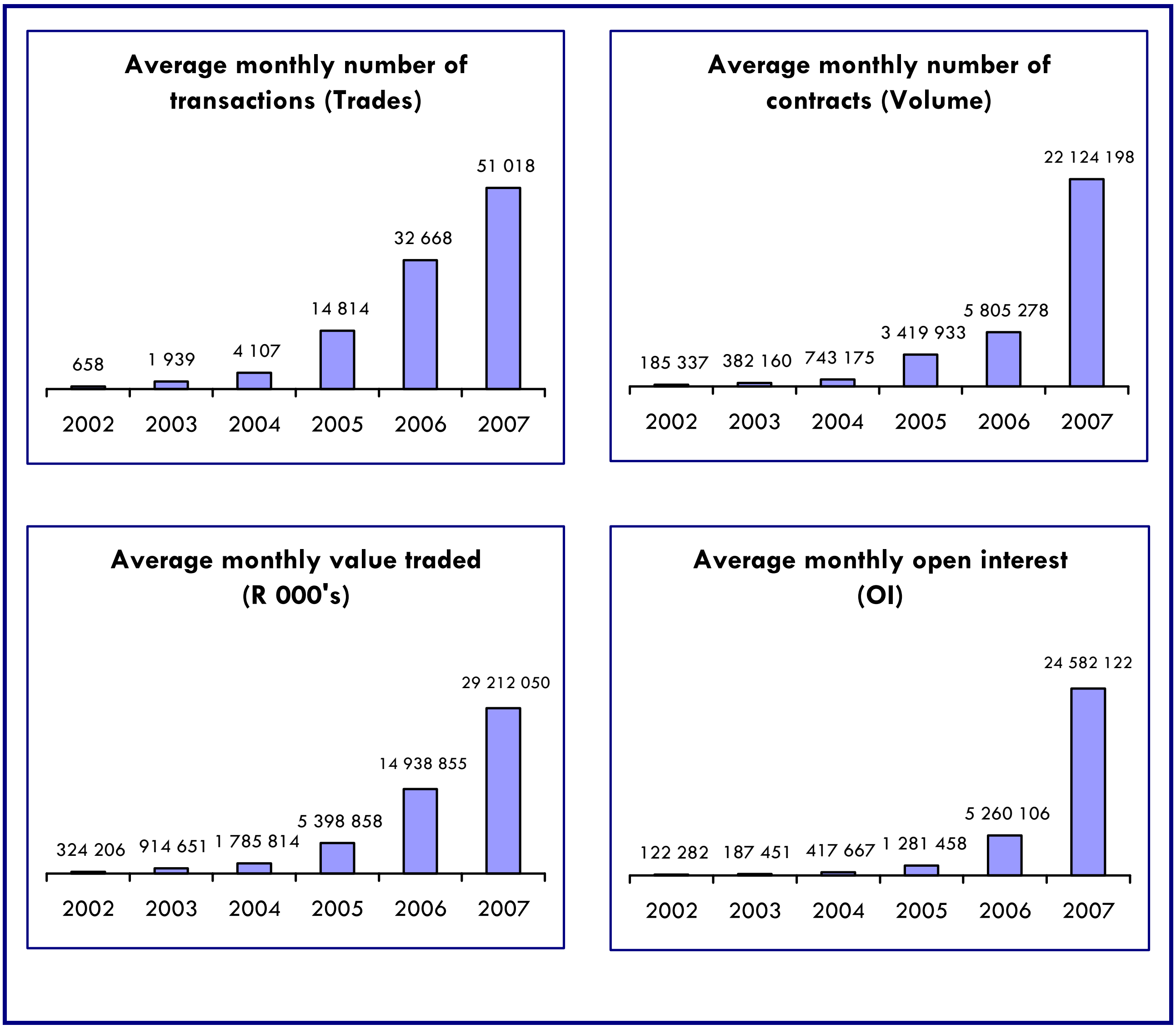
[13] Refer to sections 2.6.3 and 2.6.5 on the role of the market maker.

2.6.1 Growth

The WFE/IOMA Derivatives Market Survey 2006 (WFE & Davydoff 2007:16) reported that the National Stock Exchange of India (NSE) was the most active exchange in the world for stock futures trading in 2006. The 2007 WFE Annual Report (WFE 2008:46) confirmed that since then the JSE Limited has overtaken its Indian counterpart, showing a two-hundred and eighty percent year-on-year (2006-2007) growth in activity, which establishes the JSE as number one in SSF contracts traded (265 million contracts per annum). However, if the smaller contract size adopted by the JSE is taken into account, it still lags behind the Spanish Official Exchange for Financial Futures and Options (MEFF), which took fifth place in the rankings in terms of value traded with the NSE in first place (WFE 2008:109). Figure 2.1 illustrates the accelerated growth in activity (trades and volume), value and liquidity (open interest) of this product over the past six years.

Figure 2.1

Growth in single stock futures (South Africa), 2002-2007



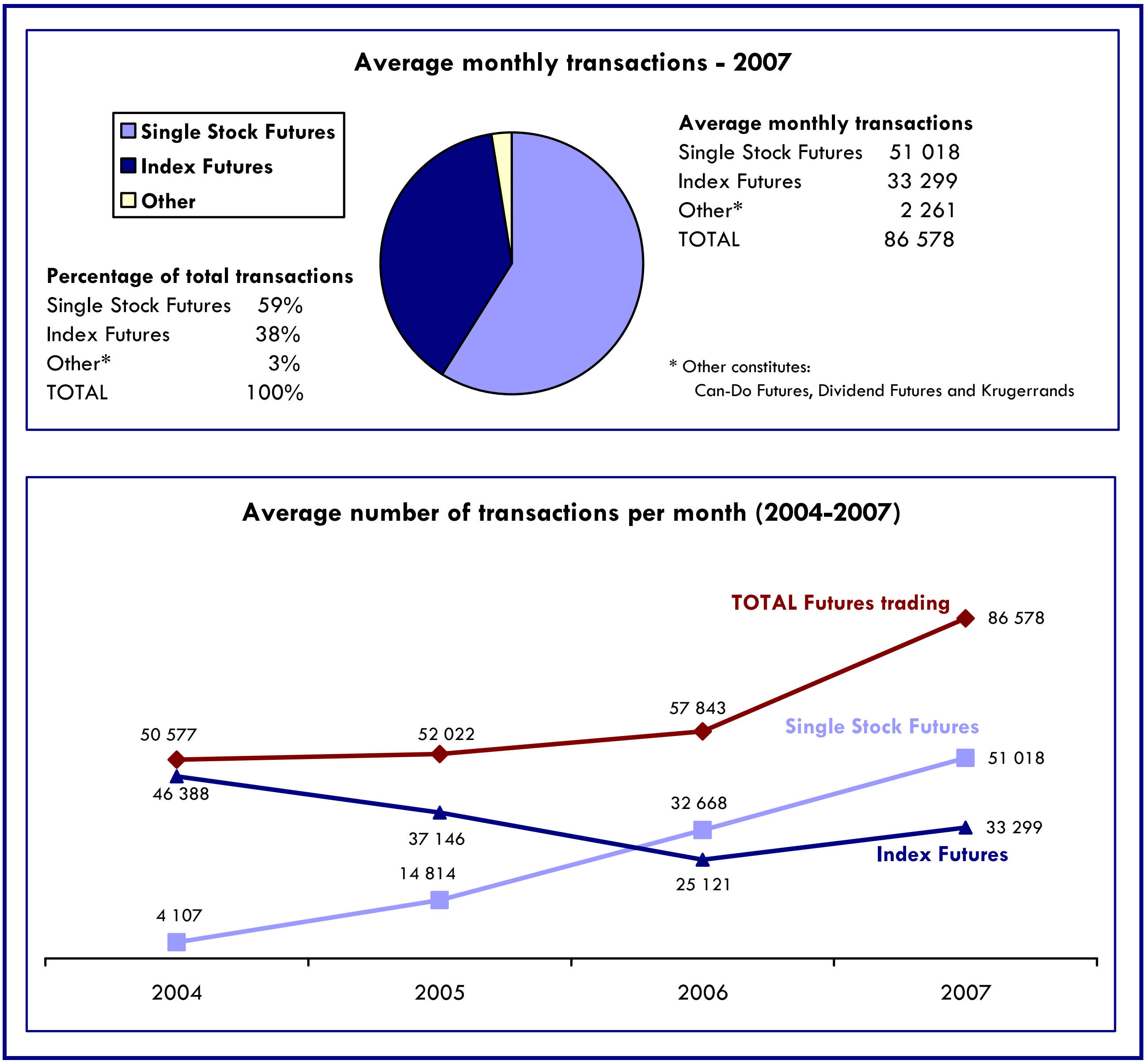
Source: JSE database

2.6.1.1 Transactions (trades)

Figure 2.2 shows the average number of transactions concluded per month in 2007 for single stock futures contracts in relation to the total number of transactions and the other kinds of futures contract transactions on the JSE Limited.

Figure 2.2

Futures trading (average number of transactions per month)



Source: JSE database

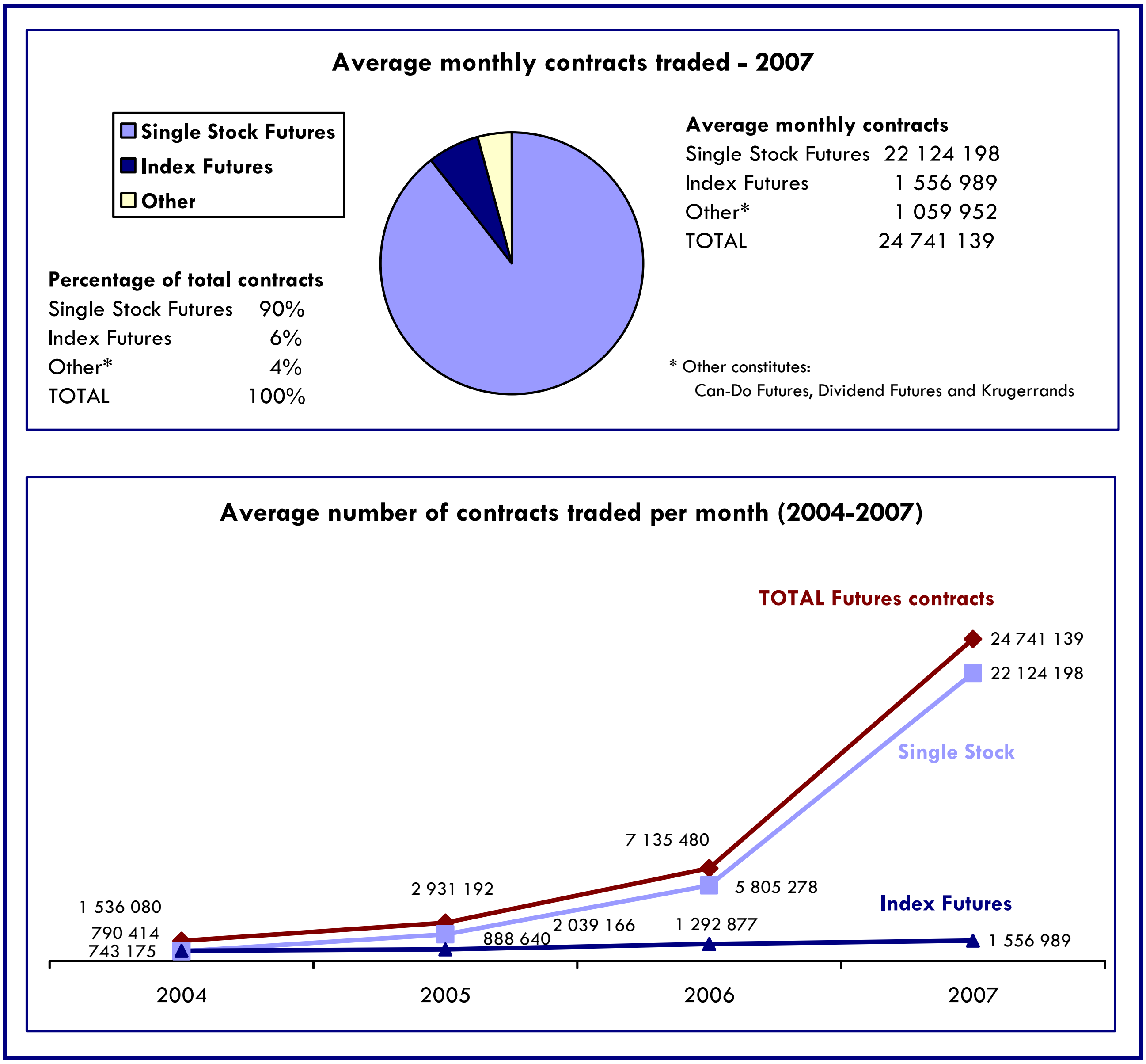
The line graph indicates a steady growth in the number of SSF transactions, surpassing that of index futures during the 2006 period. SSF trading accounted for fifty-nine percent of all futures trading during the 2007 period.

2.6.1.2 Contracts (volume)

Figure 2.3 shows the average number of contracts traded per month in 2007 for single stock futures contracts in relation to the total number of trades and the other kinds of futures contracts traded on the JSE Limited.

Figure 2.3

Futures volume (average number of contracts per month)



Source: JSE database

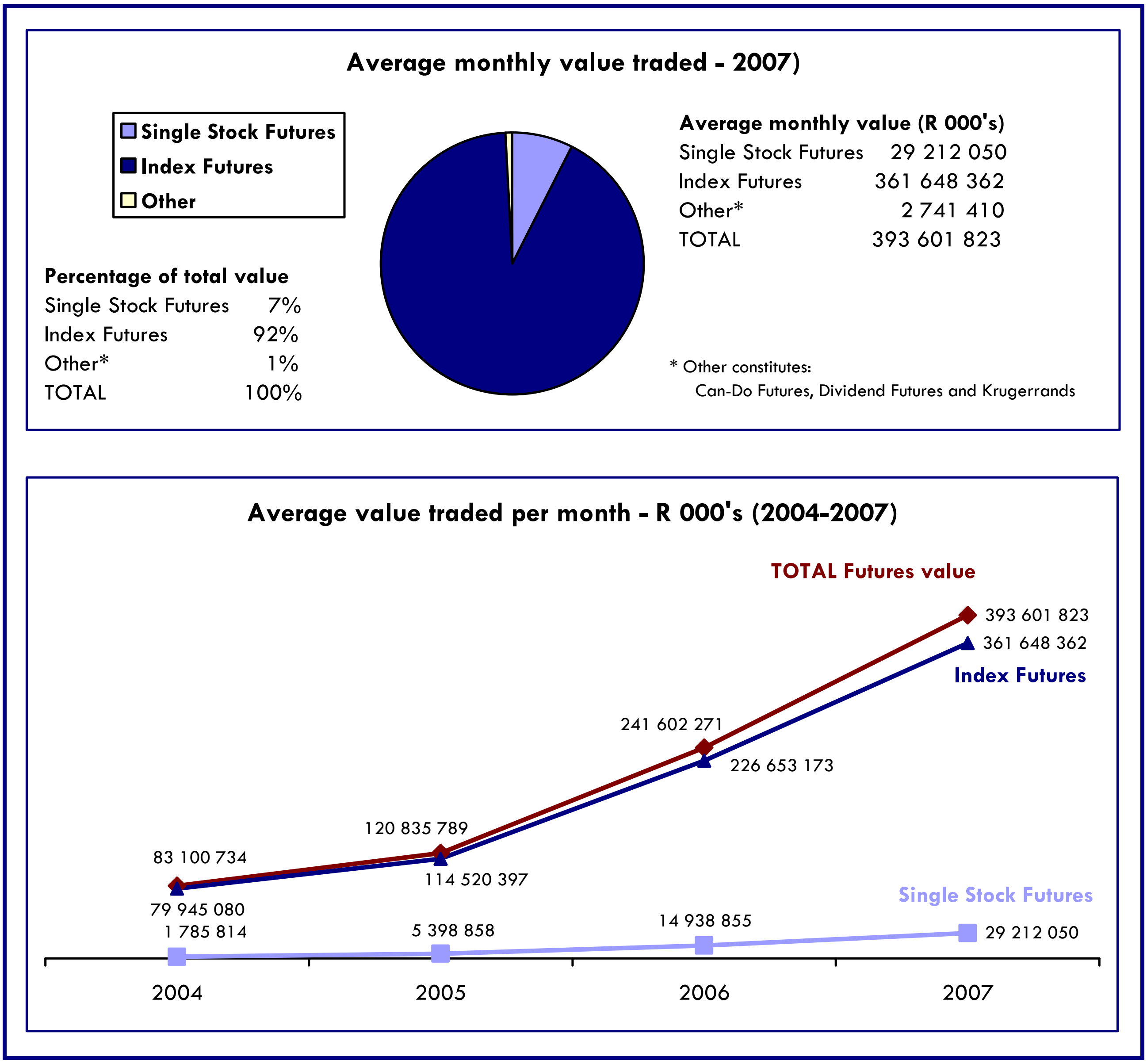
The line graph confirms the trend shown in figure 2.2, with SSF contracts accounting for the growth in total average monthly volume during 2006. Ninety percent of average monthly 2007 futures contracts traded are SSF contracts.

2.6.1.3Value

Figure 2.4 shows the average value traded per month in 2007 for single stock futures contracts in relation to the total value and the value of other kinds of futures contracts traded on the JSE Limited.

Figure 2.4

Futures value (average value traded per month)



Source: JSE database

The line graph shows that although, in terms of value traded, index futures outstrip single stock futures, SSF value traded showed a ninety-six percent year-on-year growth (2006-2007) compared to the sixty percent growth experienced by index futures.[14]

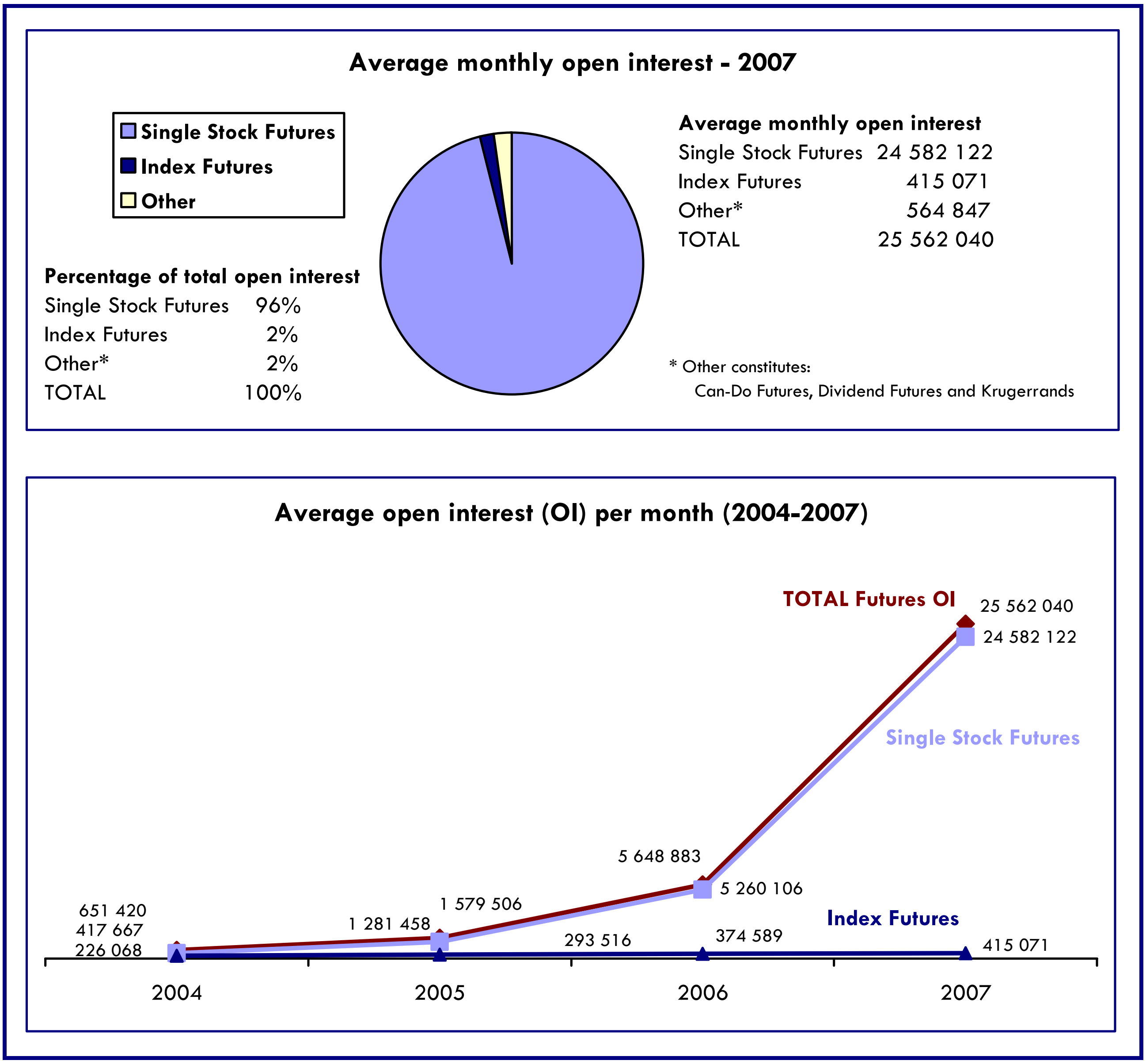
[14] Contract size accounts for the discrepancy in transactions/volume and value trends.

2.6.1.4 Open interest

Figure 2.5 shows the average open interest per month in 2007 for single stock futures contracts in relation to the total open interest and the open interest for other kinds of futures contracts traded on the JSE Limited.

Figure 2.5

Futures liquidity (average open interest per month)



Source: JSE database

The line graph clearly shows the increasing level of open interest related to single stock futures, which is rapidly rising above the stagnant level of open interest attracted by share index futures.

2.6.2 Benefits from trading SSF contracts

Single stock futures can be used to leverage funds (invest or speculate), to hedge or to engage in simple relative performance strategies, with the added benefit of reduced transactions costs. All these reasons for trading single stock futures are described in this section.

Leverage or gear funds (speculate or invest): Single stock futures give investors geared exposure to individual shares without actually owning the shares. The inherent leverage enables investors to obtain the same exposure at a fraction (initial margin) of the total cost or an enhanced exposure at the same total cost. High value (expensive) shares are therefore more accessible and investors can benefit from both up (long SSF) and down (short SSF) movements in share prices (Standard 2006:9). Replacing a direct position in a share with a margined position in an SSF contract (cash extraction) frees up cash for investing elsewhere in the financial market (Investec 2007c:4).

Reduce risk of existing portfolio (hedge): Shorting SSF contracts will protect the value of an existing share portfolio without the actual sale of any of the shares (Standard 2006:9). This is a useful strategy during a temporary decline in the market with investors maintaining the rights associated with shareholding (voting rights and dividends) and avoiding the costs of selling the shares and then repurchasing at a later stage (Investec 2007c:4). This strategy not only insulates share prices against an anticipated decline by locking in a future selling price, but the whole composition of a portfolio (i.e., exposure to certain shares) can be altered without actually selling or buying any shares and incurring the associated costs and tax liability (Mitchell 2003:72).

Pairs trading (speculate): SSF contracts allow for a long-short strategy (pairs trading) when it is believed that one share (long) will outperform the other (short). This strategy applies to shares in the same industry or sector that are affected by the same fundamental factors and the objective is to take a position on the relative performance of two highly correlated shares (Investec 2007c:2). The intention is to profit from the movement in the price differential between the two selected shares, irrespective of the individual changes in share prices. Spread trading eliminates the need to forecast market direction, thereby limiting systematic or market risk and retaining only unsystematic or firm-specific risk (Lafferty 2002:169-170).

Transaction costs: The transaction costs of trading SSF contracts are lower than the costs of trading the underlying securities, with no uncertified securities tax (UST) or STRATE[15] costs (Nedbank 2007d:3). In addition, Sanlam (2007:3) cites lower than average brokerage fees, institutional funding (credit at favourable rates), and interest on margin accounts as added benefits.

[15] Share Transactions Totally Electronic – the electronic settlement of share transactions and recording of ownership.

2.6.3 Contract specifications

Each individual SSF contract requires the parties to physically take or make delivery of one-hundred shares of a specific JSE listed company. Most contracts are offset or rolled over before expiry, however, with no actual delivery taking place (Cortex 2007). Cash-settled contracts, available since February 2007, require cash and not the actual shares to be exchanged.

Table 2.3

Contract specifications of single stock futures

Code	The three-letter share code followed by Q
Underlying	See Annexure A
Contract size	100 times the futures price
Contract months	March, June, September, December
Quotations	Price per contract in Rand to two decimal points
Minimum price movement	R1 per contract
Initial margin	Averages approximately 20% of contract value
Settlement method	Physically and cash settled[16]
Clearing fees	R0,30 per futures contract; R0,15 per option contract
Commissions	15-40 basis points to enter or exit a position
Brokerage	Fixed amount plus VAT per trade
Dividends	Reflected in the price of the futures contract
Corporate events	SSF contracts adjusted to reflect changes to underlying shares
Options on SSF contracts	Each option is on one futures contract
Strike price intervals	R5,00 in the futures price

Sources: JSE (2007d); Nedbank (2007d:9)

The nominal costs of trading SSF contracts includes the subsidiary fees charged by the market maker (commissions) and the client's Safex broker (brokerage) as well as the clearing fees claimed by the exchange (Safex) and the clearing house (Safcom). The market maker requires an additional percentage over and above the Safex initial margin percentage, managing the risk imposed by SSF trading on the cash available in an account (Standard 2007d).

Corporate events are any actions taken by a company, as the issuer of the underlying shares, that will affect the shareholder's entitlement to any benefits. These actions include share splits, capitalisation/rights issues, unbundling, mergers or takeovers and will result in the adjustment of the SSF contracts to reflect any changes in the underlying share prices (Nedbank 2007d:9; Standard 2006:9-10).

[16] The physical settlement of a futures contract refers to the actual receipt or delivery of the underlying security, while cash settlement refers to the procedure where the cash difference between the futures and market price is paid.

2.6.4 Pricing

The basic equation (cost-of-carry pricing model) to price a single stock futures contract:

- SSF price = Share price (spot) + Interest – Dividends

Table 2.4

Bid-offer quotation calculations

Share price		S_{Bid}		S_{Offer}
Commission (C)	–	$c(S_{Bid})$	+	$c(S_{Offer})$
Interest	+	$(S_{Bid}\text{-}C)[1+i(d_1/365)]$	+	$(S_{Offer}\text{-}C)[1+i(d_1/365)]$
Dividends	–	$\text{Div}\ [1+i(d_2/365)]$	–	$\text{Div}\ [1+i(d_2/365)]$
SSF		**Bid/buy price**		**Offer/ask price**

Sources: Standard (2006:21); Investec (2007c:5)

In geometric form the bid-offer quotes for long and short positions are calculated as follows:

- Long position bid-offer equations (Standard 2006:21):

$$SSF_{Bid} = S_{Bid} \times (1-c) \times (1+i)^{(d1/365)} - Div \times (1+i)^{(d2/365)}$$

$$SSF_{Offer} = S_{Offer} \times (1+c) \times (1+i)^{(d1/365)} - Div \times (1+i)^{(d2/365)}$$

- Short position bid-offer equations (Standard 2006:21):

$$SSF_{Bid} = S_{Bid} \times (1-c) \times \left[\frac{(1+i)}{(1+s)}\right]^{(d1/365)} - Div \times (1+i)^{(d2/365)}$$

$$SSF_{Offer} = S_{Offer} \times (1+c) \times \left[\frac{(1+i)}{(1+s)}\right]^{(d1/365)} - Div \times (1+i)^{(d2/365)}$$

In order to offer the investor this margined exposure, the market maker has to fully hedge itself at the attained market spot price prior to transacting at the derived futures price. The market maker has to buy the full long exposure and sell the shares for an investor going short the futures contract. Differential lending, deposit and repo rates,[17] and a script-lending rate,[18] are all factored into the final SSF price. Should the announced dividend be different from the estimated dividend, there will be a change in fair value. A dividend protection/shield accounts for possible differences between the estimated and actual dividend payouts (Investec 2007c:3).

[17] Repo rate – the discount rate at which a central bank repurchases government securities from commercial banks, thereby managing the level of money supply in the monetary system, and availability of credit.
[18] Scrip-lending rate – the rate at which shares are borrowed in order to sell short.

Expected dividends are forecasted and an adjustment is made for the future value of each estimated distribution should the ex-dividend date fall within the contract period.[19] The market maker transacts in the share on behalf of the counterparties and is entitled to the actual dividend payment (Investec 2007c:3).

Unlike commission, a brokerage fee (fixed amount plus VAT), which is charged on all matched trades, is not capitalised into the cost price of the SSF contract, but is simply a reduction in the amount of cash available to the investor (Standard 2007d).

Wasendorf and Thompson (2004:44-45) point out that other factors also come into play when pricing single stock futures. Short-term supply and demand issues related to bullish and bearish market conditions can result in an SSF contract trading at a premium or discount to fair value. The choice of interest rates, the timing and uncertainty of dividends and the compounding method all complicate the calculation of fair market value. The basic principle is straightforward, however: "Single stock futures prices should mirror current stock prices, relevant interest rates, and expected dividends over the life of the futures contract."

2.6.5 Mechanics of trading

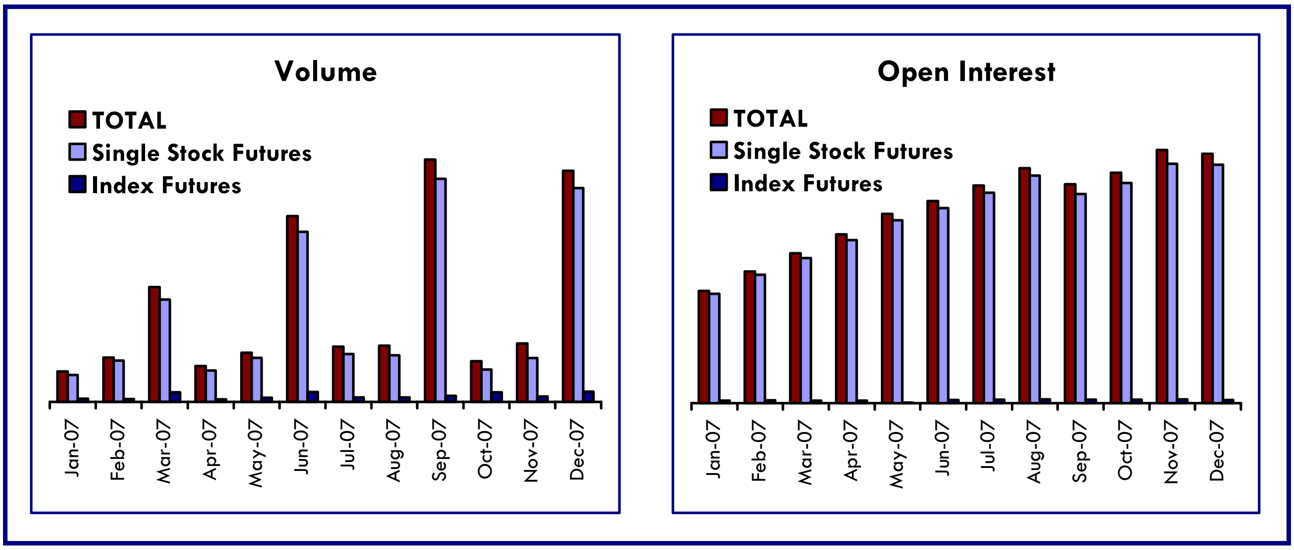
An SSF position held until expiry will result in the physical settlement (delivery) of the underlying shares.[20] The long contract holder will be obliged to buy the underlying shares from the market maker at the closing price on the expiration date. Conversely, the short position holder will have to deliver the underlying shares to the market maker and accept the amount as determined by the closing price. At any given time, a position may be liquidated or closed out prior to expiration by initiating an equal but opposite trade (offset) to the one held. Should the investor decide to maintain the current position, the contract is extended (rolled forward) into the next period prior to the last trading day (Investec 2007c:2).

Figure 2.6 shows the increased trading activity (i.e., SSF and index futures volume) in the contract months of March, June, September and December when positions are closed out or rolled over and new contracts are issued.[21] The open interest graph shows the increasing number of participants in the futures market, mainly due to the trading in SSF contracts as opposed to index futures (stagnant trend in open interest – also refer to figure 2.5).

[19] Ex-dividend date: the date after which a share begins trading without the dividend (i.e., the first day of the ex-dividend period where the seller and not the buyer will receive the dividend).
[20] Cash-settled contracts were introduced in February 2007 in terms of which cash (difference between the futures and market price) and not the actual underlying shares is exchanged at expiry (JSE 2008d).
[21] A new equity derivatives trading system went live on 18 August 2008, with live on-screen prices for single stock futures and single stock options being available to the market for the first time (JSE 2008c).

Figure 2.6

Futures volume and open interest (monthly) – 2007



Source: JSE database

Stop losses and stop profits can close out a position to either limit losses or take profits once a predetermined acceptable level is reached. An auto close-out will ensue should the available trading cash in an account be reduced to zero (due to adverse market movements) and once the additional margin requirement (set by the market maker) is exhausted (Standard 2007d).

2.6.6 Options on SSF contracts

These single stock options are American-style and are delivered into futures contracts on exercise or maturity. All in-the-money options held until maturity are automatically exercised at expiration into single stock futures, which in turn automatically expire into the physical delivery (or cash settlement) of the underlying shares. The buyer or holder has the right to exercise the option into futures at any time before expiration, provided it is sufficiently in-the-money, and thereby assumes a futures position at the strike price of the option (JSE 2005b). The call option holder expects the share price underlying the SSF to increase and will buy the SSF contract (long futures position at option strike) should the SSF price exceed the strike price. The put option holder expects the share price underlying the SSF to decrease and will sell the SSF contract (short futures position at option strike) should the strike price exceed the SSF price. An option position is offset by entering into an equal but opposite trade or allowed to lapse out-of-the money. Exercising an option therefore depends upon whether it is in-the-money and profitable to the holder. The seller or writer has the obligation to perform once the holder exercises his/her right to either buy or sell at a specified strike price (JSE 2007d).

The price or value of an option is the premium payable for the opportunity to either exercise the option when circumstances are in the holder's favour, or walk away (i.e., transact in the spot market or not at all) when they are not. This feature distinguishes options (contingent claims) from futures contracts (forward commitments) in that they provide insurance or protection against adverse market movements while retaining all the upside potential minus the premium paid. Exposure to the underlying at a fraction (premium cost) of the total possible outlay provides leverage (Reehl 2005:69-70). Futures contracts, on the other hand, lend themselves to hedging (offsetting outcome) when owning (long asset, short futures) or intending to own (short asset and long futures) the underlying and expose the speculator to potentially unlimited losses (leverage) when traded independently (long or short futures). Futures contract leverage originates from the margining system, that is, a low initial margin and the maintenance of a minimum account balance (daily settlement of gains and losses). This initial outlay, in contrast to an option premium, does not represent a cost, but the early fractional payment of a future obligation (Marshall & Bansal 1993:278-281).

Options are more versatile than futures, not only providing leverage and insurance (protection), but also allowing for different combinations and strategies (e.g., covered call, protective put, straddle, butterfly/bull/bear spreads etc.) depending upon the investor's market expectations and intentions. Probable drawbacks concern the more complex calculations and intricate behaviour of option prices. Five different variables, namely delta (change in option price due to changing underlying price), gamma (change in delta due to changing underlying price), theta (time decay), vega/kappa (changes in implied volatility) and rho (changes in interest rates) referred to as the "Greeks", impact upon an option price to varying degrees (Reehl 2005:163-172).

2.7 Other/related single equity derivatives

The following section deals with similar derivative securities based on equity shares, providing a summary of the basic features of warrants, can-do derivatives, and contracts for difference.

2.7.1 Equity warrants

Warrants[22] closely resemble exchange traded options (ETO) in that they allow leveraged trade in asset price fluctuations without the investor actually owning the assets, but provide additional features related to issuer, terms, types of products and positions taken (JSE 2007e:4). Table 2.5

[22] Warrants are also referred to as covered warrants to distinguish them from traditional corporate warrants which are issued by a company on its own shares (call warrants only) and require new shares to be issued upon exercise (McHattie 2002:8).

summarises the (dis)similarities of equity warrants and exchange-traded equity options as they apply to the South African market. The underlying instruments of the options listed on the JSE are the futures contracts listed by the JSE where the expiry date and life of the options contract are the same as the underlying futures contract (JSE 2001).[23]

Table 2.5

Key differences between warrants and options

	Warrants	Options
Issuer	Financial institutions	Futures exchange
Terms of issue	Variable depending on the issuer and type of product	Standardised and set by the futures exchange
Trading platform	JSE Limited	Safex
Types of products	Range of structures from capital guaranteed investments to instalments to high risk/return warrants	Single stock futures calls and puts
Positions (long/short)	Long (buy) positions only	Long (buy) and short (sell/write) positions
Number of underlying shares	Depends on the conversion ratio chosen by issuer	One futures contract (100 shares)
Life	Medium to long-term maturity (6 to 12 months)	3 months (equal to underlying SSF contract)

Sources: Adapted from ASX (2007d) and HKEx (2006:6)

In addition, pricing warrants entails utilising a higher volatility in calculating the premiums, making them relatively more expensive than single stock futures.[24] Secondary market trading in warrants only permits resale to the issuing financial institution (JSE 2005d).

Warrants are broadly categorised either as trading products or as investment products.

Trading-style warrants are relatively short dated, frequently traded with a higher risk/return profile, and predominantly used for speculative purposes. Equity warrants, along with index warrants and currency warrants, fall within this category (ASX 2007a). Although regarded as speculative instruments, equity warrants are also viewed as tools allowing investors to modify their risk profiles through the leverage gained (Investec 2007e:2). These warrants, also called vanilla warrants, are the most heavily traded warrant product in the South African market (Nedbank 2007e:2).

[23] See section 2.6.6 for a more detailed description regarding options on single stock futures.

[24] With options on SSF contracts being delivered into futures contracts, warrants can effectively be compared to single stock futures.

Investment-style warrants are longer dated, less frequently traded, and often have a larger initial outlay (higher face value) compared to trading warrants. Long-term leveraged exposure to the underlying, and/or specific features such as entitlement to dividends (instalment warrants), or a capital guarantee on the initial investment (capital protected warrants) are highlighted as the appeal of these instruments to investors (ASX 2007b).

The different warrant structures allow for differing levels of gearing and exposure to risk with protected share investments[25] (capital guaranteed investment structure) and turbo[26] barrier equity warrants representing the extremes (lowest to highest leverage/risk). Instalment warrants bridge the gap between these trading and investment products as a multi-purpose instrument available to the retail investor (ASX 2007c).[27]

2.7.1.1 Protected share investments (PSI)

Capital protected warrants or protected share investments as they are known in South Africa allow investors to profit from an increase in share price while the original value of the investment is assured or protected.[28] Various levels of gearing are possible with a higher gearing attainable by putting a capped level in place, thereby setting a maximum value for each protected share investment. A low/lower cap (closer to the initial price) equates to a high/higher level of gearing and stems from the fact that the capped market value translates to a lesser eventual number of shares being distributed to the investor upon expiry assuming an increase in the share price (Nedbank 2007c:1).

The investor pays R10 000 at the initiation of the PSI contract and has the right to receive two parcels of shares at maturity. The first parcel[29] comprises the number of shares worth the contracted amount as on the day of issuance in the primary market. A specific number of bonus shares are attached to each PSI and the second parcel[30] will consist of a number of shares, the market value of which will be equal to the increase in the value of these bonus shares over the investment period. The total of the two parcels is contained by the capped market value should the share price exceed the capped price upon expiration (Nedbank 2007c:1-2).

[25] See section 2.7.1.1 for a more detailed description of capital protected warrants or protected share investments.
[26] The terms turbo or knock-out refer to warrants with enhanced gearing.
[27] Instalment warrants (share instalments) feature prominently in the marketing efforts of the local financial institutions and are discussed in more depth in section 2.7.1.2.
[28] Protected share investments (PSI) are issued exclusively by Nedbank on a limited number of leading or "blue chip" JSE Limited listed shares (Nedbank 2007c).
[29] First parcel value = (capped/expiration price x initial number of shares worth R10 000).
[30] Second parcel value = (capped/expiration price – initial price) x number of bonus shares.

Therefore, depending on the scenario at expiration, the investor will receive additional shares either to compensate for a decrease in share value, or to participate in the capital gain from an increased share price (up to a capped level). Breaching the capped level will result in a reduction in the number of shares received by the investor at expiration (Nedbank 2007c:1-2).

The above account assumes that the PSI is purchased when issued (primary market transaction) and held until maturity. PSI prices in the secondary market are calculated according to the time left to maturity and the extent to which the spot prices differ from the initial prices. The value of the investment prior to maturity will not be less than the present value equivalent of R10 000 (Nedbank 2007c:3).

2.7.1.2 Share instalments (SI)

Share instalments or instalment warrants[31] expose investors to the apparent advantages (i.e. capital appreciation and dividend payouts)[32] of owning equity shares, at a specified fraction of the total cost. An upfront partial payment allows for a leveraged return and an enhanced dividend yield (Nedbank 2007b:5). Any potential loss is limited to the initial payment (downside protection) as the investor is presented with the alternatives of continuing (roll over), ending (close out) or formalising (buying outright) the transaction, depending on the movements of the underlying share price.

Share instalments allow investors to buy shares on debt, with the issuing entity financing the amount of the second instalment (loan amount). Essentially deep in-the-money call options with a fixed strike or completion payment, these American style options allow investors to exercise and settle at any time up to and including the expiration date (ABSA 2006:3; ABSA 2007:2-3). Delaying the optional payment results in the downside protection and amplified return mentioned.

Vanilla instalment holders are eligible to receive the full ordinary dividends payable on the underlying share. Discount instalments do not entitle holders to receive the actual dividend, since the dividend stream of the share is discounted into the price of the instalment instead, resulting in the lower/discounted prices as compared to vanilla instalments. Discount instalments do not change in price when the underlying share goes ex-divided (Standard 2007a:2; Standard 2007b:2-4).[33]

[31] Share instalments also known as dividend accruing retail trading securities (DARTS – ABSA 2007) or enhanced dividend securities (EDS – Investec 2007a).
[32] Vanilla instalments entitle the holder to receive the full ordinary dividend payable (Standard 2007a:1).
[33] Ex-dividend ("without dividend"): the period between the announcement of the dividend and the payment of the dividend when the seller and not the buyer will receive the dividend.

An additional stop-loss feature provides protection against a substantial fall in the underlying share price.[34] The share instalment terminates when the stop-loss (placed above the exercise price) is triggered, and the intrinsic value (if any) at that stage is paid out as a cash rebate (Investec 2007a:3). Another possible protection is the inclusion of a put option should the underlying share price fall below the exercise price. This limits the maximum potential loss to the amount initially paid (Standard 2007c:1).

Share instalments provide a less expensive, low-geared alternative to warrants without the associated volatility effect and time decay, according to Finweek (2006). Additional leverage is provided by twice geared share instalments issued with an exercise price of seventy-five percent of the underlying (25% upfront partial payment) instead of the usual fifty percent level (Standard 2007c:1).[35]

Analogous to share instalments are reverse securities (REVS – issued exclusively by Investec), effectively "deep-in-the-money" put options, providing geared exposure to declining markets. A stop-loss is placed below the exercise price, but above the spot price of the underlying. Should the share price close at or above this barrier level, the reverse security will terminate immediately and a rebate will be paid to the investor (Investec 2007d:2-3).

2.7.1.3 Barrier warrants

Barrier warrants are identical to conventional (trading/vanilla) warrants in most respects, with the exception that should the price of the underlying asset cross a pre-specified barrier, the warrant becomes worthless and lapses (i.e., the listing is terminated and the holder has no further rights). The prices of barrier warrants are less than those of vanilla warrants, incorporating the added price barriers (JSE 2007e:11).

The rationale for capping the (unlimited) upside potential for (call) warrants is found in the lower initial warrant price required and the higher delta, resulting in greater gearing – a larger move for a given change in the underlying (McHattie 2002:52).

Turbo or knock-out warrants are a special class of barrier warrant with the barrier level set at the strike price of the warrant. Delta is consequently very close to one when the warrant is in-the-money and moves in an almost one-to-one ratio with the underlying. These warrants are not

[34] Barrier level unique to the Investec issued enhanced dividend securities (EDS).
[35] Turbo SI issued by Standard Bank (Standard 2007c) or HotEDS issued by Investec (Investec 2007b).

sensitive to changes in implied volatility and have a linear theta (gradual time decay) over the life of the warrant (Standard 2007e:14).

2.7.2 Can-do derivatives

Can-do futures and can-do options on these futures or other assets allow parties to negotiate their own terms, specifically with regard to the underlying asset and expiration date. The reference asset may be an individual share, a quoted single stock futures contract, share index or a basket of shares negotiated by the long-position and short-position holders of the contract (JSE 2007a).

Seen as a hybrid of over-the-counter and exchange traded derivatives, can-do derivatives combine the flexibility of OTC contracts with the risk-offsetting properties inherent in listed derivatives (i.e., margining and the ability to "close out"). The value of an individual contract may not exceed R1 million and the position taken must have a nominal value of at least R10 million (JSE 2005c).

Can-do derivatives are unlikely to be liquid because of the tailor-made (unique) nature of OTC instruments. The minimum nominal contract value rules can-do derivatives out as a viable alternative for retail investors.

2.7.3 Contracts for difference (CFD)

Contracts for difference are the closest comparable product to single stock futures as they offer investors geared exposure to the most liquid JSE shares and allows them to benefit from both upward and downward movements in share prices (Cobbett 2007a). The concepts of increased leverage, ease of selling short, risk management capabilities (hedging) and margin requirements all place CFDs as the over-the-counter equivalent of exchange-traded single stock futures.

Cobbett (2007b) summarises the differences between CFDs and SSFs as follows:

- SSFs have expiry dates (3 to 6 months) and must be renewed to maintain a position. CFDs have no fixed expiry date and can remain open indefinitely.
- Borrowing costs and cash flows (e.g., dividends) are accounted for in the SSF price. CFD holders pay/receive interest on a daily basis and pay/receive dividends in cash.
- SSFs are regulated and trade on Safex. CFDs are unregulated and trade over-the-counter, leaving an investor exposed to counterparty risk.

The two parties to the contract agree to settle the difference between the opening price and closing price of the contract, multiplied by the number of shares specified in the contract.

An investor may be either the long or the short counterparty to the CFD. The long counterparty is effectively borrowing cash and the short counterparty is lending cash in respect of the underlying equity. A charge/credit is calculated daily on the exposure the long/short CFD provides to the investor in relation to the underlying. Long CFD positions receive and short CFD positions pay an amount equal to the value of any cash dividend owed to the holders of the underlying equity (Nedbank 2007a:3-5).

2.8 Summary

This chapter provided the background to single stock futures trading, concentrating on the interrelated concepts and terminology of the futures market and the underlying spot market. The assertions made regarding single stock futures, related to the suspected or desired impact of the introduction and increased popularity of SSF trading, was reviewed, along with the operational workings of single stock futures. Finally, alternatives to investing in single stock futures were presented in the form of similar single equity derivative securities.

Sections 2.2 and 2.3 assigned single stock futures to a particular market with specific characteristics: The JSE Limited (spot market) and the South African Futures Exchange (Safex – equity derivatives market) facilitate the trading of the underlying equity shares and single stock futures respectively. SSF contracts are exchange-traded forward commitments to buy or sell the shares of a particular JSE Limited listed company.

Section 2.4 examined the basic terminology and concepts fundamental to futures trading: SSF contracts permit the hedging of equity positions, investing in equity shares, and speculation on bi-directional (up and down) share price movements. Arbitrage practices ensure fair pricing of all tradable assets and establish the link between spot and futures markets through the cost-of-carry model. The ability to sell assets short is integral to fair pricing, and therefore arbitrage, allowing the market to trade on negative information. Open interest measures trading activity in the derivatives market, signifying market sentiment and the continuation or reversal of a prevailing trend. The concept of volatility as it relates to the underlying spot market is fundamental in determining the suitability of investment alternatives as it concerns the risk of and correlation between different securities, and therefore portfolio construction. Changing underlying market volatility is the primary focus of this research. The leverage or gearing properties of futures offer both the advantage, apart from the ability to establish future prices, and risk associated with these instruments and are linked to margin trading, which forms part of the marking-to-market system. Margining enhances exposure to an eventual gain or loss, while mitigating counterparty risk.

Section 2.5 (Market efficiency, completeness, stability and interaction) laid the foundation for researching SSF trading impact on the underlying equity market: The conceptual frameworks presented were the complete markets theory, the diminishing short sales theory and the improved information environment (informed trading) hypotheses. These theories refer to the possible stabilising or destabilising effect of derivatives trading due to the migration of traders, increased information and/or improved trading opportunities. The contribution of derivatives trading to the financial market place relates to these theories on market reaction.

Section 2.6 dealt with the actual instrument under investigation – single stock futures: The progress of single stock futures since introduction, perceived benefits to trading, contract specifications and pricing, as well as the technicalities of trading were covered. Large and ever increasing investor interest, augmented returns, mitigation of pre-existing risk, relative value trading, and transacting at reduced costs are shown as advantages from trading single stock futures. Options on SSF contracts offer investors additional strategies unique to contingent claims.

Section 2.7 positioned single stock futures relative to other comparable securities: The different types of warrants (options) offer differing levels of gearing and thus exposure to the underlying. Combining an option with an underlying (spot market security) or other options provides for risk-limiting, fixed-profit strategies (options on SSF contracts enable the same strategies). Contracts for difference tender an over-the-counter alternative to single stock futures, while the discussion on can-do derivatives suggested that they are not a viable proposition for retail investors.

In conclusion, single stock futures were shown as playing an increasingly important role in the South African financial market. The effect of this on the equity market is the topic of research, and the following chapter will describe the methodologies used to determine and analyse the extent of any influence SSF trading may have had on the underlying price (return), spot trading volume and share price volatility.

CHAPTER 3

RESEARCH METHODOLOGIES AND STATISTICAL TECHNIQUES

3.1 Introduction

The research methodologies applied to establish statistically what effect initial single stock futures trading has on the underlying are presented in this chapter. The following graphical representation (table 3.1) outlines the approaches followed to determine the price effect, volume effect and volatility effect, respectively.

Table 3.1

Price, volume, and volatility effect methodologies

Effect	Methodology	Section	Synopsis
Price	Event study: Market model	3.2.1	A market model approach was used to generate company betas and calculate normal and subsequently abnormal returns (i.e., actual minus normal).
	Event study: Dummy variable regression	3.2.6	Similar to the market model approach but abnormal returns generated directly via a dummy variable regression (day zero only).
Volume	t-test for change in mean	3.3.1	Pre- and post-period normalised (exponentially smoothed) average volumes calculated and the difference t-tested for significance.
	Dummy variable regression with trend coefficient	3.3.2	Similar to the t-test, but the dummy variable regression also includes a trend coefficient (time series variable) to account for the trending nature of volume.
Volatility	F-test for difference in variance	3.4.1	The volatility (standard deviation) of both periods (before and after the event) calculated and F-tested for significance.
	GARCH methodology	3.4.2	GARCH(1,1) model used to determine the effect and persistence of information on the conditional volatility (structure), and detect a change in the unconditional volatility (level) of a company, pre- to post-futures.
	Change in systematic risk (beta): Dummy variable regression	3.4.3	The market-company relationship was inspected before and after initial futures trading. A dummy variable regression tests for an absolute shift in the constant term (alpha) and a change in the slope coefficient (beta).

Section 3.2 describes the event study methodology used to determine the price effect and section 3.3 introduces the methods used to detect a change in the average normalised trading volume of the underling following the introduction of futures trading. Measuring changes in volatility (conditional and unconditional) and systematic risk involves a pre- to post-introduction variance comparison, a generalised autoregressive conditional heteroskedasticy model, and a dummy variable regression model, all dealt with in section 3.4.

Research done on the impact of derivatives introduction on the underlying relates to the conceptual frameworks presented in chapter 2, section 2.5, and listed as the complete markets theory, the diminishing short sales theory, and the improved information environment (informed trading) hypotheses. The results obtained from the statistical analysis are presented in chapter 4, and related to one or more of these theories.

3.2 Price effect

The expected or predicted impact on the price/return of the underlying security according to the three major theoretical frameworks is as presented in table 3.2:

Table 3.2

Predicted change in price according to conceptual frameworks

Complete markets	Diminishing short sales restrictions	Improved information environment
Positive – assuming a more efficient or complete market due to futures trading	Negative (lower) – futures allow short positions, thereby impounding negative information in the underlying. Arbitrage between futures and spot markets could also lead to lower equilibrium prices.	Either – positively related to future expectations

Source: Adapted from Clarke, Gannon & Vinning (2007:13)

An event study is conducted to determine the effect on the underlying with the introduction of futures trading (i.e., the event). A market model and regression model are used, respectively, to generate the abnormal returns required to analyse the impact. Sections 3.2.1 to 3.2.4 outline the concepts and principles of an event study. This is followed by a discussion of the market model approach to event studies (section 3.2.5); section 3.2.6 deals with the regression model which utilises a dummy variable, thereby isolating any abnormal returns caused by the event.

3.2.1 Event study methodology

The effect of a financial event on the value of a listed company can be measured using financial market data in an event study (Campbell, Lo & MacKinlay 1997:149). The effect of a firm-specific event (e.g., introduction of a single stock futures contract on a share) should reflect as an abnormal or unexpected change (positive or negative) in the firm's share price.

Event study methodology encompasses the econometric techniques used to estimate and draw inferences from the impact of an event or multiple identical events in a particular period. Table 3.3 provides a summary of the process followed to determine the price effect of single stock futures trading on the underlying.

Table 3.3

Outline of event study methodology

Event definition	Define the event of interest and identify the period under investigation. The event window including the event date and the periods prior to and after the event is specified. A multiple-day period overlapping the specific date of interest may capture additional information on the price effect of an event.
Selection criteria	Determine the security selection criteria for inclusion in the study. These criteria may include availability of data, market capitalisation, industry sector and/or distribution of event. A summary of the characteristics of the data sample is provided.
Normal and abnormal returns	Model the security price reaction. This generally involves an expectations model conditional upon the event. Any abnormal return is measured in order to appraise the event's impact on the share price. The abnormal return is the actual *ex post* return of the security minus the normal return of the security over the event window. The normal return is defined as the expected return not conditional on the event taking place. For each security i and event date τ we have: $AR_{i\tau} = R_{i\tau} - E\left[R_{i\tau} \mid X_{\tau}\right]$ (3.1) Where: $AR_{i\tau}$ = Abnormal return due to specific event $R_{i\tau}$ = Actual return during event period $E(R_{i\tau})$ = Normal return (expected return in the absence of any event) X_{τ} = Conditioning information for the normal return model

Estimation procedure	Estimate the excess returns.	The selected normal return model is used to estimate the model-parameters with a subset of data representing a defined estimation window. A normal or expected return for each security included in the study is derived from this specified pre-event period. The post-event period may be included to increase model robustness. The actual event period is not included in the estimation period to prevent the event from influencing the normal return estimates. This step entails the calculation of residuals from the returns generated by the specified model.
Testing procedure	Design the testing framework.	This step involves the formulation of the econometric design of the study. The null and alternative hypotheses are formulated and the technique for aggregating the abnormal returns of individual securities is determined.
Empirical results	Organise and group the excess returns.	Presentation of the basic empirical results and the diagnostics or analytical procedures. The residuals may be treated individually, but aggregation across securities and inferences on the average effect are standard.
Interpretation and conclusions	Analyse the results.	Insights on the apparent effect of the specified event on security prices. Concluding comments complete the study.

Sources: Adapted from Bowman (1983:563) and Campbell et al (1997:150-152)

A viable and effective event study requires the isolation of the event to the greatest degree possible, independence of individual company returns, and the assumption of constant systematic risk as represented by the beta coefficient used to determine the "normal" return. Wells (2004:66-67) recorded the following preferred features and requirements of an event study:

Feature: Extraneous factors diversified away and/or filtered out, leaving data that represent only the impact of the specified event on security returns.
Requirement: Samples are from different industries, each sample security has a different event day, and a large sample size.

Feature: Returns across the study sample are independent of one another.
Requirement: Study not focused on a specific industry.

Conversely, all the required features are potential problems and the event's impact may be confounded with other coincidental events, possibly resulting in any abnormal returns being incorrectly attributed to the studied event.

Feature: Constant beta[1] and the past is a perfect predictor of the future.
Problem: Empirical tests show that beta is not constant through time and that beta may change because the impact of a particular event may alter the co-movement between a security and the market. Shifting macroeconomic variables (e.g., interest rates, business cycles, and trade balances) also change a security's beta.

3.2.2 Normal return models

The selection of a normal return model precedes any parameter estimation, calculation of abnormal returns (residuals) and statistical significance testing. The following section provides a brief overview of the alternative models used in event studies.

Models for measuring normal performance are, according to Campbell et al (1997:153-154), loosely grouped into two categories, namely statistical and economic. Statistical models derive from statistical assumptions regarding security-return behaviour and are not dependent on any economic reasoning. Statistical models posit that asset returns are jointly multivariately normal and independently and identically distributed through time. Economic models, on the other hand, rely on assumptions concerning investors' behaviour (economic restrictions) in addition to statistical assumptions allowing for a more precise measure of the normal return.

Brown and Warner (1980:207-208) link up with the above, classifying three general benchmarks (i.e., models generating "normal" returns) to determine the *ex post*[2] abnormal return on any given security. On the basis of their classification and that of Campbell et al (1997:154-157), the following combined structure is presented:

The mean-adjusted returns model assumes that the *ex ante*[3] expected return, although it may differ across securities, is a constant and that the *ex post* predicted return equals this value. The abnormal return or residual is equal to the difference between the observed or actual return and this predicted constant return. The mean daily return on each individual security over a predetermined estimation period is thus used as the benchmark for the event period.

---

[1] Only valid if beta is required by the normal return model selected for the event study. See section 3.2.3.
[2] Ex-post (i.e., after the event) returns refer to actual returns.
[3] Ex-ante (i.e., before the event) returns refer to future or predicted returns.

The market-adjusted returns model assumes that the *ex ante* expected returns are equal across securities, but not necessarily constant for a given security. Limited availability of data dictates the use of this model because a market-adjusted return substitutes for a pre-event estimation period providing the required normal model parameters. This restricted market model's coefficients are pre-specified with α_i (intercept) constrained to be zero and β_i (slope coefficient) constrained to be one, and an estimation period is therefore not required to obtain parameter estimates. This is similar to the mean-adjusted model, but instead the market's mean return is in effect used as the benchmark for the event period.

The market model is a risk-adjusted statistical model that relates the return of any given security to the return of the market portfolio. A one-factor OLS regression analysis generates the intercept or alpha (α_i), and slope or beta (β_i), thereby incorporating a risk adjustment component to the estimate of returns. Beta is the measure of an individual security's co-movement with the market's return and is, therefore, a measure of market risk.

Risk-adjusted economic models restrict the parameters of statistical models and provide more constrained normal return models. The Capital Asset Pricing Model (CAPM) is an equilibrium model which equates the expected return of an asset to its covariance with the market portfolio and the risk-free interest rate. CAPM provides for a single risk factor (market risk premium), while the Arbitrage Pricing Theory (APT) incorporates multiple risk factors. Mackinlay (1997:19) states that the most important factor, however, remains the market factor and any additional factors add relatively little explanatory power. Statistical models provide any and all of the benefits from utilising a CAPM or APT model, and for event studies such models dominate.

3.2.3 Market model

The concept of abnormal returns is the central element of event studies and the benchmark or model generating normal returns is consequently central to conducting an event study. All extensions or variations to the market model attempt to reduce the variance of the abnormal return by explaining more of the variation in the normal return. The lack of sensitivity to model choice can be attributed to the fact that the marginal explanatory power of additional factors proved to be small and these factors contributed little to the reduction in the variance of the abnormal return. Ultimately the benefit from using the market model will depend on the coefficient of determination (R^2) of the regression as this determines the extent to which the variance of the abnormal return was reduced (Campbell et al 1997:154-155). The chosen model for this study is the market model, specified as follows:

For any security i the market model is:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{3.2}$$

$$E(\varepsilon_{it}) = 0 \qquad \text{var}(\varepsilon_{it}) = \sigma^2_{\varepsilon_i}$$

Where:

R_{it}	=	Period-t returns on security i (dependent variable)
R_{mt}	=	Period-t returns on the market portfolio m (independent variable)
ε_{it}	=	Error or disturbance term representing unsystematic risk
α_i	=	Intercept term (alpha – minimum return of security when market return is zero)
β_i	=	Slope coefficient (beta – systematic risk)
$\sigma^2_{\varepsilon_i}$	=	Variance of the disturbance term

The parameters of the model (α_i, β_i and $\sigma^2_{\varepsilon_i}$) are estimated by means of ordinary least squares (OLS) regression and used to calculate the residuals or abnormal returns.

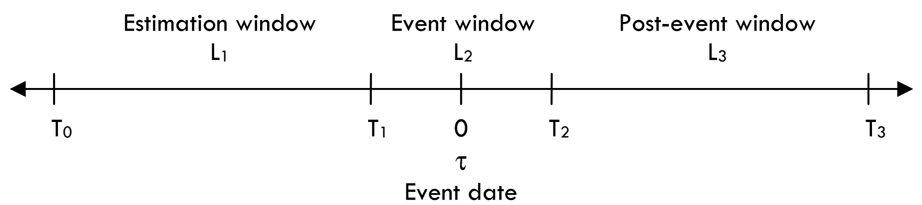
The following framework (sections 3.2.4 and 3.2.5) is based on that presented by MacKinlay (1997:19-31) and is developed with the market model as the normal returns model.

3.2.4 Measuring and analysing abnormal returns

The key focus of an event study is to measure the sample securities' average and cumulative average abnormal returns around the time of an event (Kothari & Warner 2006:7). Time is redefined relative to the day of the event and the average security price-movement for the sample securities is examined during specific days around the event month.

Figure 3.1

Time line for an event study



Returns indexed in event time using τ
Event date defined as $\tau = 0$

Estimation window: $L_1 = T_1 - T_0$ represented in event time by $\tau = T_0 + 1$ to $\tau = T_1$

Event window: $L_2 = T_2 - T_1$ represented in event time by $\tau = T_1 + 1$ to $\tau = T_2$

Post-event window: $L_3 = T_3 - T_2$ represented in event time by $\tau = T_2 + 1$ to $\tau = T_3$

The residual $\varepsilon_{i\tau}$ from the market model corresponding to day τ is the estimator of the abnormal return for security i during event day τ. This, according to Binder (1998:112-113), removes the effect of economy-wide factors on the return of the security and retains the portion of the return attributable to firm-specific information.

The design of the time line (timing sequence) eliminates any overlap between the estimation window and event window, ensuring that the estimated parameters of the normal return model are uninfluenced by the returns around the event. The exclusion of the event window when measuring the normal returns upholds the assumption that the abnormal returns will capture the impact of an event.[4] The post-event window data may also be included with the estimation period to estimate the normal return model (MacKinlay 1997:20).

3.2.5 Estimation of the market model

The relationship between a security's returns and returns on the market is estimated by ordinary least squares (OLS) regression and this relationship is used to estimate expected returns, given returns on the market.

For the i^{th} firm in event time, the OLS estimators of the market model for an estimation window of observations are:

$$\hat{\beta}_i = \frac{\sum_{\tau=T_0+1}^{T_1} \left(R_{i\tau} - \hat{\mu}_i\right)\left(R_{m\tau} - \hat{\mu}_m\right)}{\sum_{\tau=T_0+1}^{T_1} \left(R_{m\tau} - \hat{\mu}_m\right)^2} = \frac{\text{cov}_{R_{i\tau},R_{m\tau}}}{\text{var}_{R_{m\tau}}} \qquad (3.3)$$

$$\hat{\alpha}_i = \hat{\mu}_i - \hat{\beta}_i \hat{\mu}_m \qquad (3.4)$$

$$\hat{\sigma}^2_{\varepsilon_i} = \frac{1}{L_1 - 2} \sum_{\tau=T_0+1}^{T_1} \left(R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau}\right)^2 = \frac{1}{L_1 - 2} \sum_{\tau=T_0+1}^{T_1} \left(\varepsilon_{i\tau}\right)^2 \qquad (3.5)$$

Where: $\hat{\mu}_i = \frac{1}{L_1} \sum_{\tau=T_0+1}^{T_1} R_{i\tau}$ and $\hat{\mu}_m = \frac{1}{L_1} \sum_{\tau=T_0+1}^{T_1} R_{m\tau}$

$R_{i\tau}$ = Event-period-τ returns on security i

$R_{m\tau}$ = Event-period-τ returns on the market portfolio m

Source: MacKinlay (1997:20)

[4] The estimation framework will include the event window if the null hypothesis is expanded to accommodate any changes in risk (variance) of a firm due to the event.

Beta is calculated as the covariance between the market and the security during the estimation period, divided by the variance of the market in that period. The intercept term (alpha) is the difference between the average return (μ) on the security and the estimated return on the security as determined by the market return and calculated beta.

3.2.5.1 Statistical properties of abnormal returns (AR)

The parameter estimates of the market model allow the measurement and analysis of the abnormal returns.

The abnormal return $\left(AR_{i\tau}\right)$ is the disturbance term $\left(\varepsilon_{i\tau}\right)$ of the market model, calculated on an out-of-sample basis:

$$AR_{i\tau} = R_{i\tau} - \left(\hat{\alpha}_i + \hat{\beta}_i R_{m\tau}\right) = \varepsilon_{i\tau} \tag{3.6}$$

The abnormal returns are jointly normally distributed with zero conditional mean and conditional variance, $\sigma^2_{AR_{i\tau}}$, where:

$$\sigma^2_{AR_{i\tau}} = \sigma^2_{\varepsilon_i} + \frac{1}{L_1}\left[1 + \frac{\left(R_{m\tau} - \hat{\mu}_m\right)^2}{\hat{\sigma}^2_m}\right] \tag{3.7}$$

The conditional variance comprises the disturbance variance $\sigma^2_{\varepsilon_i}$ from (3.2) and the additional variance due to the sampling error in α_i and β_i. This sampling error leads to serial correlation of the abnormal returns even though the real disturbances are independent through time. However, the sampling error of the parameters disappears with a large estimation window $\left(L_1\right)$ and this additional variance then approaches zero. The variance of the abnormal return will therefore be $\sigma^2_{\varepsilon_i}$ and the abnormal return observations will become independent through time (MacKinlay 1997:21). These distributional properties are used to draw inferences over any period within the event window.

Under the null hypothesis (H_0 = Event has no impact on the behaviour of returns) the distribution of the sample abnormal returns of a given observation in the event window is:

$$AR_{i\tau} \sim N\left(0, \sigma^2_{AR_{i\tau}}\right) \tag{3.8}$$

Where: $\sigma^2_{AR_{i\tau}} = \sigma^2_{\varepsilon_i}$ with a large estimation window $\left(L_1\right)$

3.2.5.2 Aggregation of abnormal returns (CAR)

In an event study the focus is on the mean and the cumulative mean of the dispersion of abnormal returns. The abnormal return observations must be aggregated across observations of the event in order to draw overall inferences for the event of interest. Aggregation may occur along two dimensions – through time and/or across securities.[5] The event windows of the included securities should not overlap (no clustering assumption). The absence of any overlap and the distributional assumptions imply that the abnormal returns and the cumulative abnormal returns are independent across securities. The individual securities' abnormal returns are aggregated and averaged (3.9).

The cross-sectional average abnormal returns (residuals) in common event time:

$$\overline{AR}_\tau = \frac{1}{N}\sum_{i=1}^{N} AR_{i\tau} \tag{3.9}$$

For a large estimation window, L_1, the variance is:

$$\operatorname{var}\left(\overline{AR}_\tau\right) = \frac{1}{N^2}\sum_{i=1}^{N}\sigma^2_{\varepsilon_i} \tag{3.10}$$

Where:

N = Number of firms in the sample

τ = Event date

The average abnormal returns per event day are summed across days to measure the average cumulative effect of an event on the sample securities from day τ_1 to day τ_2. Cumulating these periodic average residuals over a particular time interval (number of days in the event window) allows for inferences concerning the general impact of the event.

The aggregated average abnormal returns over the event window:

$$\overline{CAR}_{\tau_1,\tau_2} = \sum_{\tau=\tau_1}^{\tau_2}\overline{AR}_\tau \tag{3.11}$$

Variance:

$$\operatorname{var}\left(\overline{CAR}_{\tau_1,\tau_2}\right) = \sum_{\tau=\tau_1}^{\tau_2}\operatorname{var}\left(\overline{AR}_\tau\right) = \frac{1}{N^2}\sum_{i=1}^{N}\sigma^2_{i_{\tau_1,\tau_2}} \tag{3.12}$$

Where $T_1 < \tau_1 \le \tau_2 \le T_2$

[5] This study focuses on the impact of a single event on several different firms (i.e., aggregation across securities). See MacKinlay (1997:21) for a discussion on the impact of multiple identical events on different firms (i.e., aggregation through time and across securities).

3.2.5.3 Tests for significance

A test statistic is calculated and compared to the assumed distribution under the null hypothesis that the event has no impact on the behaviour of returns (i.e., the mean abnormal return equals zero). The null hypothesis is rejected if the test statistic exceeds a critical value corresponding to the specified test level or size of the test. The standard test statistic is obtained by dividing the average or cumulative average abnormal return by the relevant standard deviation (3.14).

Inferences about the cumulative average abnormal returns are drawn using:

$$\overline{CAR}_{\tau_1,\tau_2} \sim N\left[0, \mathrm{var}\left(\overline{CAR}_{\tau_1,\tau_2}\right)\right] \qquad (3.13)$$

H_0 (Event has no impact on the behaviour of returns) tested using:

$$\theta_1 = \frac{\overline{CAR}_{\tau_1,\tau_2}}{\mathrm{stdev}\left(\overline{CAR}_{\tau_1,\tau_2}\right)} \sim N(0,1) \qquad (3.14)$$

A possible modification of the basic approach that may lead to more powerful tests[6] is to standardise each abnormal return using an estimator of its standard deviation (MacKinlay 1997:24). The purpose, according to Serra (2002:5) is to ensure that each abnormal return has the same variance. By dividing an abnormal residual by its standard deviation, each residual has an estimated variance of one. An amended test statistic of the hypothesis that the average standardised residual of a firm is equal to zero is calculated (not shown).

A two-sided test of the null hypothesis on the cumulative abnormal return based statistic θ_1 from (3.14) is used.[7] A confidence-interval approach as shown in (3.15) is used and values lying in this interval are plausible under H_0 with $100(1-\alpha)\%$ confidence. Hence, do not reject the null hypothesis if the value lies within this region. Outside the interval it may be rejected.

The null distribution is standard normal for a two-sided test size of α and the null hypothesis will be rejected if θ_1 lies in the following critical region:

$$\theta_1 < c\left(\frac{\alpha}{2}\right) \text{ or } \theta_1 > c\left(1-\frac{\alpha}{2}\right) \qquad (3.15)$$

Where $c(x) = \phi^{-1}(x)$

[$\phi(\cdot)$ is the standard normal cumulative distribution function (CDF)]

---

[6] The ability to detect non-zero abnormal returns.

[7] The alternative t-test and p-value approaches to significance testing are dealt with in section 3.5.

3.2.5.4 Problems with specifications

Referring to the "joint-test problem", Kothari and Warner (2006:15-18, 50) allude to the fact that event study tests are joint tests of whether abnormal returns are zero and whether the applied model of normal returns is correct. In addition, the set of assumptions regarding the statistical properties of the abnormal return measures must also be correct. Event study tests are therefore well specified only to the extent that the assumptions underlying their estimation are correct. Horizon length has a big influence on event study properties and largely determines the specification level, power, and sensitivity of test statistic specification. These possible problems do not apply to short-horizon event studies (less than 12 months) as these methods are relatively straightforward and trouble-free. Short-horizon event methods are powerful if the abnormal returns are concentrated in the event window. Also, the specification of the test statistic is not highly sensitive to the benchmark model.

A problem shared by both short- and long-horizon studies is the possible increase in the variance of the security's abnormal returns conditional on the event. As a result, test statistics can be miss-specified and the null hypothesis rejected too often (Kothari & Warner 2006:17-18).

3.2.6 Abnormal returns modelled as regression coefficients

Another approach involves regression methods with abnormal returns being generated as coefficients of dummy variables corresponding to the event dates. The regression approach is computationally simpler than the market model approach since estimation of the benchmark model and the abnormal return (dummy variable coefficient) are done concurrently, while the appropriate statistical tests are performed directly in standard regression software packages (McKenzie, Thomsen & Dixon 2004:535).

$$R_{it} = \alpha_i + \beta_i R_{mt} + \delta D_F + \varepsilon_{it} \tag{3.16}$$

Where:

D_F = Dummy variable

δ = Event coefficient

The dummy variable has a value of one on an event day and a value of zero otherwise. The coefficient is interpreted as the abnormal return on the event day and the level of significance indicated by the relevant p-value[8] generated as part of the regression output.

[8] A smal(ler) p-value is indicative of increased significance. Refer to section 3.5.

3.3 Volume effect

The expected or predicted impact on the trading volume of the underlying security according to the three major theoretical frameworks is as presented in table 3.4:

Table 3.4

Predicted change in volume according to conceptual frameworks

Complete markets	Diminishing short sales restrictions	Improved information environment
Higher - assuming a more efficient or complete market due to futures trading	Unclear – short selling occurs in the futures market and not the underlying market. Faff and Hillier (2005:1365) foresee an increase in trading volume.	Unclear – similar to diminishing short sales theory. Informed traders trade on negative information (short sell in futures market).

Source: Adapted from Clarke et al (2007:13)

To determine whether the event caused a permanent change in volume the average normalised volume pre- and post-event is calculated and tested. An additional test is performed with a dummy variable with trend coefficient regression to determine whether the volume changed significantly even after accounting for the natural increase in trading volume over time.

3.3.1 Average normalised volume

Share trading volume is a highly volatile factor, according to Clarke et al (2007:30), often resulting in large variances, generally non-normal distributions and many outliers. An exponential smoothing process is applied to the data to normalise the volume and these normalised volume figures are used in the analysis.

An exponentially weighted moving average (EWMA) process assigns exponentially decreasing weights to older data. The single exponential smoothing method is appropriate for a series that moves randomly above and below a constant mean with no trend or seasonal patterns. A double smoothing method is appropriate for a series with a linear trend. The smoothed series is calculated recursively, by evaluating the formula presented in (3.17). The forecasted value is a weighted average of the past values of the series where the weights decline exponentially with time. The smaller the damping or smoothing factor, the more smoothed the eventual forecasted series. An initial forecasted value is required to start the recursion and the mean of the initial (T+1)/2 observations of the original series is used for this purpose. The statistician's judgment is used to choose an appropriate smoothing factor. Alternatively, 2/(T+1) can be used or a method of least squares applied where the sum of squares of one-step ahead forecast errors is minimised (NIST 2006).

Single exponential smoothing formula:

$$s_t = \alpha y_t + (1-\alpha)s_{t-1} = s_{t-1} + \alpha(y_t - s_{t-1}) \quad (3.17)$$

Where:

y_t = Raw data

s = Output of the exponential smoothing algorithm

α = Smoothing factor $(0 < \alpha \leq 1)$

Sources: EViews (2007a:356) and NIST (2006)

To determine whether the event caused a permanent change in volume, the average normalised volume in a specified number of days prior to the event is compared to the average normalised volume in the period subsequent to the event. Significance is determined using a t-test for differences between means.

When it is believed that the two samples or groups are approximately normally distributed, independently of each other, and that the population variances are assumed to be equal, the following t-test is used:

Definition of the t-test:

$$t = \frac{(\overline{X}_1 - \overline{X}_2) - (\mu_1 - \mu_2)}{\left(\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}\right)^{1/2}} \quad (3.18)$$

Where:

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2} \quad ;\ df = n_1 + n_2 - 2$$

With $\mu_1 = \mu_2$ the equation simplifies to $t = \frac{\overline{X}_1 - \overline{X}_2}{S_{\overline{X}_1 - \overline{X}_2}}$ (3.19)

Where:

$$S_{\overline{X}_1 - \overline{X}_2} = \sqrt{\frac{s_1^2 + s_2^2}{n}} \quad ;\ df = 2n - 2$$

Source: Adapted from DeFusco, McLeavey, Pinto & Runkle (2004:343)

A pooled estimate, drawn from the combination of the two different samples is used. If equal variances cannot be assumed, an approximate t-test is available using “modified” degrees of freedom (DeFusco, McLeavey, Pinto & Runkle 2004:342-345).

3.3.2 Dummy variable regression

Trading volume generally tends to increase over time and a dummy variable regression considering this trend is used, as this is not captured by a t-test for change in mean.

Equation used to estimate volume:

$$V_{it} = \alpha_i + \beta_i T_{it} + \delta D_F + \varepsilon_{it} \tag{3.20}$$

Where:

V_{it}	=	Normalised volume for security i at time t
α_i	=	Intercept
$\beta_i T_{it}$	=	Trend (day) coefficient and variable
δD_F	=	Dummy coefficient and variable

The dummy variable takes the value of zero for the pre-event period and one for the post-event period. The coefficient is interpreted as a change in trading volume after considering any underlying trend which may bias the results of the dummy variable. The level of significance is indicated by the relevant p-value of the statistical output.

3.4 Volatility effect

The expected or predicted impact on the volatility of the underlying security according to the three major theoretical frameworks is as presented in table 3.5:

Table 3.5

Predicted change in volatility according to conceptual frameworks

Complete markets	Diminishing short sales restrictions	Improved information environment
Lower – assuming a more stabilised (efficient/complete) market due to futures trading	Lower – improved efficiency by reducing the asymmetric response to information. Arbitrage between futures and spot markets could lead to lower volatility.	Lower – improved price discovery due to futures trading, leading to smaller fluctuations in price

Source: Adapted from Clarke et al (2007:13)

A ratio of pre-event variance to post-event variance is calculated as a preliminary test, with a GARCH model employed as the primary evaluation technique for changes in volatility due to the event. In addition, a pre-to-post beta comparison via a dummy variable regression is used to test for a change in systematic risk (beta) of a security following the event.

3.4.1 Variance

Variance (historical) is the measure of variability or statistical dispersion of security or portfolio returns, indicating the spread of historical values around the mean value. The variance is calculated as the mean of the sum of squares of the differences between the values and the mean of the sample. A larger variance denotes higher volatility and increased risk. As stated by Engle (2001:166), "volatility is a response to news, which must be a surprise". The timing of the news may be expected and this shows up as the predictable components of volatility, such as economic announcements. In order to determine a change in unconditional variance (volatility), a ratio of pre-futures variance to post-futures variance is calculated and an F-test applied.

Test statistic for tests concerning differences between variances of two sample periods:

$$F = \frac{s_1^2}{s_2^2} \tag{3.21}$$

Where:

s_1^2 = Variance for pre-event period ($df_1 = n_1 - 1$ numerator degrees of freedom)

s_2^2 = Variance for post-event period ($df_2 = n_2 - 1$ denominator degrees of freedom)

The larger of the two ratios s_1^2/s_2^2 and s_2^2/s_1^2 is used as the actual test statistic and the value of the test statistic is therefore always greater than or equal to one. The rejection point for any formulation of the hypothesis is a single value in the right-hand side of the relevant F-distribution. A "not equal to" alternative hypothesis has the null hypothesis rejected at the α significance level[9] if the test statistic is greater than the upper $\alpha/2$ point of the F-distribution. A "greater than" or "less than" alternative hypothesis sees the null hypothesis rejected at the α significance level if the test statistic is greater than the upper α point of the F-distribution with the specified degrees of freedom (DeFusco et al 2004:353-354).

3.4.2 Generalised autoregressive conditional heteroskedasticity (GARCH) model

The impact of a security-specific event on the level or degree of the security's price changes and the duration thereof is modelled as the conditional variance of the security. An increase or decrease in the post-event unconditional variance of the security is detected by the relative changes in parameter values specified by a GARCH model. The following section sourced from DeFusco et al (2004:518-558) provides an overview of time series analysis and serves as a background to the generalised autoregressive conditional heteroskedasticity (GARCH) model.

---

[9] The level (α) of significance indicates the probability of a normally distributed variable changing by more than a specific number of standard deviations (refer to section 3.5).

3.4.2.1 Introduction to time series analysis

A time series is a set of observations on a variable over successive periods of time. Time series models include trend models, autoregressive (AR) models, moving-average (MA) models as well as autoregressive moving-average (ARMA) models. A trend is any consistent pattern in the change of a time series over time and a linear trend is a time series pattern that may be graphed using a straight line (the dependent variable changes at a constant rate with time). A log-linear trend model is a common alternative to a linear trend line and is frequently used with data that exhibit exponential growth (constant growth at a particular rate). The data are transformed by taking the natural logarithm of each observation in the series, producing a trend line with a better fit for the data and increasing the predictive ability of the model. However, linear and log-linear trend models involve only a single independent variable, time, and may not fully explain the patterns present in a data set. In any event, should a residual plot or the Durbin-Watson statistic reveal the presence of serial correlation,[10] a lagged or autoregressive model must be used.

In an autoregressive model (AR) the dependent variable is regressed against one or more lagged variables of itself. The order of the AR model is the number of lagged terms, not the length of the lag. A model with one lag is referred to as a first-order autoregressive model or AR(1). If an AR model is specified correctly (i.e., correct number of lags included), the residual terms will not exhibit serial correlation. Autocorrelations of the residuals for different lagged periods are calculated and a lag corresponding to a significant autocorrelation (if any) included in the model. The autocorrelations of the residuals are then checked again. This process is followed until all autocorrelations are insignificant, thereby having determined the correct order AR model.

In addition, in order to make valid statistical inferences based on OLS estimates for a lagged time series model, it is assumed that the time series is covariance stationary. A time series is covariance stationary if its properties, such as the mean (expected value), variance, and covariance (between current, leading or lagged values) are constant (do not change over time).

An important condition for a covariance stationary AR(1) model is a defined mean-reverting level. This excludes a random walk process[11] and the time series having a unit root.[12] With a time series that is a random walk and contains a unit root, covariance stationarity is obtained by first

[10] Serial or autocorrelation is a violation of the regression model assumptions and simply means that the error terms are correlated with one another. Multicollinearity (correlation between two or more independent variables) and heteroskedasticity (non-constant variance of the error terms) are additional violations of regression assumptions.
[11] A random walk is when the predicted value of the series in one period is equal to the value of the series in the previous period, plus some random error. Random walks may possess a drift (i.e., expected to increase or decrease by a constant amount).
[12] The coefficient on the lag variable is equal to (unit root) or larger than one (explosive root).

differencing[13] the time series and then modelling this differenced time series as an autoregressive time series.

A raw plot of the data would show the plotted points expanding or contracting (variance not constant), and/or trending upward or downward (mean not constant), thereby indicating that the covariance of the time series is not stationary. Alternatively, running an AR model and testing the correlations would establish the state of the time series, as would performing the Dickey-Fuller test for a unit root, a test that is employed before running the AR model.

Moving-average (MA) models are aimed toward removing the seasonal and irregular components or isolating the trend-cycle components of a time series, smoothing out period-to-period fluctuations. The newly generated series is simply a smoothed version (moving average) of the original series. An autoregressive moving-average (ARMA) model combines both autoregressive lags of the dependent variable and moving average methods.

3.4.2.2 Autoregressive conditional hereroskedasticity

An ordinary least squares regression model is subject to the conditions that (1) the expected value of the error terms is zero, (2) the variance of the error term is constant, that is homoskedasticity, and (3) there is no serial correlation in the time series.

The expected value of all error terms or residuals, when squared, should be the same at any given point. In other words, the variances of the error terms must remain constant with time. This assumption is referred to as homoskedasticity. The violation of this constant variance assumption is the basis for ARCH/GARCH models. Therefore, when a time series is heteroskedastic, it exhibits time-varying variance (i.e., volatility) and is said to have ARCH effects.

As stated, heteroskedasticity is associated with time-varying volatility. Also, “conditional” implies a dependence on the observations of the immediate past, and “autoregressive” describes a feedback mechanism that incorporates past observations into the present (Mathworks 2006:1.3). Autoregressive conditional heteroskedasticity (ARCH), therefore, describes the condition where the variance of the residuals in one period within a time series is dependent on, or is a function of, the variance of the residuals in another preceding period. If this condition exists, the standard errors of the regression coefficients in AR models and the hypothesis tests of these coefficients will be invalid.

[13] The first differencing process involves subtracting the value of the time series in the immediately preceding period from the current value of the time series.

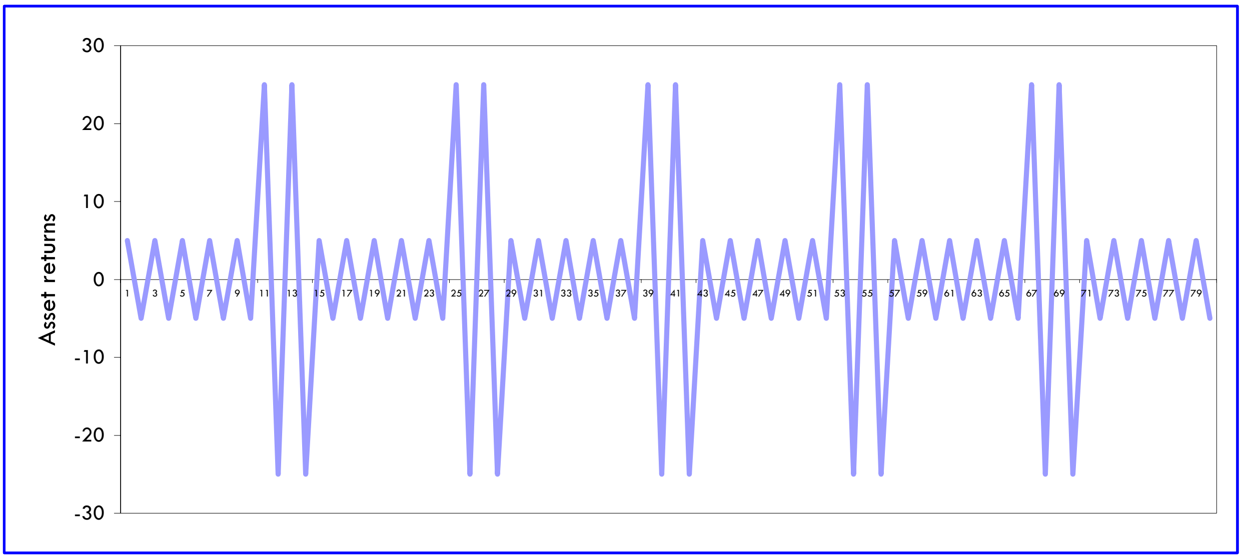
But, as stated by Engle (2001:157), "Instead of considering this as a problem to be corrected, ARCH and GARCH models treat heteroskedasticity as a variance to be modelled." GARCH models are mean reverting and conditionally heteroskedastic, with a constant unconditional variance. Therefore, the least squares deficiencies are corrected and the required conditions satisfied.

ARCH models are specifically designed to model and forecast conditional variances. The variance of the dependent variable is modelled as a function of past values of the dependent variable and independent variables. ARCH models were introduced by Engle (1982) and generalised as GARCH (Generalised ARCH) by Bollershev (1986). The standard GARCH(p,q) suggests that the conditional variance of returns is a linear function of lagged conditional variance terms and past squared residual terms (Butterworth 2000:440).

GARCH (p,q) is the standard notation in which the first number (p) refers to the number of autoregressive lags (ARCH terms) and the second number (q) refers to the number of moving average lags (GARCH terms). GARCH(1,1) therefore refers to the presence of a first order ARCH term and a first order GARCH term (Engle 2001:160).

Figure 3.2

GARCH process



Source: Adapted from Miles (2008:75)

The GARCH process, exhibited in figure 3.2, is characterised by volatility clustering, that is tranquil periods interspersed with periods of high volatility. Variance, rather than being constant, is an autoregressive (AR) process where the current period's volatility is conditional on past (lagged) volatility (Miles 2008:75).

3.4.2.3 Specification of the GARCH(1,1) model

In developing a GARCH model, two distinct specifications have to be provided – one for the conditional mean (3.22) and one for the conditional variance (3.23). The conditional variance equation is a function of three terms, namely the

- mean or constant: ω (long-term average)
- information about the volatility of the previous period, measured as the lag of the squared residual from the mean equation: ε_{t-1}^2 (ARCH term)
- forecasted variance from the last period: h_{t-1} (GARCH term)

The conditional mean equation (3.22) contains an autoregressive component that explains the current asset price. The GARCH model is captured by (3.23) where the variance of the error terms has been modified from being assumed to be constant to being time varying. The GARCH(1,1) parameterisation for the conditional variance implies that current volatility depends on past squared error terms and an autoregressive component of the conditional variance. The parameters of the GARCH(1,1) model are estimated using maximum likelihood under the assumption of conditional normality (Brooks 2002:456).

Brooks (2002:455-458) describes the maximum likelihood technique as essentially finding the most likely values of the parameters given the actual data. A statistical software programme employing iterative techniques generates the parameter values and associated standard errors that maximise the LLF.[14] Therefore, given a set of initial "guesses" for the parameter estimates, these parameter values are updated at each iteration until an optimum is reached (i.e., convergence). Convergence is achieved and the programme will stop searching when the biggest percentage change in any of the parameter estimates for the most recent iteration is smaller than 0,01% (default setting). This iterative procedure using a modification of the Berndt, Hall, Hall and Hausman (BHHH) algorithm for optimisation, namely the Marquardt algorithm, incorporates a correction, pushing the parameter estimates more quickly to their optimal values. An assumption about the conditional distribution of the error term is required and the normal (Gaussian) distribution, Student's t-distribution, and the Generalised Error Distribution (GED) are assumptions commonly employed when working with ARCH models. The Heteroskedasticity Consistent Covariance option is available when selecting the conditional normal as the error distribution, thereby calculating the quasi-maximum likelihood (QML) covariances and standard errors using the robust-to-non-normality method of Bollershev-Wooldridge (EViews 2007b:187,192).

[14] ARCH/GARCH procedure performed with the EViews6 statistical software package.

AR(1)-GARCH (1,1) model specification

Conditional mean equation

$$y_t = a + by_{t-1} + \varepsilon_t \qquad ;\ \varepsilon_t \sim N(0, h_t) \tag{3.22}$$

Conditional variance equation

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} \quad ;\omega > 0, \alpha > 0, \beta \geq 0 \tag{3.23}$$

Unconditional (constant) variance of the error term

$$\mathrm{var}(\varepsilon_t) = \frac{\omega}{1-(\alpha+\beta)} \tag{3.24}$$

Specification of the log-likelihood function (LLF)

$$L = -\frac{T}{2}\log(2\pi) - \frac{1}{2}\sum_{t=1}^{T}\log(h_t) - \frac{1}{2}\sum_{t=1}^{T}\frac{(y_t - a - by_{t-1})^2}{h_t} \tag{3.25}$$

Where:

y_t	=	Dependent variable (return on an asset)
a	=	Constant
by_{t-1}	=	Autoregressive coefficient and explanatory (lagged) variable
ε_t	=	Error term

And:

h_t	=	Conditional variance in period t
ω	=	Constant (long-term average)
$\alpha\varepsilon_{t-1}^2$	=	News coefficient and ARCH(1) term
βh_{t-1}	=	Persistence coefficient (old news) and GARCH(1) term

Source: Adapted from Brooks (2002:455-457)

If convergence is not achieved or implausible (i.e., parameter values are negative or too large) when parameter estimates are obtained with the default estimation settings, the estimation could be redone with different starting values (programme assigns its own starting values using OLS regression for the mean equation), and/or by selecting a different error distribution to the Normal (Gaussian), increasing the maximum number of iterations or adjusting the convergence criterion. The parameters should be positive and should add up to a number less than one (required for a mean reverting variance process). A variety of views and procedures for inference and diagnostic checking are available to detect model failures (Engle 2001:161; EViews 2007b:192,195).[15]

[15] Refer to section 3.4.2.4.

A GARCH model[16] is parsimonious (i.e., the coefficients of the model are easily interpreted) and gives significant results, since it allows the conditional variance of an asset price to be dependent upon previous own lags (Floros 2007:363). The advantage of a GARCH model, according to Joshi and Pandya (2008:9) and Samanta and Samanta (2007:57), is the ability to capture the tendency in financial data for volatility clustering, thereby enabling an explicit connection between information and volatility. Any change in the rate at which information arrives in the market will change the volatility in the market. According to Engle (1993:72), volatility clustering or pooling is one of the oldest noted characteristics of financial data. Periods of high/low volatility are likely to be followed by subsequent periods of high/low volatility, attesting to the predictability of volatility. The implication of such volatility clustering is that current volatility shocks will influence future expectations of volatility (Engle & Patton 2001:239). It is therefore beneficial to determine statistically whether recent information is more important than old information, and how fast information decays. Samanta and Samanta (2007:61) state that the GARCH equation has two effects: the effect of recent news to the market (ARCH effect) and the effect of the old news in the market (GARCH effect). Variation in the size of these two effects determines the current or lingering influence of news on the market; with the sum of these effects indicating the degree of persistence in volatility. Similar views on the impact, dissemination, and persistence of news are expressed by Steeves (2002), Butterworth (2000), and Bologna and Cavallo (2002), as can be seen from the discussion to follow.

Steeves (2002:43) claims that, “a significant ARCH or GARCH term in the variance equation implies that the sample follows a persistent clustered volatility process”, meaning that once there is a shock or jolt to the share price, the impact is more likely to persist for several subsequent periods. An insignificant ARCH or GARCH would indicate that the impact only would last for one period. Butterworth (2000:440) interprets the change in coefficient-size of the conditional variance equation accordingly: Following the event of interest, an increase in the ARCH(1) coefficient would suggest that news is impounded into prices more rapidly, and a decrease translates to a slower dissemination of the news and apparent impact on the asset price. An increase in GARCH(1) suggests greater persistence of the effect on price changes, while a decrease in the coefficient would imply that news does not have a prolonged effect on price changes. Different permutations of changes to the coefficients enable the GARCH framework to detect variations in both the level and structure of volatility. Bologna and Cavallo (2002:189) similarly define α as a “news” coefficient and β as an “old news” coefficient. These are explained as the speed at which information is incorporated in prices and the uncertainty about

[16] Various other ARCH-type models such as Threshold GARCH (TGARCH), ARCH-in-Mean (ARCH-M), Exponential GARCH (EGARCH), and Component GARCH (CGARCH) can be used to capture much of the time-varying volatility. However, the model used most widely is the GARCH(1,1) model, found to generally outperform the other GARCH models (Joshi & Pandya 2008:14,16).

previous news, respectively. The autoregressive root which governs the persistence of volatility shocks is the sum of these two coefficients. A root ($\alpha+\beta$) close to unity causes the effect to dissipate slowly. The tendency of shocks to persist and volatility to cluster depends on the sum of the ARCH and GARCH parameters. Engle and Patton (2001:239) refer to the propensity of volatility to return to a normal level (i.e., decay over time), meaning that volatility is mean reverting (assuming a root less than unity) and hence predictable. Mean reversion in volatility implies that current information has no effect on the long-term forecasts.

The term "persistence to shocks" is used to describe the response or reaction of a share price to shocks and refers to the propensity or inclination of a particular share to exhibit the impact and after-effect of a shock (i.e., unexpected news) on its price. The size of the autoregressive root (AR root) signifies the possible extent of any shock effect, namely the persistence to shocks.

Morimune (2007:4-5) states that for GARCH(1,1) the conditions of $\omega > 0$, $\alpha > 0$ and $\beta \geq 0$ are sufficient to ensure a strictly positive conditional variance, $h_t > 0$. The ARCH (α) effect captures the short-run persistence of shocks and the GARCH (β) effect indicates the contribution of shocks to the long-run persistence ($\alpha+\beta$) of volatility. The necessary and sufficient condition for the existence of variance stationarity (i.e., a defined mean-reverting level) is $(\alpha+\beta) < 1$. This is reiterated by Floros (2007:363) who states that all parameters must be positive, with the sum of α and β expected to be less than but close to unity, with $\beta > \alpha$. The value of ω (constant) is also expected to be small. Samouilhan (2007:105) explains that with the combined value (i.e., the autoregressive root) closer to unity, persistence declines slowly and there is much volatility clustering. In the extreme cases where $(\alpha+\beta) = 1$, the shock-effect never dissipates, and with $(\alpha+\beta) = 0$ the shock dies out immediately (i.e., no ARCH effects).

A pre-event subsample and a post-event subsample are tested separately for ARCH(1) and GARCH(1) effects. The significance, size and change in coefficients from equation (3.23) are evaluated, and the unconditional variance (3.24) calculated so long as $(\alpha+\beta) < 1$. For $(\alpha+\beta) \geq 1$, the unconditional variance is not defined and labelled as "non-stationary in variance". A change in the ω coefficient post-event relative to the change in the autoregressive root ($\alpha+\beta$) confirms an increase or decrease in the unconditional (long-term average) variance of a security (Butterworth 2000:441).

Alternatively, any change in the unconditional variance of an asset price after the event can be detected by augmenting (3.23) to include a dummy variable (3.26). The dummy variable is equal to 0 for all pre-event periods and to 1 afterwards.

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} + \delta D_F \tag{3.26}$$

$$var(\varepsilon_t) = \frac{\omega + \delta}{1 - (\alpha + \beta)} \tag{3.27}$$

Where:

δ = Coefficient

D_F = Dummy variable

The unconditional variance for the period after the event is then calculated as in (3.27), as opposed to (3.24). A significant positive (negative) coefficient points to an increase (decrease) in the volatility as a result of futures trading (Samanta & Samanta 2007:61).

3.4.2.4 Diagnostic tests

The Ljung-Box Q-statistic test with a specified number of lagged autocorrelations is utilised to test whether the ARCH/GARCH model adequately captured all of the persistence in the variance of returns. This requires an inspection of the correlogram (autocorrelations and partial autocorrelations) of the squared standardised residuals (Engle & Patton 2001:242; EViews 2007a:326). If the variance equation is specified correctly all Q-statistics should not be significant (i.e., squared standardised residuals serially uncorrelated). The specification of the mean equation can similarly be checked and tested for remaining serial correlation by looking at the correlogram of the standardised residuals with all Q-statistics expected not to be significant (EViews 2007b:195).

The ARCH LM test carries out Lagrange multiplier tests to test whether the standardised residuals exhibit additional ARCH. A correctly specified variance equation should exhibit no ARCH in the standardised residuals. Two test statistics, namely the F-statistic and the Obs*R-squared statistic, are reported from this test regression (EViews 2007b:158,196).

The Jarque-Bera (JB) statistic tests the null of whether the standardised residuals are normally distributed. If the standardised residuals are normally distributed, the Jarque-Bera statistic should not be significant. The difference between the skewness (i.e., extent not symmetric about mean value) and kurtosis (i.e., "peakedness" and "fat tails" of distribution – related to frequency and size of deviations) of the series and those from the normal distribution is measured. A small reported probability (p-value) leads to the rejection of the null hypothesis of a normal distribution. The Jarque-Bera statistic follows the chi-squared distribution with 2 degrees of freedom (EViews 2007a:308; EViews 2007b:195). Even if the conditional normality assumption does not hold, the parameter estimates will still be consistent if the mean and variance equations are specified correctly. However, the usual standard errors estimates will be inappropriate requiring the Heteroskedasticity Consistent Covariance option (available in the statistical software programme) to be selected, calculating the Bollershev-Wooldridge robust standard errors (Brooks 2002:461). The Student's t-distribution and GED (fat tail distributions) capture the non-normal aspects of the data and provide an alternative solution for the non-normality of the residuals (Samouilhan & Shannon 2008:23).

3.4.3 Systematic risk

Systematic risk, also called market risk or non-diversifiable risk is the risk attributable to all assets and is measured statistically by beta. Systematic risk is the only risk priced by rational investors since it cannot be eliminated by diversification. Beta is the measurement of a security's relative volatility, quantifying the sensitivity of a security's return to the return of the market, and calculated as follows:

$$\text{Beta} = \frac{\text{Covariance}_{\text{security,market}}}{\text{Variance}_{\text{market}}} = \frac{\text{Correlation}_{s,m} \times \text{Stdev}_s \times \text{Stdev}_m}{\text{Var}_m} = \frac{\text{Correlation}_{s,m} \times \text{Stdev}_s}{\text{Stdev}_m}$$

Security return is consequently benchmarked against an index serving as a proxy for the market return and risk is determined relative to the market. Changes in this risk (beta) are captured by the following dummy variable regression:

OLS-regression model with dummy variable:

$$R_{it} = \alpha_i + \beta_0 R_{mt} + \beta_1 (R_{mt} \times D_F) + \beta_2 D_F + \varepsilon_{it} \tag{3.28}$$

Where:

α_i	=	Constant term
$\beta_0 R_{mt}$	=	Beta coefficient and the market return
β_1	=	Coefficient measuring a change in beta
β_2	=	Coefficient measuring a shift in the constant term
D_F	=	Dummy variable

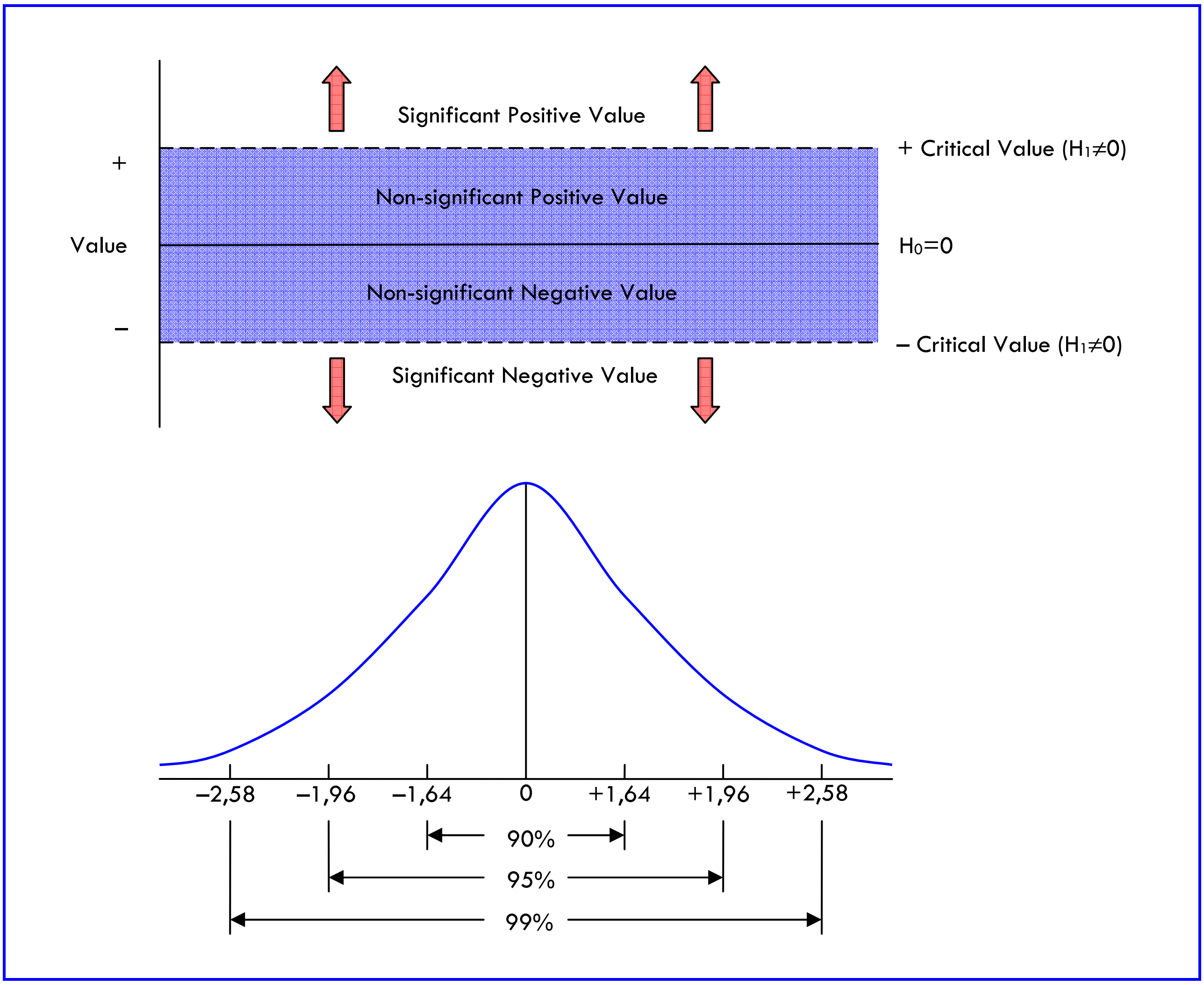
An ordinary least squares regression model is calculated between the lognormal returns of the security and the lognormal returns of the market index, for a specified number of days prior to the event (futures trading) and again subsequent to the event. A dummy variable regression is used, with a dummy variable combination testing for an absolute shift in the constant term, and for a change in the slope of the correlation between the security return and the market return. The dummy variable is zero for the pre-event period and one for the post-event period. The broad-based JSE/FTSE All Share Index (ALSI) is used as a proxy for the return on the market.

3.5 General tests for significance

This section, sourced mainly from Gujarati (1995:122-134), deals with the standard tests employed to determine the statistical significance of the results from this study. Significance, in general, is established by comparing the size of the observed value to the expected or acceptable norm (e.g., standard deviation). A large enough discrepancy between the actual and the accepted will realise significance at a certain level of confidence. The t-test as an alternative to the z-test (normal distribution), used to determine the significance of the calculated abnormal returns from the event study,[17] is discussed as well as the F-test. Three different approaches to establish significance, namely the confidence interval, test of significance and p-value (part of statistical programme output) are mentioned.

Figure 3.3

Statistical significance



Source: Adapted from Gujarati (1995:123-127)

[17] See section 3.2.5.3.

Figure 3.3 depicts the approach where the null hypothesis (H_0=0) is tested against the alternative hypothesis (H_1≠0) in order to decide whether to reject (i.e., discrepancy between actual and hypothesised value exceeds a specific critical value) or not reject (i.e., actual value sufficiently close to hypothesised value) the null hypothesis. This two-sided or two-tail test results in the null hypothesis being (not) rejected if the actual value falls (inside) outside the region or confidence interval associated with a certain level of significance/confidence. Constructing a 95% confidence interval is equivalent to using the 5% level in a test of significance and is interpreted as follows: a 95% certainty that a normally distributed variable will not change (increase or decrease) in value by more than 1,96 standard deviations, or equivalently a 5% probability that a normally distributed variable will change by more than 1,96 standard deviations.

The p-value (i.e., probability value) is known as the observed or exact level of significance and is the lowest significance level at which a null hypothesis can be rejected. This p-value provided as part of the output from a statistical software package is reported as a two-sided test. In order to reject the null hypothesis (H_0=0), the p-value has to be small (in contrast to a large test statistic) and depending on the size, translates to a significant, moderately significant or highly significant statistical finding.

A t-distribution (similar to the normal distribution, but with fatter tails and a smaller peak) is used with the t-test and the critical value is determined by the number of degrees of freedom (df). A t-distribution with an infinite number of degrees of freedom is a standard normal distribution. Aside from that, the critical values for the t-distribution are larger in absolute value than those from the standard normal. Therefore, when a t-distribution is used, for a given statistic to attain the same level of significance it has to be bigger in absolute value than where the normal is applicable (Brooks 2002:68-69).

A hypothesis on the relative values of the variances of two normally distributed populations is tested by means of an F-test, which is the ratio of the sample variances.[18] The F-distribution is asymmetrical and has only positive values. Each F-distribution is defined by two values of degrees of freedom, namely the numerator and the denominator degrees of freedom. The F-variable is simply the ratio of two independently distributed chi-square variables divided by their respective degrees of freedom (Gujarati 1995:109).[19] The null of no difference between the variances of two populations is rejected if the test statistic exceeds the critical F-value (two-sided test).

[18] See section 3.4.1.

[19] The chi-square test statistic, denoted by χ^2, is used in tests on the variance of a single normally distributed population. See also section 3.4.2.4 on the Jarque Berra (JB) test of normality that follows the chi-squared distribution with 2 df.

3.6 Summary

This chapter outlined the statistical techniques applied in researching the price effect, volume effect and volatility effect of initial futures trading on the underlying instrument. In an attempt to discern any possible statistically significant changes in the behaviour of the underlying, the following techniques were discussed: Event study methodology; t-test for change in mean; F-test for difference in variance; GARCH methodology and dummy variable regressions.

An event study methodology utilising the market model and a dummy variable regression (event-day only) should detect any significant abnormal returns during the specified event window. The individual company abnormal returns are aggregated, averaged, and finally cumulated in order to evaluate the effect of futures trading on the spot price. These average abnormal returns cumulated over a particular time interval (number of days in the event window) allow for meaningful inferences concerning the general impact of the event. Significant abnormal returns on the event day and possible significant abnormal returns on the day preceding and following the event day are indicative of a price effect caused by futures trading. The lower significance observed on the days further from the event date and for longer cumulative periods or periods not including the actual event provides supportive evidence of a price effect.

A change in the average normalised volume experienced after the onset of futures trading should be evident from a before and after trading volume comparison. A t-test for change in mean uncovers the significance of any such change. A dummy variable regression incorporating a trend coefficient (time series variable), which accounts for the tendency of trading volume to increase, verified the t-test outcomes.

The futures-trading effect on spot volatility was examined first of all by means of an F-test for difference in variance, comparing the pre- and post-futures standard deviations (unconditional volatility), and identifying any significant change. A dummy variable regression inspects the company betas before and after the trading of futures, in an attempt to discover a structural break (i.e., change in the constant term) and/or a change in the co-movement with the market (i.e., slope of beta coefficient) in the company returns.

The GARCH methodology, apart from the event study, is the principal statistical procedure in this research. ARCH models are equipped (specifically designed) to model and forecast conditional variances and the advantage of the generalised ARCH model is its ability to capture the tendency in financial data for volatility clustering, establishing a definite connection between news and volatility. Any change in the rate at which news is reflected in an asset's price will change the asset's volatility. The importance of new information and the staying power of old information are evaluated via the two effects contained in the GARCH model. The ARCH term isolates the effect of recent news (short-run persistence) while the GARCH term emphasises the effect of old news (contribution to long-run persistence) on the underlying. The joined ARCH-GARCH-term regulates the persistence of the impact caused by news and the degree of volatility clustering.

A pre-event subsample and a post-event subsample are tested separately for ARCH and GARCH effects concerning the security's conditional volatility (i.e., the behaviour of volatility). A change in the intercept term of the variance equation relative to the change in the joined ARCH-GARCH term pre- to post-futures establishes an increase or decrease in the unconditional volatility of the error terms (related to the security's volatility). However, including a dummy variable in the variance equation and running the GARCH model for the full sample (total period) provides for a more viable alternative in identifying any statistically significant change in the volatility of the underlying share.

The coefficient values will be interpreted as follows: An increase in the ARCH term with a concurrent decrease in the GARCH term (ideal situation) signifies a more rapid dissemination of current news and a diminished influence of past information on asset prices. Conversely, a reduction in α (news coefficient) and an increase in β (old news coefficient) would point towards news being incorporated into prices more slowly, and having a longer lasting impact (persistence). As stated by Bologna and Cavallo (2002:189), futures trading should facilitate the incorporation of news into asset prices and result in older news playing a smaller role in determining volatility in the underlying market – with an increased rate of information flow reducing the uncertainty about previous news. The quantity of information flowing into the spot market in the period following the onset of futures trading is established via an altered ARCH-GARCH ratio. The pre- to post-period ARCH and GARCH terms convey a change in the *behaviour* of volatility, namely the tendency to cluster and hence be predictable (future volatility determined by past volatility). On the other hand, a change in the *actual* volatility of the underlying security would show up as a significant dummy variable coefficient with the extent determined by the sign (direction of change) and size of the particular value. A change in the autoregressive effect (mean equation lagged return coefficient) may point to a change in market efficiency (ability to forecast future returns on the basis of past returns).

In chapter 4, these statistical techniques are applied, the results evaluated for significance, and inferences and attribution to the respective theoretical frameworks (chapter 2) are made.

CHAPTER 4

STATISTICAL ANALYSIS AND RESULTS

4.1 Introduction

The purpose of this chapter is to report the findings of various statistical procedures in order to determine the impact of first-time SSF trading on the underlying individual shares. Discernible changes – relative to a predetermined before-period – in price, volume, and volatility of the underlying are evaluated for statistical significance and effect.

The South African market saw three-hundred and fifty-seven (357) first-time introductions (available for trade) of physically-settled SSF contracts from 1999 to 2007 (refer to Annexure B). Ninety-nine (99) cash-settled SSF contracts (dual issues) have been introduced since February 2007. Two (2) inward listed contracts (i.e., based on foreign reference assets or issued by foreign entities and listed on the JSE) were made available for trade in this period. These potential candidates for inclusion in the study were subjected to the following selection criteria:

- No corporate actions.[1]
- No direct or indirect (e.g., Iscor Limited)[2] prior introductions of SSF contracts.
- Trading activity.[3]
- No overlapping of the 11-day (including day zero) event periods.[4]
- 250 days (excluding the event period) of spot trading before and after the event.[5]

Thirty-eight (38) companies matched all the selection criteria, representing seven (7) different industries which in turn translate to twelve (12) supersectors, eighteen (18) sectors, and twenty-five (25) subsectors (refer to Annexure C).[6]

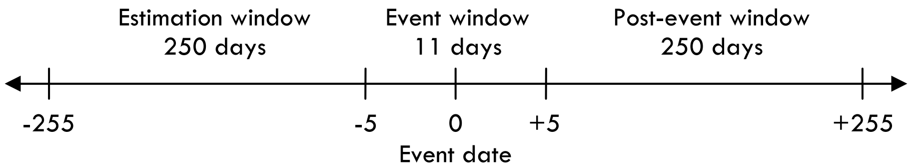
The sections to follow (4.2-4.3) deal with the price effect, volume effect and volatility effect individually and provide the statistical output and inferences specific to each method.

---

[1] Corporate actions or events affect the shareholder's entitlement to benefits and include share splits, capitalisation/rights issues, unbundling, mergers, or takeovers.
[2] SSF contracts on Iscor Limited were introduced in 2000. The unbundling from Iscor (which became Mittal Steel South Africa in 2005) of Kumba Resource and the subsequent unbundling of its iron ore assets (Kumba Iron Ore) and being relisted as Exxaro resulted in the ineligibility of Kumba Resources, Kumba Iron Ore, Exxaro and Mittal Steel to form part of this study.
[3] Available for trade and the actual trading of contracts occurring within a two week period.
[4] Event study methodology requires the abnormal returns and cumulative abnormal returns to be independent across securities. This no-clustering assumption (different event days and event periods not overlapping) was extended to the other methodologies in this study in order to use the same sampled group of companies in determining the price, volume and volatility effect of SSF trading on the underlying.
[5] In later years the introduction of SSF contracts coincided with the listing of new shares on the JSE.
[6] This satisfies the event study requirement that samples are from different industries and not focused on a specific industry.

4.2 Price effect

An event study was conducted to determine the effect (if any) caused by the initial trading (introduction) of a single futures contract on the spot price of the underlying company. A market model[7] was used to regress the company returns on the returns of the market (All Share Index – ALSI), thereby determining the company's beta (slope coefficient – sensitivity to return of the market) in order to establish the "normal" daily returns of a company during the event period. The difference between this normal or anticipated return (beta times the market return) and the actual return of the company, represents the abnormal return on a specified day.



The 250 daily returns of the company and the ALSI preceding the event period (ten days excluding the event date) were used in the market model regression.[8] The abnormal returns (actual minus normal) five days before (pre-SSF period), on the actual first trading day (day 0), and after (post-SSF period) the event were calculated and assigned to either a one-, five- or ten-percent level of significance, or as non-significant (too small relative to the standard deviation). These daily abnormal returns for each company were averaged (average abnormal return – AAR), cumulated (cumulative average abnormal return – CAAR) and evaluated for statistical significance.

In addition, a dummy variable regression was performed for the total period (255 days prior and post the event date) to determine the abnormal return on the actual first trading day (day 0), to confirm the results obtained from the event study (day zero only).

The selected model (market model), generating individual company betas, was not assessed in terms of "goodness-of-fit" (R-squared) in each instance, but simply used to establish a normal return as determined by the market, to be compared with the actual return from the movement in individual share prices. The discrepancies between the relative and actual company returns during the event period are presented and attributed in the following table (table 4.1). Inferences regarding the statistical validity of each abnormal return and the conclusion reached on the impact of initial SSF trading on the underlying share price follow the statistical output.

---

[7] See chapter 3, section 3.2.3.

[8] While there are 365 days in a year, only approximately 250 of them are trading days, thus representing a one-year period of trading data before and after an event or event window.

Table 4.1

Price results

Panel A shows the abnormal returns (AR) as calculated from a market model ($R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$) for all companies on a specific day during the event period. Panel B displays the abnormal return on the actual event day (day zero) obtained from a dummy variable regression ($R_{it} = \alpha_i + \beta_i R_{mt} + \delta D_F + \varepsilon_{it}$).

Day	Panel A: Event study – Abnormal returns											
	1 AFE		2 AFL		3 ALT		4 AMA		5 APK		6 ART	
	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat
-5	1.24%	0.79	-1.78%	-0.37	-0.01%	0.00	-0.46%	-0.23	-0.97%	-0.33	-0.27%	-0.13
-4	2.11%	1.34	0.62%	0.13	1.12%	0.75	-1.09%	-0.54	2.71%	0.92	0.06%	0.03
-3	0.14%	0.09	1.38%	0.29	2.22%	1.47	0.42%	0.21	-0.75%	-0.26	3.51%	1.67
-2	-0.33%	-0.21	-5.08%	-1.07	-1.11%	-0.74	-1.58%	-0.78	-0.27%	-0.09	-0.31%	-0.15
-1	-0.43%	-0.27	-3.32%	-0.70	-0.01%	0.00	0.72%	0.36	0.64%	0.22	1.08%	0.52
0	-1.00%	-0.64	-0.28%	-0.06	0.66%	0.44	-0.24%	-0.12	-0.75%	-0.25	-0.52%	-0.25
+1	-0.56%	-0.35	-3.42%	-0.72	1.53%	1.01	-0.53%	-0.27	-0.85%	-0.29	-1.28%	-0.61
+2	-1.79%	-1.14	-5.13%	-1.08	-2.25%	-1.49	0.66%	0.33	-0.67%	-0.23	-1.04%	-0.49
+3	-1.47%	-0.94	2.25%	0.47	-1.30%	-0.87	3.41%	1.69	0.78%	0.26	0.29%	0.14
+4	-0.15%	-0.10	5.98%	1.25	3.53%	2.35	5.46%	2.71	-0.02%	-0.01	-1.19%	-0.57
+5	-0.37%	-0.24	-3.44%	-0.72	-0.49%	-0.32	-0.55%	-0.27	1.07%	0.36	-2.04%	-0.97
σ	1.57%		4.77%		1.51%		2.02%		2.95%		2.10%	
	Panel B: Dummy variable regression – Abnormal return on initial trading day (0)											
AR	-1.07%	-0.71	0.05%	0.01	0.44%	0.32	-0.13%	-0.07	-0.80%	-0.34	-0.56%	-0.27
σ	1.51%		5.04%		1.39%		1.83%		2.35%		2.04%	

Day	Panel A: Event study – Abnormal returns											
	7 BRC		8 CDZ		9 CPT		10 CSB		11 DDT		12 DGC	
	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat
-5	3.19%	1.31	0.32%	0.13	0.15%	0.08	1.10%	0.65	1.58%	0.60	1.19%	0.42
-4	1.03%	0.42	-1.18%	-0.49	-0.94%	-0.49	0.59%	0.35	1.92%	0.72	-0.01%	0.00
-3	-0.51%	-0.21	3.19%	1.33	-0.48%	-0.25	0.29%	0.17	-2.23%	-0.84	-1.51%	-0.53
-2	1.22%	0.50	5.13%	2.14	0.53%	0.28	1.42%	0.85	-2.31%	-0.87	-0.20%	-0.07
-1	1.20%	0.49	0.01%	0.00	-0.21%	-0.11	-0.10%	-0.06	-2.19%	-0.82	-0.60%	-0.21
0	-1.00%	-0.41	-0.44%	-0.18	1.74%	0.91	0.64%	0.38	-0.93%	-0.35	3.90%	1.38
+1	-0.79%	-0.33	-1.45%	-0.60	2.63%	1.37	-0.23%	-0.14	-0.17%	-0.07	3.34%	1.18
+2	-4.32%	-1.77	3.79%	1.58	0.51%	0.27	0.57%	0.34	-3.49%	-1.32	-3.41%	-1.21
+3	3.64%	1.49	-0.45%	-0.19	-0.33%	-0.17	-0.09%	-0.05	-1.33%	-0.50	-0.18%	-0.06
+4	2.20%	0.90	-0.10%	-0.04	0.19%	0.10	-0.18%	-0.11	-2.24%	-0.84	1.97%	0.70
+5	1.05%	0.43	-0.21%	-0.09	0.02%	0.01	0.32%	0.19	1.15%	0.43	2.32%	0.82
σ	2.44%		2.39%		1.92%		1.68%		2.65%		2.83%	
	Panel B: Dummy variable regression – Abnormal return on initial trading day (0)											
AR	-0.93%	-0.45	-0.39%	-0.18	1.85%	1.06	0.63%	0.37	-0.83%	-0.33	3.93%	1.44
σ	2.07%		2.20%		1.74%		1.72%		2.52%		2.73%	
z-value	1% level of significance				5% level of significance				10% level of significance			

Panel A shows the abnormal returns (AR) as calculated from a market model ($R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$) for all companies on a specific day during the event period. Panel B displays the abnormal return on the actual event day (day zero) obtained from a dummy variable regression ($R_{it} = \alpha_i + \beta_i R_{mt} + \delta D_F + \varepsilon_{it}$).

Day	Panel A: Event study – Abnormal returns											
	13 DUR		14 EOH		15 ERM		16 GDF		17 GIJ		18 GND	
	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat
-5	0.16%	0.03	-1.75%	-1.34	1.40%	0.58	-0.19%	-0.07	0.06%	0.01	2.18%	0.91
-4	-2.17%	-0.41	-0.54%	-0.42	-1.72%	-0.72	0.90%	0.31	-1.65%	-0.30	4.70%	1.96
-3	1.29%	0.25	3.08%	2.36	1.53%	0.64	-0.16%	-0.05	0.18%	0.03	1.42%	0.59
-2	-2.31%	-0.44	-0.10%	-0.08	-0.11%	-0.05	-0.32%	-0.11	1.85%	0.33	-1.79%	-0.75
-1	-0.47%	-0.09	-0.56%	-0.43	-2.32%	-0.97	-0.18%	-0.06	3.45%	0.62	-3.27%	-1.37
0	-1.07%	-0.20	-0.82%	-0.63	1.58%	0.66	1.09%	0.38	1.84%	0.33	2.25%	0.94
+1	-4.20%	-0.80	2.72%	2.08	-3.09%	-1.28	-0.57%	-0.20	1.74%	0.31	-2.41%	-1.01
+2	0.67%	0.13	0.43%	0.33	-0.88%	-0.37	-0.48%	-0.17	-6.61%	-1.19	1.49%	0.62
+3	-2.48%	-0.47	0.01%	0.01	5.92%	2.46	-0.75%	-0.26	1.74%	0.31	-0.37%	-0.15
+4	-0.37%	-0.07	-1.77%	-1.35	-0.85%	-0.36	0.38%	0.13	1.77%	0.32	-0.39%	-0.16
+5	-0.56%	-0.11	1.32%	1.01	0.86%	0.36	-0.14%	-0.05	0.18%	0.03	3.90%	1.63
σ	5.23%		1.31%		2.40%		2.88%		5.54%		2.39%	
Panel B: Dummy variable regression – Abnormal return on initial trading day (0)												
AR	-1.12%	-0.20	-0.91%	-0.69	2.07%	0.68	1.11%	0.48	1.84%	0.41	2.47%	1.18
σ	5.57%		1.32%		3.05%		2.33%		4.44%		2.10%	

Day	Panel A: Event study – Abnormal returns											
	19 HDC		20 JCD		21 JSC		22 KAP		23 KGM		24 KWV	
	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat
-5	3.01%	2.49	4.43%	1.15	-2.69%	-0.88	-2.07%	-0.36	-1.90%	-1.01	-2.66%	-1.54
-4	-4.18%	-3.46	2.32%	0.61	3.28%	1.07	0.59%	0.10	-1.42%	-0.76	-0.01%	-0.01
-3	3.99%	3.30	-0.37%	-0.10	2.09%	0.68	1.24%	0.22	-0.79%	-0.42	0.18%	0.10
-2	2.65%	2.20	0.94%	0.24	-3.08%	-1.00	3.30%	0.58	0.85%	0.46	-0.20%	-0.12
-1	-0.26%	-0.21	-0.51%	-0.13	-0.31%	-0.10	-1.28%	-0.23	-0.13%	-0.07	0.17%	0.10
0	-4.30%	-3.56	4.13%	1.08	-2.10%	-0.68	-1.69%	-0.30	0.10%	0.05	-0.18%	-0.10
+1	-1.56%	-1.29	-0.33%	-0.09	5.29%	1.73	-1.25%	-0.22	-0.22%	-0.12	-0.06%	-0.04
+2	1.39%	1.15	-4.45%	-1.16	-1.79%	-0.58	-3.29%	-0.58	-0.10%	-0.05	-1.92%	-1.11
+3	1.41%	1.17	2.28%	0.60	0.99%	0.32	-0.51%	-0.09	0.72%	0.38	0.17%	0.10
+4	2.68%	2.22	1.02%	0.27	-1.89%	-0.62	0.66%	0.12	0.89%	0.47	-0.48%	-0.28
+5	-0.75%	-0.62	1.90%	0.50	0.23%	0.07	5.76%	1.02	-1.19%	-0.64	0.26%	0.15
σ	1.21%		3.84%		3.07%		5.67%		1.87%		1.72%	
Panel B: Dummy variable regression – Abnormal return on initial trading day (0)												
AR	-4.19%	-3.09	4.57%	1.34	-2.15%	-0.74	-1.48%	-0.35	0.14%	0.09	-0.21%	-0.14
σ	1.35%		3.42%		2.90%		4.24%		1.62%		1.50%	
z-value	1% level of significance				5% level of significance				10% level of significance			

Panel A shows the abnormal returns (AR) as calculated from a market model ($R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$) for all companies on a specific day during the event period. Panel B displays the abnormal return on the actual event day (day zero) obtained from a dummy variable regression ($R_{it} = \alpha_i + \beta_i R_{mt} + \delta D_F + \varepsilon_{it}$).

Day	25 LBH AR	25 LBH z-stat	26 LON AR	26 LON z-stat	27 MCE AR	27 MCE z-stat	28 OMN AR	28 OMN z-stat	29 PCN AR	29 PCN z-stat	30 PIM AR	30 PIM z-stat
Panel A: Event study – Abnormal returns												
-5	-0.68%	-0.45	-3.78%	-1.67	-3.05%	-0.84	0.48%	0.21	4.68%	1.28	7.46%	1.48
-4	-1.30%	-0.85	1.51%	0.66	-2.19%	-0.60	-1.20%	-0.54	0.05%	0.01	2.24%	0.45
-3	0.42%	0.28	1.38%	0.61	-1.22%	-0.34	-0.49%	-0.22	3.99%	1.09	-5.51%	-1.10
-2	0.23%	0.15	0.93%	0.41	-1.05%	-0.29	-1.21%	-0.54	-7.29%	-2.00	2.40%	0.48
-1	4.01%	2.63	-1.15%	-0.51	-1.46%	-0.40	-0.15%	-0.07	6.95%	1.91	4.23%	0.84
0	-0.71%	-0.46	-0.07%	-0.03	-3.28%	-0.90	-0.66%	-0.30	-4.86%	-1.33	4.71%	0.94
+1	0.84%	0.55	0.62%	0.27	-3.56%	-0.98	-0.18%	-0.08	0.90%	0.25	1.72%	0.34
+2	0.55%	0.36	0.15%	0.06	1.00%	0.28	-0.36%	-0.16	-0.21%	-0.06	-6.33%	-1.26
+3	0.40%	0.26	-0.93%	-0.41	0.64%	0.17	-0.84%	-0.38	-3.45%	-0.95	8.72%	1.73
+4	-1.41%	-0.92	-0.53%	-0.23	-0.45%	-0.12	0.22%	0.10	-0.24%	-0.07	-1.96%	-0.39
+5	-0.82%	-0.54	1.40%	0.62	-2.97%	-0.82	0.01%	0.00	-1.15%	-0.32	-11.63%	-2.31
σ	1.52%		2.27%		3.64%		2.22%		3.64%		5.03%	
Panel B: Dummy variable regression – Abnormal return on initial trading day (0)												
AR	-0.71%	-0.54	-0.02%	-0.01	-2.89%	-0.91	-0.65%	-0.33	-4.85%	-1.53	4.68%	1.02
σ	1.31%		2.06%		3.16%		1.95%		3.17%		4.58%	

Day	31 PWK AR	31 PWK z-stat	32 SGG AR	32 SGG z-stat	33 SHP AR	33 SHP z-stat	34 SIM AR	34 SIM z-stat	35 SLM AR	35 SLM z-stat	36 SPG AR	36 SPG z-stat
Panel A: Event study – Abnormal returns												
-5	-0.31%	-0.23	2.86%	0.72	-0.23%	-0.14	1.43%	0.20	0.72%	0.34	3.28%	1.72
-4	0.18%	0.14	0.15%	0.04	3.09%	1.88	18.05%	2.53	-0.02%	-0.01	-0.15%	-0.08
-3	0.74%	0.55	0.13%	0.03	-0.71%	-0.43	11.18%	1.57	0.76%	0.36	-1.06%	-0.55
-2	-0.94%	-0.70	0.21%	0.05	0.27%	0.17	2.41%	0.34	0.62%	0.29	-2.06%	-1.08
-1	0.69%	0.51	-1.19%	-0.30	2.79%	1.70	-1.52%	-0.21	-1.24%	-0.58	-2.19%	-1.15
0	2.37%	1.77	1.15%	0.29	1.82%	1.11	1.24%	0.17	-0.29%	-0.14	-0.38%	-0.20
+1	-0.13%	-0.10	2.84%	0.71	1.17%	0.71	1.51%	0.21	-2.01%	-0.95	-4.32%	-2.26
+2	-2.70%	-2.01	0.20%	0.05	2.31%	1.41	4.98%	0.70	-3.37%	-1.59	4.29%	2.24
+3	1.23%	0.92	5.86%	1.47	-0.82%	-0.50	3.68%	0.52	-0.12%	-0.06	0.89%	0.47
+4	-1.24%	-0.92	5.25%	1.32	-1.51%	-0.92	5.76%	0.81	-0.98%	-0.46	0.23%	0.12
+5	1.90%	1.42	-1.39%	-0.35	-3.82%	-2.32	5.18%	0.73	-1.28%	-0.60	-2.90%	-1.52
σ	1.34%		3.98%		1.64%		7.14%		2.12%		1.91%	
Panel B: Dummy variable regression – Abnormal return on initial trading day (0)												
AR	2.34%	1.78	1.14%	0.32	1.60%	0.92	1.00%	0.17	-0.43%	-0.24	-0.30%	-0.17
σ	1.31%		3.57%		1.74%		5.77%		1.83%		1.75%	
z-value	1% level of significance				5% level of significance				10% level of significance			

Panel A shows the abnormal returns (AR) as calculated from a market model ($R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$) for all companies on a specific day during the event period. Panel B displays the abnormal return on the actual event day (day zero) obtained from a dummy variable regression ($R_{it} = \alpha_i + \beta_i R_{mt} + \delta D_F + \varepsilon_{it}$).

Day	Panel A: Event study – Abnormal returns			
	37 UCS		38 WNH	
	AR	z-stat	AR	z-stat
-5	-2.93%	-1.05	-0.17%	-0.07
-4	1.31%	0.47	0.33%	0.14
-3	1.11%	0.40	0.82%	0.34
-2	-0.23%	-0.08	0.28%	0.12
-1	3.29%	1.17	-0.06%	-0.02
0	-0.70%	-0.25	7.19%	2.99
+1	0.39%	0.14	-5.60%	-2.33
+2	2.83%	1.01	-0.85%	-0.35
+3	-0.55%	-0.20	6.18%	2.57
+4	3.42%	1.22	0.16%	0.07
+5	4.97%	1.78	-4.20%	-1.75
σ	2.80%		2.41%	
Panel B: Dummy variable regression – Abnormal return on initial trading day (0)				
AR	-0.82%	-0.32	7.12%	2.61
σ	2.58%		2.72%	
z-value	1% level of significance		5% level of significance	10% level of significance

Table 4.1: panel A depicts the abnormal returns for each company represented in the study (thirty-eight in total) obtained from the event study methodology. Panel B exhibits the day-zero abnormal return results from the dummy variable regression. In general, most daily abnormal returns proved to be non-significant, not exceeding the 1,68 critical value cut-off for a 10%-level of significance (90% confidence level). SSF trading, according to this event study, had no effect (no significant abnormal returns during the event period) on the share prices of eighteen (out of thirty-eight) companies included in this study.

The following fourteen companies showed a statistically significant abnormal return on a single day during the event period under investigation – Allied Technologies (3 – ALT), Amalgamated Appliance Holdings (4 – AMA), Argent Industrial (6 – ART), Brandcorp Holdings (7 – BRC), Cadiz Holdings (8 – CDZ), Enterprise Risk Management (15 – ERM), Grindrod (18 –GND), Jasco Electronics (21 –JSC), Liberty Holdings (25 – LBH), Lonmin (26- LON), Prism Holdings (30 – PIM), Pick and Pay Holdings (31 – PWK), Simmer and Jack Mines (34 – SIM) and UCS Group (37 – UCS). With only one day showing a statistically significant deviation from the normal return, it can be concluded that the advent of SSF trading had very little effect on the share prices of these fourteen companies.

EOH Holdings (14 – EOH) and Paragon Holdings (29 – PCN) each exhibited only two days of statistically significant abnormal returns, providing virtually no evidence that SSF trading had influenced their share prices. Similarly, only three days of sufficiently sized abnormal returns reported by Shoprite Holdings (33 – SHP), Super Group (36 – SPG) and Winhold (38 – WNH) confirmed that SSF trading had little effect on the returns of these companies.

Hudaco Industries (19 – HDC) was the only company to reveal some share-price impact caused by initial SSF trading. Showing abnormal returns on six days (including day zero), Hudaco Industries mainly experienced abnormal share-price activity in the five-day period leading up to the availability of SSF contracts on its equity shares.

Only three companies displayed statistically significant abnormal returns on trading-day zero (verified by the dummy variable regression – see panel B), namely Hudaco Industries, Pick and Pay Holdings, and Winhold. The dummy variable regression isolating day-zero returns confirmed the results obtained by the market model in all instances except for Afrikander Lease Limited (2 – AFL).[9]

On an individual company-by-company basis it is clear that the introduction (trading) of single stock futures had little or no impact on the underlying companies' share prices. The event study in conjunction with the dummy variable regression presented no conclusive evidence to establish either a positive or a negative price effect due to SSF trading.

However, as stated in chapter 3, section 3.2.5.2, in an event study the focus is on the mean and the cumulative mean of the dispersion of abnormal returns. The individual securities' abnormal returns are aggregated and averaged. These average abnormal returns per event day are summed across days to measure the average cumulative effect of the event on the sample securities for the whole event period or a variety of periods within the event window. Cumulating these periodic average residuals over a particular time interval (number of days in the event window) allows for meaningful inferences concerning the general impact of the event. If the initial SSF trading caused a price effect, significant abnormal returns on day zero and possible significant abnormal returns on day -1 and day +1 should be uncovered. Significance should be lower as one moves further from the event date and for longer periods or periods not including the actual event.

[9] The event study indicated a 0,28% negative abnormal return on day zero (-0,06 critical value), while the dummy variable regression (DVR) showed a 0,05% above normal return (0,01 cv). The fact that the dummy DVR spanned the total 511 day period (beta estimation period) compared to 250 days (event study) could account for this inconsistency.

Table 4.2

Price results – Average and cumulative average abnormal returns

The table shows the average abnormal returns (AAR) for all companies on a specific day during the event period and the cumulative average abnormal returns (CAAR) for the whole period as well as over a variety of time periods within the event window.

Day	AAR	σ	z-stat	Period		CAAR	σ	z-stat	Period		CAAR	σ	z-stat
-5	0.40%	0.51%	0.77	-5	-5	0.40%	0.51%	0.77	-1	+1	0.07%	0.89	0.08
-4	0.77%	0.51%	1.49	-5	-4	1.16%	0.72%	1.60	-2	+2	-0.88%	1.15	-0.77
-3	0.81%	0.51%	1.59	-5	-3	1.97%	0.89%	2.22	-3	+3	0.86%	1.36	0.63
-2	-0.18%	0.51%	-0.34	-5	-2	1.80%	1.02%	1.76	-4	+4	2.25%	1.54	1.46
-1	0.11%	0.51%	0.21	-5	-1	1.91%	1.15%	1.66	-5	+5	2.48%	1.70	1.46
0	0.27%	0.51%	0.52	-5	0	2.17%	1.25%	1.73	-5	0	2.17%	1.25	1.73
+1	-0.30%	0.51%	-0.59	-5	+1	1.87%	1.36%	1.38	0	+5	0.58%	1.25	0.46
+2	-0.78%	0.51%	-1.52	-5	+2	1.09%	1.45%	0.75	-3	0	1.01%	1.02	0.99
+3	0.93%	0.51%	1.81	-5	+3	2.02%	1.54%	1.31	0	+3	0.11%	1.02	0.11
+4	0.63%	0.51%	1.22	-5	+4	2.64%	1.62%	1.63	-1	0	0.37%	0.72	0.52
+5	-0.16%	0.51%	-0.31	-5	+5	2.48%	1.70%	1.46	0	+1	-0.04%	0.72	-0.05
1% level of significance				5% level of significance					10% level of significance				

Table 4.2 shows that the only significant average abnormal return was recorded on day +3 of the event period. Periods (-5 to -3), (-5 to -2), (-5 to -1) and (-5 to 0) all showed significant cumulative average abnormal returns. Results indicate a 10% significance level for a period that includes the event day (-5 to 0), but for shorter periods inclusive of day zero [(-3 to 0), (0 to +3), (-1 to 0) and (0 to +1)] no significance is evidenced. Shorter time periods (-5 to -2) and (-5 to -3) do show increased significance, but do not include the actual event date. The most promising result, therefore, is the significant positive CAAR of 2,17% during the six-day (including the event day) pre-SSF period. Positive, but non-significant, average abnormal returns on day -1 and 0, as well as positive, but non-significant, cumulative average abnormal returns in periods (-3 to 0) and (-1 to 0) tend to confirm the favourable impact of SSF trading on the underlying share price in the period immediately preceding the event and on the event day itself, as shown by the significant (-5 to 0) subperiod.

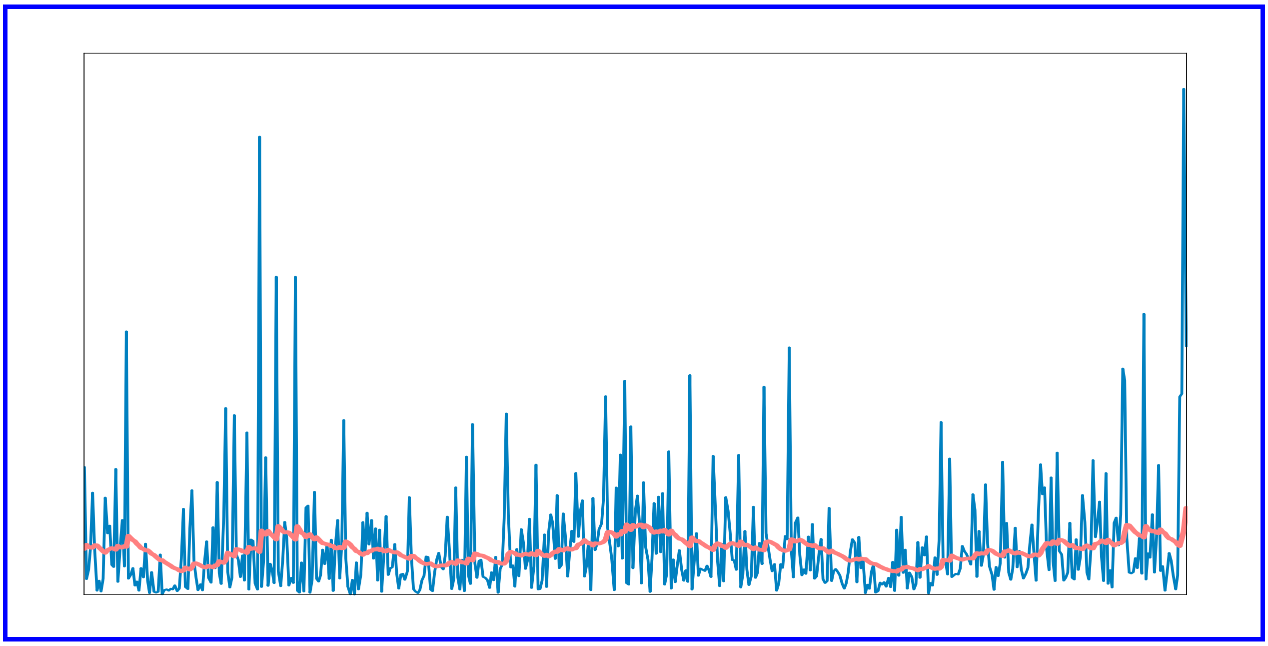
Diminishing significance for shorter periods closer to the event implies that no clear evidence to suggest any price effect (positive or negative) on the underlying due to the introduction of single stock futures resulted from this study. None of the three theorems (complete markets, short-sales restrictions or improved information) therefore holds or explains the actual SSF trading (non)impact.

4.3 Volume effect

The effect of SSF trading on the spot market volume of the underlying company before and after the first futures market transaction is tested by comparing the average normalised trading volume pre- and post-SSF. An additional test is performed with a dummy variable and trend coefficient (a time series variable that checks for a trend) regression to determine whether the volume significantly changed after accounting for the tendency of the volume to increase (trend) over time.

Figure 4.1

Normalised (smoothed) volume



Source: McGregor-BFA (EViews6 generated)

Figure 4.1 depicts the normalised daily trading volume (red) of AECI Holdings (1 – AFE), used as an example, after an exponential smoothing process was performed on the actual data (blue). The forecasted value is a weighted average of the past values of the series where the weights decline exponentially with time (higher weight allocated to more recent data).

Panel A in table 4.3 shows the output from the t-test for change in mean that is used to determine whether initial SSF trading caused a permanent change in trading volume of the underlying. The average normalised volume in a specified number of days prior to SSF trading is compared with the average normalised volume in the period subsequent to the first SSF trade. The significance of the difference is determined by the size of the increase/decrease relative to the standard deviation of the underlying trading volume over the specified period.[10]

[10] At 498 df the relevant t-values (two-sided) are 1,648 (10%), 1,965 (5%) and 2,586 (1%) respectively.

Table 4.3

Volume results

Panel A displays a simple t-test for change in mean between the pre- and post-SSF periods. Panel B shows the results from a dummy variable regression that checks for an underlying trend that may have resulted in the trading volume of a share naturally increasing (or decreasing) between the periods. The dummy tests for a structural break in the trend around the initial trading of single stock futures. The equation $V_{it} = \alpha_i + \beta_i T_{it} + \delta D_F + \varepsilon_{it}$ included a time series variable (T) that checked for a trend and a dummy variable to differentiate between the two periods.

No	Company (JSE Code)	Panel A: Change in average volume			Panel B: Dummy variable regression			10% / 5% / 1%
		Change	σ	t-test	Constant	Trend	Change	
1	AFE	+9 675	3 687.30	2.62	158205.8	-7.04	11441.80	
					0.0000	0.7832	0.1229	*p-value*
2	AFL	-188 084	32 727.94	-5.75	763589.7	84.47	-209287.90	
					0.0000	0.7099	0.0015	*p-value*
3	ALT	+15 935	957.89	16.64	69614.9	-21.86	21420.91	
					0.0000	0.0009	0.0000	*p-value*
4	AMA	+185 343	6 133.14	30.22	327494.9	511.50	56956.11	
					0.0000	0.0000	0.0000	*p-value*
5	APK	+60 170	7 876.33	7.64	143858.9	112.73	31874.35	
					0.0000	0.0387	0.0435	*p-value*
6	ART	+62 988	9 342.56	6.74	109958.7	-94.63	86738.92	
					0.0000	0.1439	0.0000	*p-value*
7	BRC	+3 213	198.37	16.20	65698.96	15.40	-652.87	
					0.0000	0.0000	0.0586	*p-value*
8	CDZ	+118 721	4 970.29	23.89	171395.4	268.19	51405.31	
					0.0000	0.0000	0.0000	*p-value*
9	CPT	+64 235	3 034.81	21.17	198929.7	315.92	-15059.80	
					0.0000	0.0000	0.0009	*p-value*
10	CSB	+127	23.63	5.37	24061.8	-1.39	477.01	
					0.0000	0.0000	0.0000	*p-value*
11	DDT	+513 063	42 014.52	12.21	1385476.0	2632.65	-147731.90	
					0.0000	0.0000	0.0560	*p-value*
12	DGC	+99 458	10 381.46	9.58	82987.6	-1098.69	375229.80	
					0.0000	0.0000	0.0000	*p-value*
13	DUR	+152 563	13 288.72	11.48	173906.4	115.23	123640.30	
					0.0000	0.2110	0.0000	*p-value*
14	EOH	+1 334	149.13	8.94	82169.9	-1.41	1687.96	
					0.0000	0.1722	0.0000	*p-value*
15	ERM	+23 004	968.90	23.74	166149.6	83.70	1994.31	
					0.0000	0.0000	0.2170	*p-value*
16	GDF	-3 280	194.85	-16.83	144191.1	-16.63	894.98	
					0.0000	0.0000	0.0063	*p-value*
17	GIJ	+263 401	40 213.61	6.55	629430.4	410.04	160480.00	
					0.0000	0.1413	0.0470	*p-value*
18	GND	+97 555	1 886.82	51.70	66352.8	145.92	60929.19	
					0.0000	0.0000	0.0000	*p-value*
19	HDC	-16 510	1 078.80	-15.30	55036.7	-17.12	-12211.89	
					0.0000	0.0218	0.0000	*p-value*
20	JCD	-448 658	117 727.00	-3.81	3089814.0	1287.41	-771797.3	
					0.0000	0.1146	0.0011	*p-value*

Panel A displays a simple t-test for change in mean between the pre- and post-SSF periods. Panel B shows the results from a dummy variable regression that checks for an underlying trend that may have resulted in the trading volume of a share naturally increasing (or decreasing) between the periods. The dummy tests for a structural break in the trend around the initial trading of single stock futures. The equation $V_{it} = \alpha_i + \beta_i T_{it} + \delta D_F + \varepsilon_{it}$ included a time series variable (T) that checked for a trend and a dummy variable to differentiate between the two periods.

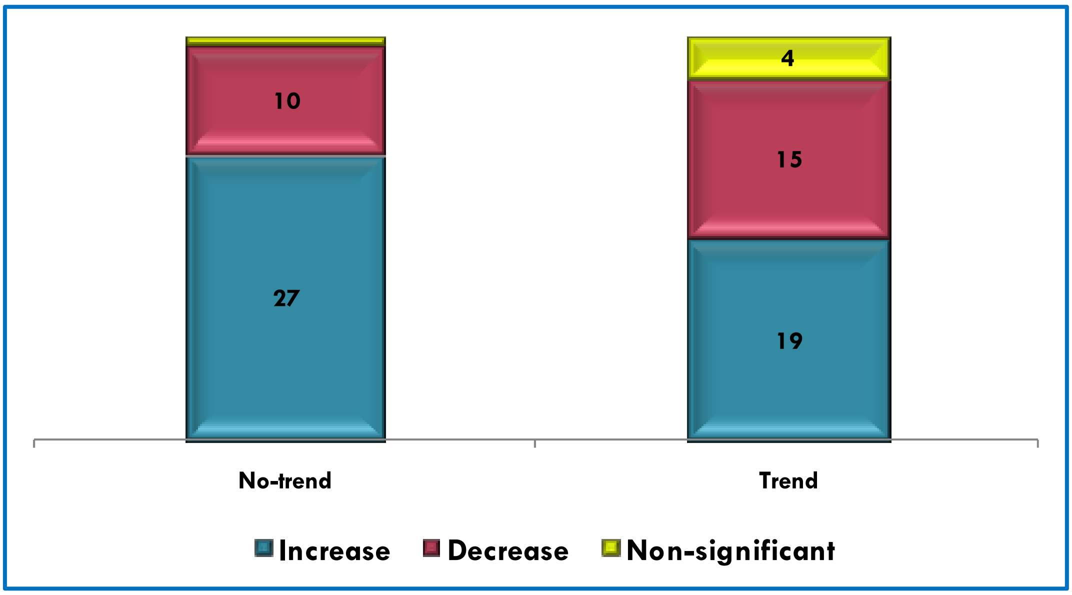
No	Company (JSE Code)	Panel A: Change in average volume			Panel B: Dummy variable regression			10% / 5% / 1%
		Change	σ	t-test	Constant	Trend	Change	
21	JSC	+27 940	2 233.95	12.51	36622.3	-85.22	49330.38	
					0.0000	0.0000	0.0000	p-value
22	KAP	+405 735	18 872.98	21.50	328572.4	1674.91	-14667.84	
					0.0000	0.0000	0.6367	p-value
23	KGM	-3 162	328.57	-9.62	112820.7	6.54	-4803.55	
					0.0000	0.0040	0.0000	p-value
24	KWV	+1 029	50.49	20.38	14363.6	5.45	-339.41	
					0.0000	0.0000	0.0000	p-value
25	LBH	+11 572	438.79	26.37	15951.2	36.60	2386.05	
					0.0000	0.0000	0.0014	p-value
26	LON	+6 163	2 371.80	2.60	9446.3	-167.02	48085.26	
					0.0001	0.0000	0.0000	p-value
27	MCE	+185 400	28 795.01	6.44	1878747.0	2843.96	-528433.7	
					0.0000	0.0000	0.0000	p-value
28	OMN	-38 053	1 765.88	-21.55	81503.2	-222.15	17707.26	
					0.0000	0.0000	0.0000	p-value
29	PCN	+109 744	3 852.56	28.49	172809.2	353.01	21137.59	
					0.0000	0.0000	0.0007	p-value
30	PIM	+12 675	788.04	16.08	560205.7	-17.19	16990.66	
					0.0000	0.0016	0.0000	p-value
31	PWK	-69 755	11 445.78	-6.09	198642.5	-337.35	14920.04	
					0.0000	0.0000	0.5087	p-value
32	SGG	-70 310	7 451.73	-9.44	127997.1	-105.90	-43728.75	
					0.0000	0.0401	0.0035	p-value
33	SHP	+997	704.34	1.42	991653.3	22.86	-4739.76	
					0.0000	0.0000	0.0007	p-value
34	SIM	+2 746 499	174 707.70	15.72	398052.0	-3566.00	3641565.0	
					0.0410	0.0031	0.0000	p-value
35	SLM	-831 840	53 048.47	-15.68	4807648.0	-1033.15	-572519.1	
					0.0000	0.0048	0.0000	p-value
36	SPG	+243 216	17 073.89	14.24	546217.5	1289.45	-80435.78	
					0.0000	0.0000	0.0074	p-value
37	UCS	+13 074	785.69	16.64	207701.9	79.77	-6948.04	
					0.0000	0.0000	0.0000	p-value
38	WNH	-2 295	138.63	-16.55	103075.0	23.79	-2832.91	
					0.0000	0.0000	0.0000	p-value

Trading volume generally tends to increase over time and a dummy variable regression considering this trending nature of volume is used, as this is not captured by a t-test for change in mean. The dummy variable regression is augmented with a trend (day) coefficient to isolate the size of the increase/decrease in trading volume witnessed after initial SSF trading. In some instances the apparent increase or decrease was reversed as a result of the natural trend in trading volume. The dummy variable takes the value of zero for the pre-SSF period and one for the post-SSF period. The coefficient is interpreted as a change in trading volume after considering any underlying trend which may bias the results of the dummy variable.

Panel A tables the average change in normalised (smoothed) trading volume for each company subsequent to the initial trading of a SSF contract. In each instance the relevant standard deviation and critical value are listed, showing highly significant changes, with the exception of Shoprite Holdings (33 – SHP), in average normalised volume post-SSF for all companies. In the majority of cases (27 of 37 significant results) the introduction of SSF trading resulted in a highly significant increase in normalised trading volume.

Figure 4.2

Changes in normalised trading volume



In line with the dummy variable regression (with trend), the number of companies showing a significant increase in average normalised volume is nineteen (three non-significant increases). Fifteen companies exhibited a significant decrease in average normalised trading volume (one non-significant decrease). A small majority of companies (19 vs. 15), therefore, experienced a significant increase in trading volume following the onset of single stock futures trading. Figure 4.2 illustrates the result from the t-test (no-trend) compared to that of the dummy regression with trend coefficient. Accounting for the tendency of volume to increase (trend) over time, the results were thus altered in terms of statistical significance (number) and the direction of change.[11]

[11] Notable instances where the trend coefficient caused a change (reversal) in direction are: 7-BRC, 9-CPT, 11-DDT, 16-GDF, 22-KAP, 27-MCE, 28-OMN, 31-PWK, 33-SHP, 36-SPG, and 37-UCS (see table 4.3).

This increase is predicted by the complete markets hypothesis, assuming a more complete market due to more investor participation. Market-makers have to cover/hedge their exposure in the SSF market with equivalent transactions in the spot market. The diminishing short-sales restrictions hypothesis is ambivalent regarding the volume effect of futures trading as short-selling occurs in the corresponding futures market and not the spot market. The improved information environment hypothesis suggests two opposing effects: attributing a reported increase to enhanced interest and analysis by market followers, and ascribing decreasing volumes to a shift in speculator activity to highly leveraged derivative products, substituting for trading in the underlying equity shares. This substitution theorem indirectly classifies single stock futures as speculative instruments, providing an incentive for speculators to shift their activities away from the underlying share and towards the derivative.[12]

The observed changes in volume (increase or decrease) as highlighted by this study arguably depend on the dominating cause (increased investor participation or speculative activity) on a company by company basis. In general, this study concludes that increased investor participation via the market makers accounted for the change (increase) in normalised (smoothed) spot trading volume for a majority of the companies investigated.

4.4 Volatility effect

The volatility effect study comprises three different procedures. As a preliminary test, an F-test is performed on the ratio of pre-SSF variance to post-SSF variance per company to reveal a change in the unconditional volatility of the spot price [results reported in table 4.6: panel A (refer to page 100)]. A Generalised Conditional Autoregressive Heteroskedasticity (GARCH) model is employed as the primary evaluation technique to detect any changes in the structure of volatility (conditional volatility) and the level of volatility (unconditional variance of the error term) due to the introduction of single stock futures. The third procedure involves a dummy variable regression to test for a change in the systematic risk (beta – slope coefficient) of each company and a shift in the constant term (alpha – minimum return when market return equals zero) after introducing SSF trading on the underlying.

4.4.1 ARCH-GARCH effects

The GARCH model,[13] as stated in chapter 3, section 3.4.2.2 is mean reverting and conditionally heteroskedastic, with a constant unconditional variance. Any least squares deficiencies are

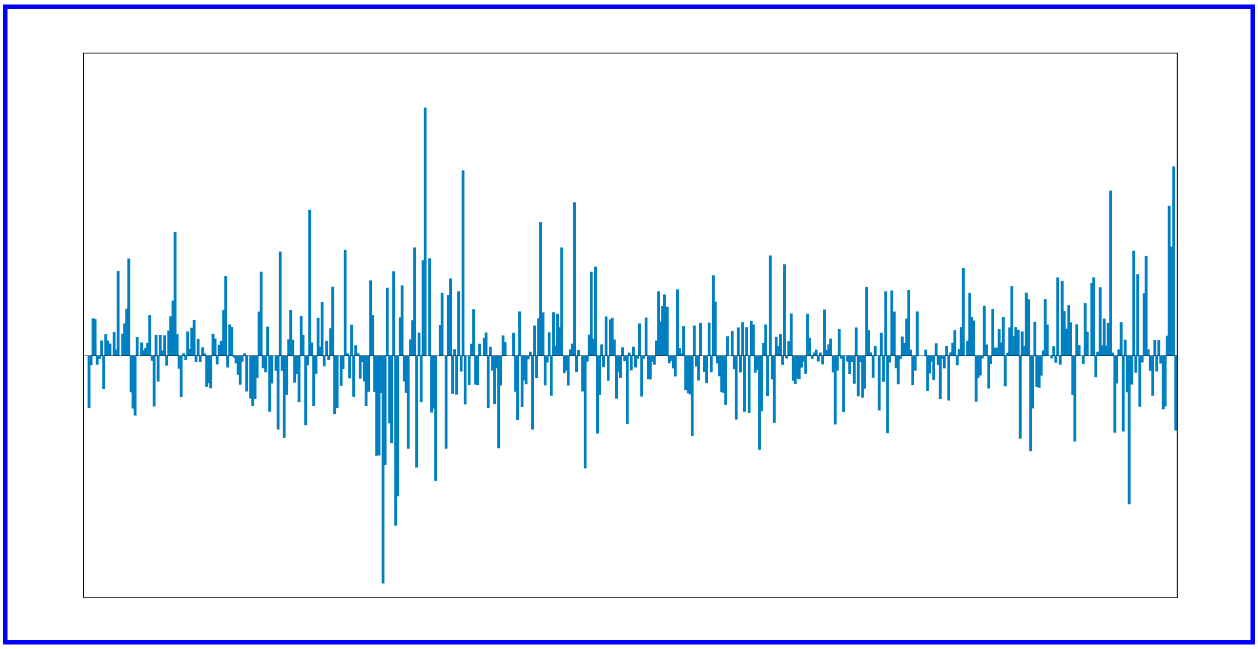
[12] Substitution theorem as phrased by Clarke et al (2007:52).
[13] The ARCH/GARCH procedure was performed with the EViews6 statistical software package.

corrected with the GARCH procedure and the required conditions satisfied. No additional tests were performed on the validity of the model. The conditional mean term was defined with the independent variable as the lagged value of the dependent variable (lognormal share return), that is an AR(1)-model.[14] A large ARCH or GARCH term in the variance equation would indicate that the impact of a shock to the share price is likely to persist for several subsequent periods. A small ARCH or GARCH term implies a short-lived impact on the underlying. Correspondingly, an increase/decrease in the ARCH(1) coefficient suggests a faster/slower dissemination of news and apparent impact on the share price, while an increase in the GARCH(1) coefficient implies a prolonged effect of past news on the underlying. A summed ARCH (new news) and GARCH (old news) value represents the persistence of the shock-effect on the underlying price. An autoregressive (AR) root (ARCH plus GARCH) of less than one (unity) indicates a stationary and predictable volatility.

The results of Dimension Data Holdings (11 – DDT) are used to illustrate the process followed in obtaining the required values and verifying the assertion that any least square deficiencies are corrected with the GARCH procedure. The inherent volatility clustering present in equity returns can be seen in figure 4.2 (DDT daily-returns), which exhibits significant levels of volatility persistence; large movements (magnitude of returns) are clustered with large movements, and small movements clustered with small movements.

Figure 4.3

Daily returns – Dimension Data Holdings (11 – DDT)



Source: McGregor-BFA (EViews6 generated)

[14] Refer to chapter 3, equation 3.21.

Annexure D (pages D-i and D-ii) shows the ARCH and GARCH coefficients obtained from running the GARCH model for the pre-SSF (table D.1), post-SSF (table D.2), and total period (table D.3) which included a dummy variable, respectively. Statistically significant (small p-values) small and decreasing ARCH values (pre to post) with large and increasing GARCH values (pre to post) were observed. The size of the AR root is indicative of a "high persistence to shocks" (i.e., volatility clustering) and therefore predictable volatility (function of past volatility). The direction of change after initial SSF trading reveals a slower dissemination but longer lasting impact of information. This would suggest that the trading of SSF contracts has attracted additional, relatively uninformed traders to both the futures and spot markets, leading in turn to a smaller immediate response to news and to news having a more persistent impact on the spot market. The dummy variable coefficient indicates a decrease (non-significant) in volatility post SSF trading.

The Ljung-Box Q-statistics (Annexure D: table D.7, page D-iv – Correlogram of standardised residuals squared) provide evidence that the GARCH model adequately captured all of the persistence in the variance of returns, with no statistically significant Q-stats. The variance equation proves to be specified correctly, with no remaining ARCH detected. Similarly, the mean equation is tested for any remaining serial correlation (Annexure D: table D.5, page D-iii – Correlogram of standardised residuals) with the Q-stats all reported to be non-significant as expected. These results can be compared with the residual tests performed on the lagged lognormal returns regression (Annexure D, pages D-iii and D-iv). Table D.6 shows large and statistically significant Q-stats (small p-values) indicative of the residuals being serially correlated. Table D.4 reveals some linear dependence at lagged periods 23 and 24, corrected for in the GARCH model.

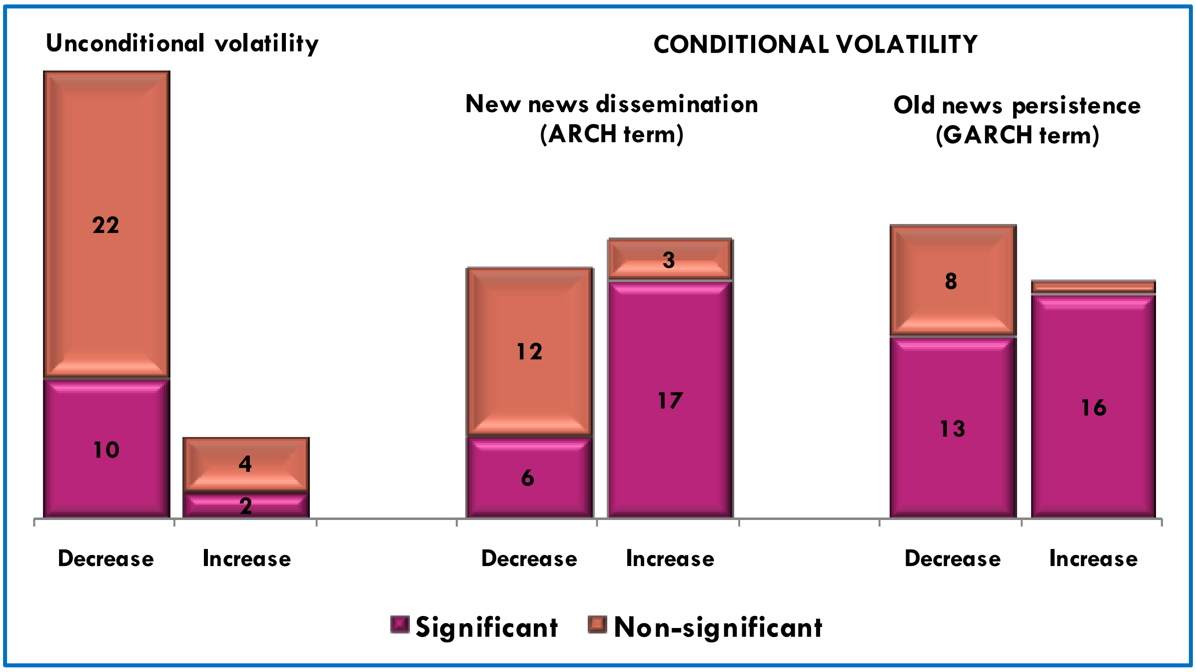
The ARCH LM test carried out on the variance equation exhibits no ARCH in the standardised residuals with both the F-statistic and the Obs*R-squared statistic, reported as non-significant (see Annexure D: table D.9, page D-v) in contrast to the regression results before applying the GARCH concepts (table D.8) showing statistical significance and heteroskedasticity (i.e., non-constant variance of the error terms or residuals).

The Jarque-Bera (JB) statistic, testing the null of whether the standardised residuals are normally distributed, is significant (see Annexure D: figure D.2, page D-vi) and consequently the conditional normality assumption does not hold. The parameter estimates, however, are still consistent when the mean and variance equations are correctly specified. Violating the conditional normality assumption (i.e., a financial time series exhibiting fatter tails than the normal distribution), required the Heteroskedasticity Consistent Covariance option to be selected with the Normal (Gaussian) error distribution in order to calculate the Bollershev-Wooldridge robust standard errors. The Student's t-distribution and Generalised Error Distribution (GED), which also accounts for non-normality, allowed for the assumption of a more likely error distribution and the re-estimation of the model in some cases.

These diagnostics tests are important when GARCH model values are used to predict future volatility. Attempting to detect a change in the level (unconditional volatility) and structure (conditional volatility) of volatility from one period to another (e.g., pre- to post-futures) simply requires a comparison of the relative values and direction of change. For the purposes of this study, the conditions of $\omega > 0$, $\alpha > 0$, $\beta \geq 0$ and $(\alpha+\beta) < 1$ are necessary and sufficient to ensure a positive conditional variance and the existence of variance stationarity (i.e., a defined mean-reverting level). All parameters must therefore be positive, with the sum of α and β expected to be less than but close to unity, with $\beta > \alpha$. Therefore, subject to these conditions, the ARCH/GARCH results for the thirty-eight companies are presented and interpreted in table 4.4 (refer to pages 85-96). These results are summarised in table 4.5 (refer to page 97) and presented graphically in figure 4.4 in an attempt to determine the general impact of initial SSF trading on the level and structure of spot market volatility.

Figure 4.4

Changes in volatility, ARCH and GARCH



A significant ARCH or GARCH term implies that the share returns exhibited a pattern of persistent volatility clustering, meaning that once there is a shock or jolt to the share price, the impact is more likely to persist for several subsequent periods. An insignificant ARCH or GARCH would indicate that the impact only lasted for one period.

Table 4.4

ARCH and GARCH effects

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-SSF period and post-SSF period. The mean equation [$y_t = a + by_{t-1} + \varepsilon_t$] generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation [$h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1}$] produced the ARCH and GARCH terms for the pre- and post-period. A variance equation [$h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1} + \delta D_F$] that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post SSF. The autoregressive root (α+β) governs the persistence of volatility shocks.

No, Company (JSE Code), inferences and error distribution			**ARCH/GARCH effects**					**10%** / **5%** / **1%**
No	**Inferences**	**ε**	**δ**	**ω**	**ARCH(α)**	**GARCH(β)**	**α+β**	
1 AFE	Negative δ - ns decrease in spot volatility. An increase in the ARCH and decrease in GARCH term post-SSF reveal a more immediate (ns) response to news and old news having a shorter-lasting (s) impact. The persistence (ARCH plus GARCH) of shocks dropped off post-SSF.	Normal (Gaussian)	-0.00001	0.00006	0.07607	0.69049	0.76656	
			0.5472	0.1943	0.1081	0.0002		*p-value*
			Pre-SSF	0.00005	0.06097	0.75175	0.81272	
				0.3634	0.2759	0.0006		*p-value*
			Post-SSF	0.00006	0.07062	0.64107	0.71169	
				0.3379	0.3618	0.0622		*p-value*
2 AFL	Model results not assessed due to post-SSF ARCH term and autoregressive root exceeding 1. The pre-SSF model does show a significant persistent old news effect on spot volatility. Model re-estimated with Student's t error distribution (OLS starting values).	Normal (Gaussian)	-0.00060	0.00131	0.55636	0.21281	0.76917	
			0.1664	0.0087	0.2827	0.3386		*p-value*
			Pre-SSF	0.00004	0.04418	0.94068	0.98486	
				0.3536	0.0658	0.0000		*p-value*
			Post-SSF	0.00057	1.06346	0.13981	1.20327	
				0.0000	0.1849	0.3017		*p-value*
	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate an increased (s) rate of information flow with past news playing a smaller (s) role and a reduced persistence to shocks (α+β).	Student's t	-0.00001	0.00006	0.05183	0.92147	0.97330	
			0.6192	0.1111	0.0105	0.0000		*p-value*
			Pre-SSF	0.00004	0.05353	0.93093	0.98446	
				0.3715	0.1193	0.0000		*p-value*
			Post-SSF	0.00013	0.11798	0.80965	0.92763	
				0.0715	0.0604	0.0000		*p-value*
3 ALT	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate increased (ns) dissemination of information, but also a greater (s) contribution to persistence by old news resulting in an increased persistence to shocks (α+β).	Normal (Gaussian)	-0.00001	0.00004	0.06630	0.77885	0.84515	
			0.4043	0.3545	0.0983	0.0001		*p-value*
			Pre-SSF	0.00005	0.06371	0.73571	0.79942	
				0.5166	0.2430	0.0296		*p-value*
			Post-SSF	0.00002	0.07393	0.78136	0.85529	
				0.4175	0.2155	0.0002		*p-value*
4 AMA	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate increased (s) dissemination of information and a smaller (s) contribution to persistence by old news, leading overall to an increased persistence to shocks (α+β).	Normal (Gaussian)	-0.00002	0.00007	0.04817	0.76085	0.80902	
			0.3372	0.2388	0.1212	0.0000		*p-value*
			Pre-SSF	0.00008	0.01072	0.75986	0.77057	
				0.8512	0.8236	0.5486		*p-value*
			Post-SSF	0.00005	0.09949	0.72699	0.82648	
				0.1960	0.0480	0.0000		*p-value*

Notes:

- Default: Normal (Gaussian) error distribution with OLS starting values
- Alternative distributions: Student's t (optional fixed degrees of freedom) and GED (optional fixed parameter)
- Starting coefficients generated with Ordinary Least Squares (OLS); 0.8/0.5/0.3 x OLS; or set as zero
- ns = not statistically significant
- s = statistically significant

Table 4.4 (continued)

ARCH and GARCH effects

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-SSF period and post-SSF period. The mean equation [$y_t = a + by_{t-1} + \varepsilon_t$] generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation [$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$] produced the ARCH and GARCH terms for the pre- and post-period. A variance equation [$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} + \delta D_F$] that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post SSF. The autoregressive root ($\alpha+\beta$) governs the persistence of volatility shocks.

No, Company (JSE Code), inferences and error distribution			ARCH/GARCH effects					10% / 5%
No	**Inferences**	**ε**	**δ**	**ω**	**ARCH(α)**	**GARCH(β)**	**α+β**	**1%**
5 APK	Model results not assessed due to negative values and post-GARCH term exceeding 1. Model re-estimated with Generalised Error Distribution (GED) – 0.5OLS starting values.	Normal (Gaussian)	-0.00046	0.00070	0.12239	-0.09128	0.03112	
			0.1462	0.0433	0.2396	0.3956		*p-value*
			Pre-SSF	0.00070	0.11325	-0.10198	0.01127	
				0.0851	0.5482	0.6268		*p-value*
			Post-SSF	0.000003	-0.04308	1.03571	0.99264	
				0.0005	0.0744	0.0000		*p-value*
	Positive δ - ns increase in spot volatility. Pre to post α and β values indicate increased (s) dissemination of information and a smaller (s) contribution to persistence by old news, overall leading to a stagnant persistence to shocks ($\alpha+\beta$).	GED	0.00003	0.00008	0.14889	0.60640	0.75528	
			0.3850	0.0334	0.1178	0.0001		*p-value*
			Pre-SSF	0.00001	0.03597	0.89954	0.93551	
				0.0400	0.0110	0.0000		*p-value*
			Post-SSF	0.00003	0.23549	0.69278	0.92828	
				0.2084	0.1246	0.0000		*p-value*
6 ART	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate increased (ns) dissemination of information, but also a greater (s) contribution to persistence by old news resulting in an increased persistence to shocks ($\alpha+\beta$).	Normal (Gaussian)	-0.00007	0.00023	0.29973	0.26745	0.56718	
			0.3409	0.0455	0.0138	0.1954		*p-value*
			Pre-SSF	0.00028	0.22667	0.17859	0.40525	
				0.1291	0.0563	0.6294		*p-value*
			Post-SSF	0.00013	0.30405	0.36472	0.66877	
				0.0170	0.0745	0.0890		*p-value*
	Re-estimated with GED (OLS) to obtain $\alpha<\beta$ values. Similar inferences made. Negative δ - ns decrease in spot volatility. Increased (s) dissemination of information, but also a greater (s) contribution to persistence by old news resulting in an increased persistence to shocks ($\alpha+\beta$).	GED	-0.00003	0.00017	0.20011	0.40035	0.60046	
			0.4745	0.0199	0.0288	0.0699		*p-value*
			Pre-SSF	0.00018	0.16670	0.46388	0.63057	
				0.2470	0.3322	0.2791		*p-value*
			Post-SSF	0.00010	0.21309	0.51674	0.72983	
				0.1438	0.0786	0.0498		*p-value*
7 BRC	Negative δ - ns decrease in spot volatility. Pre-to-post results not assessed due to a negative pre-SSF ARCH term. Post-SSF persistence to shocks is average. Model re-estimated with GED1.0 (OLS starting values).	Normal (Gaussian)	-0.00005	0.00009	0.00599	0.82805	0.83404	
			0.4638	0.4550	0.7789	0.0002		*p-value*
			Pre-SSF	0.00007	-0.01127	0.87373	0.86246	
				0.4907	0.6904	0.0000		*p-value*
			Post-SSF	0.00007	0.02393	0.72096	0.74489	
				0.4440	0.6744	0.0407		*p-value*
	Negative δ - s decrease in spot volatility. Pre to post α and β values indicate increased (s) dissemination of information, but also a greater (s) contribution to persistence by old news resulting in an increased persistence to shocks ($\alpha+\beta$).	GED	-0.00018	0.000274	0.15900	0.38439	0.54339	
			0.0228	0.0146	0.0179	0.0690		*p-value*
			Pre-SSF	0.00018	0.05319	0.53249	0.58568	
				0.2920	0.3630	0.1913		*p-value*
			Post-SSF	0.00006	0.13744	0.57130	0.70874	
				0.0770	0.0777	0.0033		*p-value*

Table 4.4 (continued)

ARCH and GARCH effects

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-SSF period and post-SSF period. The mean equation [$y_t = a + by_{t-1} + \varepsilon_t$] generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation [$h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1}$] produced the ARCH and GARCH terms for the pre- and post-period. A variance equation [$h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1} + \delta D_F$] that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post SSF. The autoregressive root ($\alpha+\beta$) governs the persistence of volatility shocks.

No, Company (JSE Code), inferences and error distribution			ARCH/GARCH effects					10% 5%
No	**Inferences**	**ε**	**δ**	**ω**	**ARCH(α)**	**GARCH(β)**	**α+β**	**1%**
8 CDZ	Negative δ - ns decrease in spot volatility. Pre-to-post results not assessed due to negative pre-SSF GARCH and autoregressive root values. Model re-estimated with GED (zero starting values).	Normal (Gaussian)	-0.00009	0.00025	0.20683	0.40111	0.60794	
			0.1900	0.0432	0.1096	0.1077		*p-value*
			Pre-SSF	0.00069	0.09164	-0.28746	-0.19581	
				0.0001	0.1952	0.1153		*p-value*
			Post-SSF	0.00028	0.33287	0.01713	0.35000	
				0.0000	0.1981	0.7299		*p-value*
	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate a much increased (s) rate of information flow with past news playing a small (ns) role and a reduced persistence to shocks (α+β).	GED	-0.00003	0.00010	0.06954	0.72567	0.79521	
			0.2663	0.1711	0.0856	0.0000		*p-value*
			Pre-SSF	0.00010	0.03598	0.80366	0.83964	
				0.6971	0.6444	0.0909		*p-value*
			Post-SSF	0.00017	0.25120	0.33982	0.59102	
				0.0791	0.0553	0.2204		*p-value*
9 CPT	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate faster (s) incorporation of new information into the share price with old news having a diminished (ns) effect, resulting in an overall reduction in the persistence to shocks (α+β).	Normal (Gaussian)	-0.00005	0.00017	0.15899	0.41416	0.57316	
			0.3075	0.0526	0.0310	0.0756		*p-value*
			Pre-SSF	0.00014	0.11198	0.51043	0.62241	
				0.2647	0.2342	0.1518		*p-value*
			Post-SSF	0.00017	0.31931	0.10455	0.42387	
				0.0068	0.0164	0.5083		*p-value*
	Re-estimated with GED (0.8OLS) to obtain α<β values. Similar inferences made. Negative δ - ns decrease in spot volatility. Increased (s) new news incorporation and reduced (ns) role played by old information. Less persistent shock effect.	GED	-0.00001	0.00003	0.08015	0.81803	0.89818	
			0.4330	0.1021	0.0397	0.0000		*p-value*
			Pre-SSF	0.00008	0.07150	0.67194	0.74344	
				0.4043	0.3829	0.0566		*p-value*
			Post-SSF	0.00011	0.24250	0.34198	0.58448	
				0.0898	0.1317	0.2679		*p-value*
10 CSB	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate an increased (ns) rate of news flow and an enhanced (s) old news effect contributing to a much larger persistence to shocks (α+β).	Normal (Gaussian)	-0.00001	0.00017	0.24749	0.20116	0.44865	
			0.7875	0.0030	0.0627	0.2457		*p-value*
			Pre-SSF	0.00021	0.14698	0.08721	0.23420	
				0.1615	0.0832	0.8680		*p-value*
			Post-SSF	0.00010	0.36142	0.37832	0.73973	
				0.0025	0.1644	0.0242		*p-value*
	Re-estimated with GED (0.8OLS) to obtain α<β values. Negative δ - ns decrease in spot volatility. Similar final outcome (increased persistence), but due more to an increased (ns) rate of news flow and less to the staying power (s) of old news.	GED	-0.00001	0.00004	0.06966	0.79611	0.86577	
			0.4816	0.1309	0.0596	0.0000		*p-value*
			Pre-SSF	0.00010	0.05686	0.47605	0.53291	
				0.4357	0.4259	0.4552		*p-value*
			Post-SSF	0.00010	0.21998	0.51201	0.73199	
				0.1110	0.1586	0.0374		*p-value*

Table 4.4 (continued)

ARCH and GARCH effects

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-SSF period and post-SSF period. The mean equation [$y_t = a + by_{t-1} + \varepsilon_t$] generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation [$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$] produced the ARCH and GARCH terms for the pre- and post-period. A variance equation [$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} + \delta D_F$] that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post SSF. The autoregressive root ($\alpha+\beta$) governs the persistence of volatility shocks.

No, Company (JSE Code), inferences and error distribution			ARCH/GARCH effects					10% / 5% / 1%
No	Inferences	ε	δ	ω	ARCH(α)	GARCH(β)	α+β	
11 DDT	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate slower (s) incorporation of new information into the share price with old news having a larger (s) impact, resulting in an even higher persistence to shocks (α+β).	Normal (Gaussian)	-0.00002	0.00005	0.07052	0.89281	0.96333	
			0.3575	0.1170	0.0056	0.0000		*p-value*
			Pre-SSF	0.00005	0.08021	0.88633	0.96654	
				0.1471	0.0529	0.0000		*p-value*
			Post-SSF	0.00001	0.04065	0.95154	0.99219	
				0.7882	0.0714	0.0000		*p-value*
12 DGC	Positive δ - ns increase in spot volatility. Pre to post α and β values indicate a much reduced (ns) rate at which news is incorporated and this combined with a stable (ns) old news impact results in a reduced persistence to shocks (α+β).	Normal (Gaussian)	0.00001	0.00032	0.12950	0.45957	0.58906	
			0.9403	0.0114	0.0222	0.0148		*p-value*
			Pre-SSF	0.00019	0.33948	0.49727	0.83674	
				0.0010	0.0081	0.0000		*p-value*
			Post-SSF	0.00034	0.06225	0.47650	0.53875	
				0.5151	0.4706	0.5287		*p-value*
13 DUR	Positive δ - ns increase in spot volatility. Pre to post α and β values indicate a reduced (s) rate at which news is incorporated but combined with a much larger (s) old news impact result in a greater persistence to shocks (α+β).	Normal (Gaussian)	0.00021	0.00156	0.21398	0.26048	0.47447	
			0.6270	0.0655	0.0146	0.2936		*p-value*
			Pre-SSF	0.00209	0.25368	0.02675	0.28042	
				0.0037	0.0882	0.7981		*p-value*
			Post-SSF	0.00084	0.17901	0.57977	0.75878	
				0.0457	0.0596	0.0010		*p-value*
	Re-estimated with GED (0.8OLS) to obtain α<β values. Similar inferences made. Positive δ - ns increase in spot volatility. Reduced (s) new news incorporation and a larger (s) old news impact leading to a much more persistent shock effect.	GED	0.00065	0.00113	0.27638	0.29574	0.57212	
			0.1780	0.0133	0.0201	0.2060		*p-value*
			Pre-SSF	0.00127	0.24791	0.25832	0.50623	
				0.1155	0.1149	0.5180		*p-value*
			Post-SSF	0.00083	0.19437	0.57391	0.76828	
				0.1464	0.0491	0.0068		*p-value*
14 EOH	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate that a much higher (s) rate at which news is impounded into the share price along with a stable (s) old news component result in an increased persistence to shocks (α+β).	Normal (Gaussian)	-0.00001	0.00007	0.14641	0.49994	0.64635	
			0.4899	0.0554	0.0175	0.0145		*p-value*
			Pre-SSF	0.00007	0.07496	0.53807	0.61304	
				0.3236	0.3164	0.1941		*p-value*
			Post-SSF	0.00004	0.25101	0.52451	0.77551	
				0.0617	0.0072	0.0043		*p-value*

Notes:

- Default: Normal (Gaussian) error distribution with OLS starting values
- Alternative distributions: Student's t (optional fixed degrees of freedom) and GED (optional fixed parameter)
- Starting coefficients generated with Ordinary Least Squares (OLS); 0.8/0.5/0.3 x OLS; or set as zero
- ns = not statistically significant
- s = statistically significant

Table 4.4 (continued)

ARCH and GARCH effects

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-SSF period and post-SSF period. The mean equation [$y_t = a + by_{t-1} + \varepsilon_t$] generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation [$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$] produced the ARCH and GARCH terms for the pre- and post-period. A variance equation [$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} + \delta D_F$] that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post SSF. The autoregressive root ($\alpha+\beta$) governs the persistence of volatility shocks.

No, Company (JSE Code), inferences and error distribution			ARCH/GARCH effects					10% / 5% / 1%
No	**Inferences**	**ε**	**δ**	**ω**	**ARCH(α)**	**GARCH(β)**	**α+β**	**1%**
15 ERM	Model results not assessed due to negative ARCH values, GARCH values and post-SSF autoregressive root exceeding 1. Model re-estimated with GED1.5 (OLS).	Normal (Gaussian)	0.00001	0.00001	-0.02301	1.01302	0.99001	
			0.0000	0.0000	0.0038	0.0000		*p-value*
			Pre-SSF	0.00001	-0.04670	1.03571	0.98901	
				0.0000	0.0005	0.0000		*p-value*
			Post-SSF	-0.00002	-0.02006	1.03407	1.01401	
				0.0000	0.3896	0.0000		*p-value*
	Positive δ - s increase in spot volatility. Pre to post α and β values indicate an increased (s) rate at which news is incorporated and combined with a much smaller (s) old news impact result in a reduced persistence to shocks ($\alpha+\beta$).	GED	0.00001	0.00001	0.01695	0.96450	0.98144	
			0.0163	0.0001	0.0047	0.0000		*p-value*
			Pre-SSF	0.00001	0.01681	0.96919	0.98600	
				0.0001	0.0230	0.0000		*p-value*
			Post-SSF	0.00024	0.09958	0.66690	0.76649	
				0.1343	0.1153	0.0006		*p-value*
16 GDF	Negative δ - s decrease in spot volatility. Pre- to post-result not assessed due to negative post-ARCH. Model re-estimated with GED1.0 (0.3OLS).	Normal (Gaussian)	-0.00044	0.00069	0.08495	0.00708	0.09202	
			0.0415	0.0151	0.2375	0.9828		*p-value*
			Pre-SSF	0.00058	0.10821	0.13871	0.24692	
				0.1014	0.3282	0.7760		*p-value*
			Post-SSF	0.00002	-0.01620	0.94320	0.92701	
				0.0580	0.2444	0.0000		*p-value*
	Negative δ - s decrease in spot volatility. Pre to post α and β values indicate a steady (ns) dissemination of news but a longer lasting (s) effect of old news leading to an increased persistence to shocks ($\alpha+\beta$).	GED	-0.00026	0.00035	0.06604	0.46080	0.52685	
			0.1403	0.1387	0.0643	0.1676		*p-value*
			Pre-SSF	0.00024	0.09428	0.43802	0.53230	
				0.0809	0.0598	0.1175		*p-value*
			Post-SSF	0.00007	0.09359	0.58299	0.67658	
				0.1876	0.1494	0.0286		*p-value*
17 GIJ	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate little change in the dissemination (ns) and staying power of news (s). Constant persistence to shocks ($\alpha+\beta$) observed.	Normal (Gaussian)	-0.00009	0.00013	0.15636	0.82033	0.97669	
			0.4045	0.3778	0.0079	0.0000		*p-value*
			Pre-SSF	0.00013	0.16391	0.81715	0.98106	
				0.5401	0.0225	0.0000		*p-value*
			Post-SSF	0.00004	0.14312	0.82718	0.97031	
				0.4590	0.1978	0.0000		*p-value*

Notes:

- Default: Normal (Gaussian) error distribution with OLS starting values
- Alternative distributions: Student's t (optional fixed degrees of freedom) and GED (optional fixed parameter)
- Starting coefficients generated with Ordinary Least Squares (OLS); 0.8/0.5/0.3 x OLS; or set as zero
- ns = not statistically significant
- s = statistically significant

Table 4.4 (continued)

ARCH and GARCH effects

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-SSF period and post-SSF period. The mean equation $[y_t = a + by_{t-1} + \varepsilon_t]$ generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation $[h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}]$ produced the ARCH and GARCH terms for the pre- and post-period. A variance equation $[h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} + \delta D_F]$ that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post SSF. The autoregressive root $(\alpha+\beta)$ governs the persistence of volatility shocks.

No, Company (JSE Code), inferences and error distribution			ARCH/GARCH effects					10% 5%
No	**Inferences**	**ε**	**δ**	**ω**	**ARCH(α)**	**GARCH(β)**	**α+β**	**1%**
18 GND	Negative δ - s decrease in spot volatility. Pre- to post-result not assessed due to pre-period negative ARCH and GARCH exceeding 1. Model re-estimated with GED (0.3OLS).	Normal (Gaussian)	-0.00021	0.00037	0.15940	0.27115	0.43055	
			0.0845	0.0398	0.0182	0.3129		*p-value*
			Pre-SSF	0.00001	-0.03709	1.02343	0.98635	
				0.0011	0.7342	0.0000		*p-value*
			Post-SSF	0.00020	0.27405	0.07836	0.35240	
				0.0037	0.0132	0.7352		*p-value*
	Positive δ - s increase in spot volatility. Pre to post α and β values indicate an increased (s) rate at which news is incorporated and combined with a smaller (s) old news impact, less persistence to shocks (α+β).	GED	0.00085	0.00005	0.40780	0.53942	0.94722	
			0.0712	0.0201	0.0337	0.0000		*p-value*
			Pre-SSF	0.00000	0.13086	0.81881	0.94967	
				0.2098	0.0065	0.0000		*p-value*
			Post-SSF	0.00003	0.16295	0.75062	0.91357	
				0.1763	0.0387	0.0000		*p-value*
19 HDC	Positive δ - ns increase in spot volatility. Pre to post result not assessed due to post-period negative ARCH term. Model re-estimated with GED1.0 (OLS).	Normal (Gaussian)	0.00002	0.00004	0.08973	0.66266	0.75240	
			0.3246	0.1798	0.0983	0.0026		*p-value*
			Pre-SSF	0.00006	0.14966	0.46350	0.61316	
				0.1186	0.1236	0.1168		*p-value*
			Post-SSF	0.00020	-0.06934	0.12209	0.05275	
				0.1112	0.0000	0.8364		*p-value*
	Negative δ - s decrease in spot volatility. Pre to post α and β values indicate a slower (ns) rate at which news is absorbed, a smaller (ns) reliance on old news, and therefore less persistence to shocks (α+β).	GED	-0.00005	0.00011	0.13049	0.55015	0.68065	
			0.0613	0.0472	0.0650	0.0059		*p-value*
			Pre-SSF	0.00004	0.14115	0.58340	0.72455	
				0.1664	0.0712	0.0157		*p-value*
			Post-SSF	0.00008	0.07317	0.55484	0.62801	
				0.4340	0.4381	0.2801		*p-value*
20 JCD	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate an increased (s) rate at which news is incorporated but, with a much smaller (s) role played by old news impact, lower persistence to shocks (α+β).	Normal (Gaussian)	-0.00003	0.00015	0.22152	0.66813	0.88965	
			0.4837	0.0247	0.0007	0.0000		*p-value*
			Pre-SSF	0.00014	0.22800	0.67368	0.90167	
				0.0802	0.0035	0.0000		*p-value*
			Post-SSF	0.00028	0.28755	0.41480	0.70235	
				0.0337	0.0715	0.0597		*p-value*
21 JSC	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate a decreased (s) rate at which news is incorporated but together with old information having a longer remaining (s) influence, higher persistence to shocks.	Normal (Gaussian)	-0.00004	0.00018	0.17133	0.65005	0.82138	
			0.5035	0.0356	0.0029	0.0000		*p-value*
			Pre-SSF	0.00021	0.19066	0.59842	0.78908	
				0.1719	0.0184	0.0035		*p-value*
			Post-SSF	0.00008	0.12312	0.77932	0.90244	
				0.0693	0.0549	0.0000		*p-value*

Table 4.4 (continued)
ARCH and GARCH effects

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-SSF period and post-SSF period. The mean equation $[y_t = a + by_{t-1} + \varepsilon_t]$ generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation $[h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1}]$ produced the ARCH and GARCH terms for the pre- and post-period. A variance equation $[h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1} + \delta D_F]$ that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post SSF. The autoregressive root $(\alpha+\beta)$ governs the persistence of volatility shocks.

No, Company (JSE Code), inferences and error distribution			ARCH/GARCH effects					10% 5% 1%
No	**Inferences**	**ε**	**δ**	**ω**	**ARCH(α)**	**GARCH(β)**	**α+β**	
22 KAP	Model results not assessed due to negative ARCH and GARCH values. Pre-SSF period shows a lingering old news effect and a high persistence to shocks. Model re-estimated with GED1.0 (OLS).	Normal (Gaussian)	-0.00133	0.00170	0.30706	-0.00244	0.30462	
			0.0004	0.0000	0.0375	0.9786		*p-value*
			Pre-SSF	0.00024	0.20663	0.73645	0.94308	
				0.2331	0.2871	0.0001		*p-value*
			Post-SSF	0.00044	-0.06122	-0.00366	-0.06487	
				0.3371	0.0000	0.9974		*p-value*
	Negative δ - s decrease in spot volatility. Pre to post α and β values shows a much decreased (ns) rate of news dissemination and although old news makes a greater (ns) contribution to persistence, overall persistence to shocks $(\alpha+\beta)$ decreased.	GED	-0.00043	0.00064	0.23647	0.37506	0.61153	
			0.0004	0.0000	0.0003	0.0003		*p-value*
			Pre-SSF	0.00042	0.34319	0.44405	0.78725	
				0.0001	0.0004	0.0000		*p-value*
			Post-SSF	0.00015	0.07388	0.58118	0.65506	
				0.6165	0.5270	0.4438		*p-value*
23 KGM	Negative δ - ns decrease in spot volatility. Pre to post result not assessed due to post-period negative ARCH term, with GARCH and autoregressive root exceeding 1. Model re-estimated with GED1.0 (OLS).	Normal (Gaussian)	-0.00012	0.00026	0.09511	0.13715	0.23225	
			0.2799	0.2817	0.1993	0.8605		*p-value*
			Pre-SSF	0.00022	0.06026	0.25357	0.31383	
				0.6171	0.5095	0.8599		*p-value*
			Post-SSF	-0.000002	-0.01654	1.03384	1.01730	
				0.0025	0.0248	0.0000		*p-value*
	Negative δ - s decrease in spot volatility. Pre to post α and β values shows an increased (s) rate of news dissemination with old news making a greater (s) contribution to persistence. Generally, the persistence to shocks $(\alpha+\beta)$ increased.	GED	-0.00010	0.00015	0.08559	0.48963	0.57522	
			0.0551	0.0499	0.0267	0.0330		*p-value*
			Pre-SSF	0.00012	0.04095	0.49165	0.53259	
				0.3671	0.1400	0.3479		*p-value*
			Post-SSF	0.00005	0.11122	0.56515	0.67637	
				0.1310	0.1091	0.0187		*p-value*
24 KWV	Negative δ - ns decrease in spot volatility. Pre to post result not assessed due to post-period negative ARCH term, with GARCH and autoregressive root exceeding 1. Model re-estimated with GED1.5 (OLS).	Normal (Gaussian)	-0.00004	0.00009	0.02454	0.68520	0.70974	
			0.5764	0.5614	0.5362	0.1739		*p-value*
			Pre-SSF	0.00031	0.05785	-0.09799	-0.04014	
				0.0288	0.5614	0.7745		*p-value*
			Post-SSF	0.00013	-0.03821	0.20457	0.16635	
				0.4299	0.0000	0.8472		*p-value*
	Negative δ - s decrease in spot volatility. Pre to post α and β values shows a slow (ns) dissemination of new information and an increased (s) influence of old news, contributing to an increased persistence to shocks $(\alpha+\beta)$ decreased.	GED	-0.00002	0.00005	0.02749	0.72282	0.75031	
			0.0792	0.0793	0.0614	0.0000		*p-value*
			Pre-SSF	0.00006	0.03805	0.68682	0.72487	
				0.0973	0.1320	0.0002		*p-value*
			Post-SSF	0.00002	0.01120	0.80171	0.81292	
				0.6040	0.4981	0.0292		*p-value*

Table 4.4 (continued)

ARCH and GARCH effects

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-SSF period and post-SSF period. The mean equation $[y_t = a + by_{t-1} + \varepsilon_t]$ generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation $[h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}]$ produced the ARCH and GARCH terms for the pre- and post-period. A variance equation $[h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} + \delta D_F]$ that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post SSF. The autoregressive root $(\alpha+\beta)$ governs the persistence of volatility shocks.

No, Company (JSE Code), inferences and error distribution			ARCH/GARCH effects					10% / 5% / 1%
No	**Inferences**	**ε**	**δ**	**ω**	**ARCH(α)**	**GARCH(β)**	**α+β**	
25 LBH	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate a decreased (ns) rate at which news is incorporated and a longer lasting (ns) impact exerted by old news. Increased but low persistence to shocks.	Normal (Gaussian)	-0.00008	0.00015	0.06393	0.38993	0.45386	
			0.2248	0.1879	0.3398	0.3682		*p-value*
			Pre-SSF	0.00022	0.09834	0.10079	0.19913	
				0.1526	0.4244	0.8578		*p-value*
			Post-SSF	0.00006	0.03989	0.45786	0.49775	
				0.6283	0.3921	0.6711		*p-value*
	Re-estimated with GED1.5 (OLS) to obtain different α and β values. Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate a slower (ns) incorporation of news and the impact of old news dissipating more quickly (ns). Lower persistence to shocks.	GED	-0.00008	0.00014	0.06136	0.37163	0.43299	
			0.1645	0.1679	0.0972	0.3817		*p-value*
			Pre-SSF	0.00006	0.06947	0.67953	0.74899	
				0.2811	0.0930	0.0088		*p-value*
			Post-SSF	0.00007	0.04056	0.39813	0.43869	
				0.5457	0.5875	0.6737		*p-value*
26 LON	Dummy variable model not assessed due to negative GARCH value. Pre- to post-SSF effects shows a slower incorporation (ns) of news but a longer lasting (s) impact of news on the share price and consequent persistence to shocks. Model re-estimated with GED1.0 (OLS).	Normal (Gaussian)	-0.00019	0.00059	0.08418	-0.08837	-0.00420	
			0.1349	0.0033	0.2385	0.7913		*p-value*
			Pre-SSF	0.00012	0.10395	0.69735	0.80129	
				0.2671	0.1624	0.0007		*p-value*
			Post-SSF	0.00004	0.01707	0.87611	0.89317	
				0.2311	0.6819	0.0000		*p-value*
	Negative δ - ns decrease in spot volatility. Pre- to post-SSF terms show an improved rate (ns) at which news gets reflected in the price but quicker (ns) dissipation of the impact. Persistence to shocks decreased as a result.	GED	-0.00018	0.00031	0.07452	0.49708	0.57160	
			0.2188	0.2163	0.1594	0.1872		*p-value*
			Pre-SSF	0.00010	0.12871	0.55099	0.67970	
				0.0325	0.0313	0.0012		*p-value*
			Post-SSF	0.00015	0.14757	0.41585	0.56342	
				0.1546	0.1688	0.2433		*p-value*
27 MCE	Negative δ - ns decrease in spot volatility. Pre- to post-SSF terms show a greatly worsened rate (s) at which news gets reflected in the price but slower (s) dissipation of the impact. Persistence to shocks increased as a result.	Normal (Gaussian)	-0.00001	0.00007	0.13303	0.82956	0.96259	
			0.6746	0.0462	0.0032	0.0000		*p-value*
			Pre-SSF	0.00027	0.35292	0.52597	0.87889	
				0.0188	0.0005	0.0000		*p-value*
			Post-SSF	0.00008	0.09774	0.82592	0.92366	
				0.1797	0.0725	0.0000		*p-value*

Notes:

- Default: Normal (Gaussian) error distribution with OLS starting values
- Alternative distributions: Student's t (optional fixed degrees of freedom) and GED (optional fixed parameter)
- Starting coefficients generated with Ordinary Least Squares (OLS); 0.8/0.5/0.3 x OLS; or set as zero
- ns = not statistically significant
- s = statistically significant

Table 4.4 (continued)

ARCH and GARCH effects

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-SSF period and post-SSF period. The mean equation [$y_t = a + by_{t-1} + \varepsilon_t$] generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation [$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$] produced the ARCH and GARCH terms for the pre- and post-period. A variance equation [$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} + \delta D_F$] that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post SSF. The autoregressive root ($\alpha+\beta$) governs the persistence of volatility shocks.

No, Company (JSE Code), inferences and error distribution			ARCH/GARCH effects					10% / 5%
No	**Inferences**	**ε**	**δ**	**ω**	**ARCH(α)**	**GARCH(β)**	**α+β**	**1%**
28 OMN	Negative δ - s decrease in spot volatility. Pre to post α and β values indicate a much-increased (s) rate at which news is incorporated although the impact dissolves quickly (s). Quicker dissemination caused the higher persistence to shocks (α+β).	Normal (Gaussian)	-0.00014	0.00022	0.45417	0.26869	0.72285	
			0.0067	0.0004	0.0002	0.0088		*p-value*
			Pre-SSF	0.00012	0.10643	0.63199	0.73842	
				0.2910	0.1398	0.0282		*p-value*
			Post-SSF	0.00007	0.67781	0.22779	0.90560	
				0.0111	0.0009	0.0246		*p-value*
	Re-estimated with GED1.3 (zero) to obtain different α and β values. Results confirmed inferences drawn. Statistically significant rapid dissemination of news and dissipation of impact. High persistence to shocks.	GED	-0.00011	0.00017	0.43150	0.30987	0.74137	
			0.0004	0.0000	0.0000	0.0011		*p-value*
			Pre-SSF	0.00009	0.09085	0.66018	0.75102	
				0.0950	0.0891	0.0001		*p-value*
			Post-SSF	0.00006	0.69116	0.24646	0.93762	
				0.0001	0.0001	0.0193		*p-value*
29 PCN	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate a slower (s) dissemination of news but a longer-lasting impact (s) causing a higher persistence to shocks (α+β).	Normal (Gaussian)	-0.00019	0.00036	0.15167	0.59137	0.74304	
			0.1937	0.1063	0.0346	0.0011		*p-value*
			Pre-SSF	0.00040	0.17082	0.54690	0.71772	
				0.2123	0.1225	0.0479		*p-value*
			Post-SSF	0.00005	0.06366	0.86583	0.92949	
				0.3879	0.1033	0.0000		*p-value*
30 PIM	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate a constant (s) rate at which news is incorporated and the impact dissolved. The persistence to shocks remains high.	Normal (Gaussian)	-0.00007	0.00022	0.13033	0.77662	0.90695	
			0.2494	0.0469	0.0067	0.0000		*p-value*
			Pre-SSF	0.00017	0.10258	0.82079	0.92336	
				0.1154	0.0498	0.0000		*p-value*
			Post-SSF	0.00015	0.11672	0.78482	0.90153	
				0.3278	0.0968	0.0000		*p-value*
31 PWK	Positive δ - ns increase in spot volatility. Pre to post α and β values indicate an increased (s) rate at which news is incorporated although the impact dissolves more quickly (s), causing the persistence to shocks (α+β) to decrease.	Normal (Gaussian)	0.000004	0.00003	0.07983	0.72028	0.80011	
			0.6454	0.0878	0.0387	0.0000		*p-value*
			Pre-SSF	0.00002	0.07252	0.78585	0.85837	
				0.0971	0.1146	0.0000		*p-value*
			Post-SSF	0.00006	0.10962	0.56927	0.67889	
				0.2120	0.1228	0.0463		*p-value*

Notes:

- Default: Normal (Gaussian) error distribution with OLS starting values
- Alternative distributions: Student's t (optional fixed degrees of freedom) and GED (optional fixed parameter)
- Starting coefficients generated with Ordinary Least Squares (OLS); 0.8/0.5/0.3 x OLS; or set as zero
- ns = not statistically significant
- s = statistically significant

Table 4.4 (continued)

ARCH and GARCH effects

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-SSF period and post-SSF period. The mean equation [$y_t = a + by_{t-1} + \varepsilon_t$] generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation [$h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1}$] produced the ARCH and GARCH terms for the pre- and post-period. A variance equation [$h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1} + \delta D_F$] that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post SSF. The autoregressive root (α+β) governs the persistence of volatility shocks.

No, Company (JSE Code), inferences and error distribution			ARCH/GARCH effects					10% 5%
No	**Inferences**	**ε**	**δ**	**ω**	**ARCH(α)**	**GARCH(β)**	**α+β**	**1%**
32 SGG	Negative δ - ns decrease in spot volatility. Pre to post α and β values indicate a decreased (ns) rate at which news is incorporated and an almost immediate dissipation (ns) of any subsequent effect. Very low persistence to shocks (α+β).	Normal (Gaussian)	-0.00025	0.00078	0.12925	0.32913	0.45839	
			0.1796	0.0240	0.0376	0.2327		*p-value*
			Pre-SSF	0.00054	0.16377	0.48161	0.64539	
				0.0494	0.0603	0.0349		*p-value*
			Post-SSF	0.0083	0.11063	0.01556	0.12619	
				0.1050	0.1595	0.9766		*p-value*
	Re-estimated with GED0.7 (OLS) to obtain different α and β values. Positive δ - ns increase in spot volatility. Large decrease (ns) in the speed of news dissemination and a far less (ns) enduring effect. Low persistence to shocks (α+β).	GED	0.00007	0.00048	0.25747	0.45965	0.71712	
			0.6587	0.0953	0.0969	0.0694		*p-value*
			Pre-SSF	0.00027	0.42088	0.53589	0.95677	
				0.0758	0.0908	0.0019		*p-value*
			Post-SSF	0.00108	0.07313	0.20923	0.28236	
				0.7601	0.7349	0.9327		*p-value*
33 SHP	Positive δ - ns increase in spot volatility. Pre-post results not assessed due to negative ARCH and GARCH exceeding 1. Model re-estimated with Student's t (OLS).	Normal (Gaussian)	0.000005	0.00006	0.11959	0.69298	0.81257	
			0.7499	0.0628	0.0319	0.0000		*p-value*
			Pre-SSF	0.00000	-0.03884	1.03316	0.99432	
				0.0000	0.0291	0.0000		*p-value*
			Post-SSF	0.00010	0.21834	0.48680	0.70514	
				0.0216	0.0260	0.0025		*p-value*
	Negative δ - ns decrease in spot volatility. Pre to post α and β values show a much higher (s) rate at which news is impounded into the share price with the impact not lasting (s) as long. A big decrease in the persistence to shocks is observed.	Student's t	-0.000003	0.00007	0.15810	0.64155	0.79965	
			0.8694	0.0762	0.0286	0.0000		*p-value*
			Pre-SSF	0.00002	0.04565	0.89708	0.94273	
				0.3653	0.2829	0.0000		*p-value*
			Post-SSF	0.00011	0.29240	0.47783	0.77023	
				0.0802	0.0813	0.0194		*p-value*
34 SIM	Negative δ - ns decrease in spot volatility. Pre to post α and β values show a steady (s) rate at which news is incorporated into the share price but a longer lasting (s) impact by old news. Autoregressive root exhibits a very high persistence to shocks.	Normal (Gaussian)	-0.00033	0.00038	0.09304	0.84886	0.94190	
			0.4116	0.3901	0.0102	0.0000		*p-value*
			Pre-SSF	0.00063	0.08857	0.78156	0.87013	
				0.4904	0.1599	0.0001		*p-value*
			Post-SSF	0.00001	0.07476	0.91705	0.99181	
				0.5150	0.0099	0.0000		*p-value*

Notes:

- Default: Normal (Gaussian) error distribution with OLS starting values
- Alternative distributions: Student's t (optional fixed degrees of freedom) and GED (optional fixed parameter)
- Starting coefficients generated with Ordinary Least Squares (OLS); 0.8/0.5/0.3 x OLS; or set as zero
- ns = not statistically significant
- s = statistically significant

Table 4.4 (continued)

ARCH and GARCH effects

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-SSF period and post-SSF period. The mean equation $[y_t = a + by_{t-1} + \varepsilon_t]$ generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation $[h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1}]$ produced the ARCH and GARCH terms for the pre- and post-period. A variance equation $[h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1} + \delta D_F]$ that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post SSF. The autoregressive root $(\alpha+\beta)$ governs the persistence of volatility shocks.

No, Company (JSE Code), inferences and error distribution			ARCH/GARCH effects					10% / 5% / 1%
No	**Inferences**	**ε**	**δ**	**ω**	**ARCH(α)**	**GARCH(β)**	**α+β**	
35 SLM	Negative δ - s decrease in spot volatility. Pre to post α and β values indicate a decreased (s), but high, rate at which news is incorporated and an almost immediate dissipation (ns) of any subsequent effect. Very low persistence to shocks (α+β).	Normal (Gaussian)	-0.00019	0.00034	0.30869	0.25468	0.56337	
			0.0171	0.0027	0.0017	0.1098		*p-value*
			Pre-SSF	0.00028	0.37561	0.30807	0.68369	
				0.0093	0.0380	0.0647		*p-value*
			Post-SSF	0.00021	0.29019	0.03357	0.32376	
				0.0014	0.0079	0.8678		*p-value*
	Re-estimated with GED1.0 (OLS) to obtain α<β values. Negative δ - s decrease in spot volatility. Decreased (ns) rate at which news is incorporated and a more prolonged (s) old news effect recorded. Constant persistence to shocks (α+β).	GED	-0.00020	0.00034	0.27638	0.36804	0.64443	
			0.1010	0.0594	0.0297	0.1488		*p-value*
			Pre-SSF	0.00028	0.31250	0.43447	0.74697	
				0.1932	0.1186	0.1907		*p-value*
			Post-SSF	0.00009	0.15699	0.58371	0.74069	
				0.3613	0.2106	0.1071		*p-value*
36 SPG	Negative δ - ns decrease in spot volatility. Pre-to-post effects not assessed due to pre AR root exceeding 1. Model re-estimated with GED (0.8OLS).	Normal (Gaussian)	-0.000004	0.00003	0.14741	0.76009	0.90750	
			0.7049	0.0169	0.0023	0.0000		*p-value*
			Pre-SSF	0.00000	0.24619	0.79861	1.04480	
				0.1920	0.0013	0.0000		*p-value*
			Post-SSF	0.00009	0.10462	0.51493	0.61956	
				0.2398	0.1074	0.1438		*p-value*
	Negative δ - s decrease in spot volatility. Quick, but slower (ns) dissemination of news with a shorter after-effect (ns). Much smaller persistence to shocks.	GED	-0.00006	0.00014	0.23719	0.41794	0.65513	
			0.0896	0.0161	0.0319	0.0153		*p-value*
			Pre-SSF	0.00006	0.32256	0.56937	0.89193	
				0.1173	0.0578	0.0005		*p-value*
			Post-SSF	0.00010	0.20658	0.36224	0.56882	
				0.0855	0.2148	0.2204		*p-value*
37 UCS	Negative δ - ns decrease in spot volatility. Much slower (ns) dissemination of news and a shorter after-effect (ns) resulting in a low persistence to shocks.	Normal (Gaussian)	-0.00001	0.00018	0.16186	0.56037	0.72223	
			0.7299	0.0262	0.0033	0.0001		*p-value*
			Pre-SSF	0.00014	0.20572	0.60643	0.81215	
				0.0225	0.0139	0.0000		*p-value*
			Post-SSF	0.00031	0.07893	0.32011	0.39904	
				0.4436	0.2979	0.6875		*p-value*

Notes:

- Default: Normal (Gaussian) error distribution with OLS starting values
- Alternative distributions: Student's t (optional fixed degrees of freedom) and GED (optional fixed parameter)
- Starting coefficients generated with Ordinary Least Squares (OLS); 0.8/0.5/0.3 x OLS; or set as zero
- ns = not statistically significant
- s = statistically significant

Table 4.4 (continued)

ARCH and GARCH effects

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-SSF period and post-SSF period. The mean equation [$y_t = a + by_{t-1} + \varepsilon_t$] generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation [$h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1}$] produced the ARCH and GARCH terms for the pre- and post-period. A variance equation [$h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1} + \delta D_F$] that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post SSF. The autoregressive root ($\alpha+\beta$) governs the persistence of volatility shocks.

No, Company (JSE Code), inferences and error distribution			ARCH/GARCH effects					10% 5% 1%
No	**Inferences**	**ε**	**δ**	**ω**	**ARCH(α)**	**GARCH(β)**	**α+β**	
38 WNH	Positive δ - ns increase in spot volatility.	Normal (Gaussian)	0.00004	0.00017	0.14410	0.59813	0.74223	
			0.4646	0.0475	0.0026	0.0002		*p-value*
	Pre-to-post-effects not assessed due to negative pre-period ARCH with GARCH exceeding 1.		**Pre-SSF**	0.00001	-0.03928	1.03154	0.99226	
				0.0000	0.1937	0.0000		*p-value*
	Model re-estimated with GED0.9 (0.3OLS).		**Post-SSF**	0.00021	0.27911	0.49784	0.77695	
				0.0701	0.0004	0.0051		*p-value*
	Negative δ - s decrease in spot volatility.	GED	-0.00017	0.00031	0.16846	0.52051	0.68897	
			0.0356	0.0147	0.0153	0.0008		*p-value*
	Despite a smaller (s) contribution by old news, a much faster (s) dissemination of current news resulted in a larger persistence to shocks.		**Pre-SSF**	0.00020	0.10540	0.55214	0.65754	
				0.3723	0.3780	0.2030		*p-value*
			Post-SSF	0.00012	0.29237	0.47090	0.76327	
				0.0126	0.0159	0.0007		*p-value*

The preferred outcome of futures trading is a more efficient market, namely a faster dissemination of news by the underlying share price, a shorter-lived after-effect, and subsequently a less persistent shock-effect on the share price. This translates into a larger ARCH term, a smaller GARCH term and smaller AR root (ARCH plus GARCH). Eleven companies experienced this desired result (full benefit) attributed to futures trading (refer to table 4.5). The statistical output of nine companies confirmed that futures trading had the exact opposite consequence for the behaviour of their share prices. A decreased ARCH and increased GARCH expose a more persistent shock-effect due to the longer-lasting influence of old news which, initially, was incorporated into the share price at a slower pace, since the start of SSF trading.

Table 4.5 summarises the individual company results post-futures with the majority (17 from 20) showing a statistically significant increase in the dissemination rate of news. Thirteen statistically significant instances of a reduced contribution to persistence by past news were also recorded among the twenty-one (majority) companies exhibiting this tendency. Overall, more companies (20) showed a shortened period of excessive price movements following the incorporation of news, compared to those (18) showing an increased persistence to shocks (extended period of volatility). However, more statistically significant increases (16 from 17) in the long-term impact of old news were recorded.

Table 4.5

Summary of ARCH/GARCH model results

The table shows the per company change in spot volatility, change in the speed at which new information is incorporated in the share price (ARCH effect), and change in the influence of past news on the current share price (GARCH effect). A change in the autoregressive root (ARCH plus GARCH effect) represents a change in the persistence of shocks on the share price, determined jointly by the rate of dissemination and lingering impact of news.

No	Code	σ	ARCH	GARCH	AR Root	No	Code	σ	ARCH	GARCH	AR Root
1	AFE	–	+	–	–	20	JCD	–	+	–	–
2	AFL	–	+	–	–	21	JSC	–	–	+	+
3	ALT	–	+	+	+	22	KAP	–	–	+	–
4	AMA	–	+	–	+	23	KGM	–	+	+	+
5	APK	+	+	–	–	24	KWV	–	–	+	+
6	ART	–	+	+	+	25	LBH	–	–	–	–
7	BRC	–	+	+	+	26	LON	–	–	+	+
8	CDZ	–	+	–	–	27	MCE	–	–	+	+
9	CPT	–	+	–	–	28	OMN	–	+	–	+
10	CSB	–	+	+	+	29	PCN	–	–	+	+
11	DDT	–	–	+	+	30	PIM	–	+	–	–
12	DGC	+	–	–	–	31	PWK	+	+	–	–
13	DUR	+	–	+	+	32	SGG	–	–	–	–
14	EOH	–	+	–	+	33	SHP	–	+	–	–
15	ERM	+	+	–	–	34	SIM	–	–	+	+
16	GDF	–	–	+	+	35	SLM	–	–	+	–
17	GIJ	–	–	+	–	36	SPG	–	–	–	–
18	GND	+	+	–	–	37	UCS	–	–	–	–
19	HDC	–	–	–	–	38	WNH	–	+	–	+

Statistically significant change

Spot volatility				Dissemination rate				Long-term impact				Persistence of shocks	
Decrease		Increase		Decrease		Increase		Decrease		Increase		Decrease	Increase
32		6		18		20		21		17		20	18
s	ns	s	ns	s	ns	s	ns	s	ns	s	ns		
10	22	2	4	6	12	17	3	13	8	16	1		

The majority (32) of companies showed a decline in spot volatility following the onset of futures trading. Only ten (10) shares exhibited a statistically significant decline in volatility.

The majority (20) of companies showed an increase in the speed at which new information is incorporated in the price, seventeen (17) at a statistically significant level.

The majority (21) of companies showed a decrease in the durability of disseminated news. Thirteen (13) shares revealed a statistically significant decline in the role played by old news in establishing the price.

The majority (20) of companies displayed a diminished propensity to shocks influencing the share price.

A futures-trading-effect of news being impounded in prices more rapidly, along with a decrease in persistence, conforms to a liquid underlying market (i.e., the individual share) with informed investors dominating. A less liquid share (lower trading volumes) could see the influx of more uninformed traders, less concerned with fundamentals, attracted by the newly available futures contract allowing for an additional or alternative access to the spot position. Market makers (see chapter 2, section 2.6.4) have to hedge themselves by buying the full long exposure and selling the short exposure in the spot market, thereby generating activity in the underlying share as a consequence of futures trading. A smaller immediate response to news having a more persistent impact on the spot market results from more uninformed traders entering the spot and futures markets.[15] These results are in line with the complete markets hypothesis (more efficient market due to futures trading), diminishing short-sales restrictions hypothesis (reduced asymmetric response to information resulting from the ability to sell short), and the improved information environment hypothesis (improved price discovery through futures trading activity).

Companies were categorised in terms of a distinct and statistically significant ARCH, GARCH, and AR root combination and assigned to the respective sectors, but no per sector pattern emerged.

ARCH-GARCH effects	Companies	Sectors[16]
(+) Increase in ARCH (–) Decrease in GARCH (–) Decrease in AR root	AFL, ERM, GND, JCD, PIM, SHP	Basic Materials, Financials, Industrials, Technology,
Interpretation	Faster incorporation of news into share price Smaller contribution of old news to volatility Shortened period of volatility (persistence to shocks)	
(+) Increase in ARCH (–) Decrease in GARCH (+) Increase in AR root	AMA, EOH, OMN, WNH	Consumer Goods, Technology, Basic Materials, Industrials
Interpretation	Faster incorporation of news into share price Smaller contribution of old news to volatility Extended period of volatility (persistence to shocks)	
(+) Increase in ARCH (+) increase in GARCH (+) Increase in AR root	ART	Industrial
Interpretation	Faster incorporation of news into share price Larger contribution of old news to volatility Extended period of volatility (persistence to shocks)	
(–) Decrease in ARCH (+) Increase in GARCH (+) Increase in AR root	DDT, DUR, JSC, MCE, SIM	Technology, Basic Materials, Industrials, Telecommunications,
Interpretation	Slower incorporation of news into share price Larger contribution of old news to volatility Extended period of volatility (persistence to shocks)	

The dummy variable included in the GARCH model revealed that the majority of companies (32) experienced a decrease in the level of spot volatility, with only ten showing a statistically significant decrease. It is therefore reasonable to conclude that the introduction of futures trading generally subdues movements in share prices (i.e., volatility). The following section investigates this further, providing corroborative evidence.

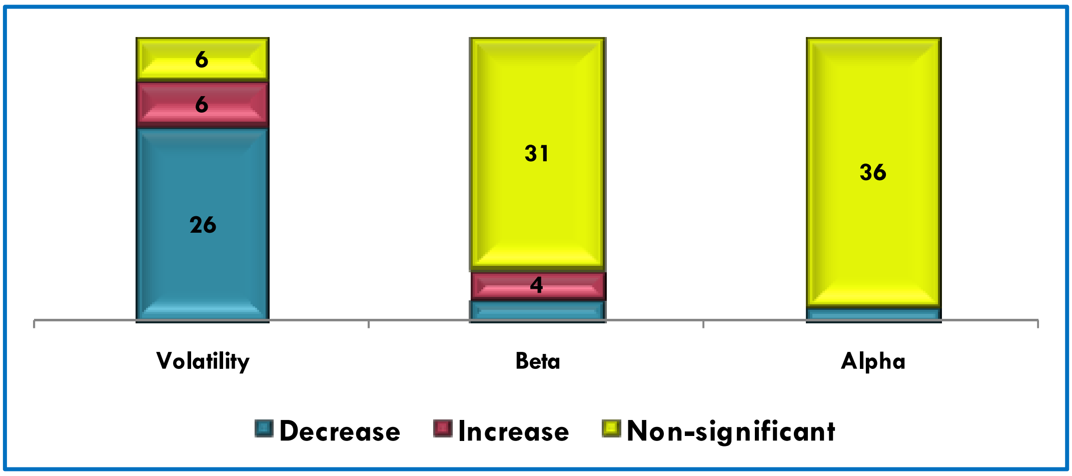
[15] Butterworth (2000:441-442) formulated this argument in comparing the impact of the FTSE100 contract (highly liquid underlying market) to that of the Mid250 contract (illiquid underlying market).
[16] Refer to Annexure C.

4.4.2 Changes in volatility, systematic risk and minimum return

Table 4.6: panel A reports the outcomes of the F-test performed on the differences between variances. All but six companies displayed a significant difference in pre-SSF and post-SSF volatility.[17] A large majority of the companies (26) experienced a significant decrease in volatility, while only six companies showed a significant increase in volatility. It is therefore concluded that SSF trading in general leads to a significant decrease in spot price volatility. These results tend to confirm those obtained by the GARCH model, concluding that SSF trading in general does not destabilise (unpredictable volatility and share price movements) the underlying security. All three theoretical frameworks hold true, predicting a decrease in volatility after the introduction of derivatives trading. These results are presented graphically in figure 4.5.

Figure 4.5

Changes in volatility, beta and alpha



Panel B concludes the study by listing the pre- and post-SSF company betas and associated increase or decrease. The dummy variable regression tested for both a change in the slope of beta and a structural break (shift in the constant). A significant change in beta was recorded in only seven instances, while two (JCD and MCE) shifts in the constant term (alpha) appeared to be sizable at a 5% level of significance. SSF trading in general did not alter the relation between company and market (pre to post) to any significant extent. It can be concluded from the beta-test that systematic risk remained largely unaffected, with only small changes in the majority of cases reported. Notable exceptions are KAP Holdings (22 – KAP), which showed a large decrease in co-movement (1,2599 to 0,3186) at a 5% significance level, and both Shoprite Holdings (33 – SHP) and Sanlam (35 – SLM), which experienced changes significant at a 1% level. No result regarding the general direction of change in systematic risk emerged from this study (four/three significant increases/decreases). These results are presented graphically in figure 4.5.

[17] Statistical significance arises from exceeding the critical F-values (two-sided test) calculated at 249 numerator and denominator degrees of freedom, and being 1,23 (10%), 1,28 (5%) and 1,39 (1%) respectively.

Table 4.6

Standard deviation and beta results

Panel A shows the individual standard deviations for companies in the pre-SSF period compared to the post-SSF period along with the observed change (increase or decrease) between the periods. The ratio of pre- and post-variances was F-tested (difference in variance) for significance. Panel B displays the results of the dummy variable regression [$R_{it} = \alpha_i + \beta_0 R_{mt} + \beta_1 (R_{mt} \times D_F) + \beta_2 D_F + \varepsilon_{it}$] used to determine an absolute shift (dummy) in the constant term (structural break) and a change (Index*dummy) in the slope coefficient (beta).

No	Company (JSE Code)	Panel A: Change in standard deviation				Panel B: Dummy Variable Regression Coefficients				10% / 5% / 1%
		Pre-SSF	Post-SSF	Change	F-test	Constant	Market	Change	Shift	
1	AFE	1.5977	1.4655	-0.1323	1.1886	0.0010	0.2349	0.1031	0.0003	
						0.3235	0.0177	0.5195	0.8140	*p-value*
2	AFL	4.7035	5.3172	+0.6137	1.2780	0.0026	0.0574	0.1649	-0.0056	
						0.4084	0.8333	0.6776	0.2144	*p-value*
3	ALT	1.5159	1.2084	-0.3075	1.5737	0.0002	0.1767	0.0409	0.0010	
						0.8467	0.0094	0.7069	0.4100	*p-value*
4	AMA	1.9257	1.7300	-0.1956	1.2390	0.0008	0.4233	-0.0367	-0.0016	
						0.4761	0.0040	0.8270	0.3196	*p-value*
5	APK	2.9293	1.5697	-1.3597	3.4827	0.0017	0.2204	0.1423	-0.0001	
						0.2672	0.1354	0.5847	0.9519	*p-value*
6	ART	2.1146	1.9661	-0.1485	1.1568	0.0022	0.2375	-0.1282	0.0000	
						0.0936	0.0724	0.5726	0.9953	*p-value*
7	BRC	2.4107	1.6485	-0.7622	2.1385	0.0025	0.1916	0.0362	-0.0019	
						0.0591	0.1722	0.8655	0.3172	*p-value*
8	CDZ	2.3966	2.0143	-0.3823	1.4156	0.0014	0.2075	0.0236	-0.0015	
						0.3115	0.2704	0.9114	0.4407	*p-value*
9	CPT	1.9241	1.6239	-0.3003	1.4040	0.0001	0.1524	0.3595	0.0004	
						0.9242	0.0999	0.0136	0.7824	*p-value*
10	CSB	1.6740	1.7803	+0.1063	1.1310	0.0018	0.1173	0.0172	0.0003	
						0.1085	0.3495	0.9196	0.8562	*p-value*
11	DDT	3.5894	2.6644	-0.9250	1.8149	0.0007	1.3808	-0.2015	-0.0004	
						0.6505	0.0000	0.2771	0.8746	*p-value*
12	DGC	2.8335	2.7513	-0.0822	1.0607	0.0030	0.3392	0.1218	-0.0012	
						0.0912	0.1779	0.6630	0.6272	*p-value*
13	DUR	5.2451	6.0085	+0.7633	1.3122	0.0026	0.3853	0.4329	0.0011	
						0.4589	0.1589	0.2640	0.8218	*p-value*
14	EOH	1.3716	1.3425	-0.0291	1.0439	0.0002	0.3937	-0.1927	0.0008	
						0.8463	0.0000	0.0827	0.5301	*p-value*
15	ERM	2.3903	3.6519	+1.2616	2.3341	0.0012	0.0401	0.3597	-0.0009	
						0.5414	0.8847	0.2419	0.7400	*p-value*
16	GDF	2.8771	1.6372	-1.2400	3.0882	0.0031	0.1585	-0.1565	-0.0007	
						0.0391	0.2807	0.5107	0.7270	*p-value*
17	GIJ	5.5101	3.0517	-2.4584	3.2601	-0.0009	0.1396	0.0466	0.0006	
						0.7620	0.7319	0.9178	0.8839	*p-value*
18	GND	2.4346	1.7719	-0.6628	1.8880	0.0042	0.1554	0.2894	-0.0014	
						0.0018	0.2242	0.1528	0.4818	*p-value*
19	HDC	1.2847	1.4631	+0.1784	1.2970	0.0014	0.1362	0.2022	-0.0005	
						0.1173	0.1749	0.1212	0.6879	*p-value*
20	JCD	3.8526	3.0218	-0.8308	1.6255	0.0028	0.2688	0.5337	-0.0060	
						0.2027	0.1328	0.0568	0.0497	*p-value*

Panel A shows the individual standard deviations for companies in the pre-SSF period compared to the post-SSF period along with the observed change (increase or decrease) between the periods. The ratio of pre- and post-variances was F-tested (difference in variance) for significance. Panel B displays the results of the dummy variable regression [$R_{it} = \alpha_i + \beta_0 R_{mt} + \beta_1 (R_{mt} \times D_F) + \beta_2 D_F + \varepsilon_{it}$] used to determine an absolute shift (dummy) in the constant term (structural break) and a change (Index*dummy) in the slope coefficient (beta).

No	Company (JSE Code)	Panel A: Change in standard deviation				Panel B: Dummy Variable Regression Coefficients				10% / 5% / 1%
		Pre-SSF	Post-SSF	Change	F-test	Constant	Market	Change	Shift	
21	JSC	3.0874	2.7770	-0.3103	1.2360	0.0001	0.3436	-0.0230	0.0006	
						0.9536	0.1130	0.9280	0.8180	*p-value*
22	KAP	5.4526	2.0330	-3.4197	7.1938	0.0038	1.2599	-0.9413	-0.0033	
						0.1342	0.0000	0.0233	0.3725	*p-value*
23	KGM	1.8335	1.3358	-0.4978	1.8842	0.0011	0.1259	0.0144	-0.0010	
						0.3035	0.2988	0.9258	0.5090	*p-value*
24	KWV	1.7595	1.2493	-0.5103	1.9837	0.0007	0.2253	-0.0978	0.0013	
						0.4514	0.0011	0.3679	0.3361	*p-value*
25	LBH	1.6837	1.1168	-0.5669	2.2729	-0.0002	0.5725	-0.1333	0.0003	
						0.7659	0.0000	0.2295	0.7765	*p-value*
26	LON	2.4331	2.0212	-0.4119	1.4492	-0.0006	0.7442	0.2220	-0.0004	
						0.6476	0.0000	0.2154	0.8275	*p-value*
27	MCE	4.3331	3.2589	-1.0742	1.7679	0.0031	1.8008	-0.0300	-0.0067	
						0.1197	0.0000	0.8958	0.0170	*p-value*
28	OMN	2.1931	1.6767	-05164	1.7107	0.0015	0.1238	0.0620	0.0003	
						0.2328	0.1943	0.6964	0.8518	*p-value*
29	PCN	3.6918	2.5582	-1.1337	2.0827	0.0017	-0.1877	0.2316	-0.0005	
						0.3975	0.4504	0.4209	0.8554	*p-value*
30	PIM	5.0216	4.1360	-0.8856	1.4741	-0.0003	0.4158	0.1560	0.0006	
						0.9054	0.1774	0.7432	0.8792	*p-value*
31	PWK	1.3432	1.3561	+0.0128	1.0192	0.0007	0.1914	0.2151	-0.0005	
						0.4164	0.0495	0.0892	0.6633	*p-value*
32	SGG	3.9582	3.1559	-0.8023	1.5731	-0.0008	0.1976	-0.1139	0.0003	
						0.7184	0.3314	0.7261	0.9210	*p-value*
33	SHP	1.6691	1.8662	+0.1971	1.2501	0.0005	0.1116	0.3735	0.0001	
						0.6683	0.1898	0.0038	0.9689	*p-value*
34	SIM	7.0121	4.0137	-2.9984	3.0522	0.0064	0.4419	0.3687	-0.0027	
						0.0788	0.3006	0.4596	0.5990	*p-value*
35	SLM	2.7945	1.7372	-1.0573	2.5875	-0.0001	1.3517	-0.5024	0.0006	
						0.9608	0.0000	0.0002	0.6903	*p-value*
36	SPG	1.9686	1.5498	-0.4188	1.6135	0.0015	0.3510	-0.0944	-0.0016	
						0.1680	0.0006	0.5605	0.3218	*p-value*
37	UCS	2.7475	2.3074	-0.4401	1.4178	0.0006	0.1344	-0.0552	0.0024	
						0.6939	0.4903	0.8077	0.2980	*p-value*
38	WNH	2.3881	3.0584	+0.6703	1.6401	-0.0009	0.1586	0.1647	0.0013	
						0.6157	0.1922	0.4204	0.6035	*p-value*

In the section to follow, all the results from the price effect, volume effect, and volatility effect procedures are summarised per company and a conclusion regarding the general impact (based on the majority of individual results) is presented.

4.5 Summary

This section assembles the three components of this study, namely the price, volume and volatility effects, providing a per company breakdown of how first-time single stock futures trading impacted upon each. Table 4.7 shows the direction of change (increase or decrease) in the price level, trading volume, volatility level, volatility structure (dissemination rate of news and duration of impact as well as the level of persistence), and systematic risk for all thirty-eight companies.

Ideally, the introduction of futures trading should result in an increase in price, higher trading volume, lower volatility, reduced persistence to shocks (i.e., shortened volatile periods), and less systematic risk.

4.5.1 Conclusions on the price results

On an individual per company basis it is concluded that the introduction of single stock futures had little or no impact on the underlying share prices. The event study (market model plus dummy variable regression) presented no conclusive evidence to establish either a positive or a negative impact on the underlying prices. Table 4.7 shows that only three companies experienced a significant price effect on the first day (day zero) of futures trading.

Table 4.7

Summary of all results (1 – 13)

		No	1	2	3	4	5	6	7	8	9	10	11	12	13
		JSE Code	AFE	AFL	ALT	AMA	APK	ART	BRC	CDZ	CPT	CSB	DDT	DGC	DUR
		Industry	BM	BM	T	CG	I	I	CS	F	F	CS	T	I	BM
		Spot trading volume	L	M	L	L	L	L	L	L	L	L	H	L	L
		Year of introduction	04	03	03	05	04	04	04	05	03	05	99	05	01
Price effect	**Event study**	**Market**	–	–	+	–	–	–	–	–	+	+	–	+	–
		Dummy	–	+	+	–	–	–	–	–	+	+	–	+	–
Volume effect	**Normalised volume**	**t-test**	+	–	+	+	+	+	+	+	+	+	+	+	+
		Trend	+	–	+	+	+	+	–	+	–	+	–	+	+
Volatility effect	**Level**	**F-test**	–	+	–	–	–	–	–	–	–	+	–	–	+
		Dummy	–	–	–	–	+	–	–	–	–	–	–	+	+
	Structure	**Dissemination**	+	+	+	+	+	+	+	+	+	+	–	–	–
		Duration	–	–	+	–	–	+	+	–	–	+	+	–	+
		Persistence	–	–	+	+	–	+	+	–	–	+	+	–	+
	Beta	**Shift**	+	–	+	–	–	+	–	–	+	+	–	–	+
		Slope	+	+	+	–	+	–	+	+	+	+	–	+	+

Statistically significant change

Summary of all results (14 – 26)

		No	14	15	16	17	18	19	20	21	22	23	24	25	26
		JSE Code	EOH	ERM	GDF	GIJ	GND	HDC	JCD	JSC	KAP	KGM	KWV	LBH	LON
		Industry	T	F	CS	T	I	I	BM	I	I	CS	CS	F	BM
		Spot trading volume	L	L	L	M	L	L	H	L	M	L	L	L	L
		Year of introduction	06	05	04	05	04	05	03	06	05	05	06	03	03
Price effect	Event study	Market	–	+	+	+	+	–	+	–	–	+	–	–	–
		Dummy	–	+	+	+	+	–	+	–	–	+	–	–	–
Volume effect	Normalised volume	t-test	+	+	–	+	+	–	–	+	+	–	+	+	+
		Trend	+	+	+	+	+	–	–	+	–	–	–	+	+
Volatility effect	Level	F-test	–	+	–	–	–	+	–	–	–	–	–	–	–
		Dummy	–	+	–	–	+	–	–	–	–	–	–	–	–
	Structure	Dissemination	+	+	–	–	+	–	+	–	–	+	–	–	–
		Duration	–	–	+	+	–	–	–	+	+	+	+	–	+
		Persistence	+	–	+	–	–	–	–	+	–	+	+	–	+
	Beta	Shift	+	–	–	+	–	–	–	+	–	–	+	+	–
		Slope	–	+	–	+	+	+	+	–	–	+	–	–	+

Statistically significant change

Summary of all results (27 – 38)

		No	27	28	29	30	31	32	33	34	35	36	37	38
		JSE Code	MCE	OMN	PCN	PIM	PWK	SGG	SHP	SIM	SLM	SPG	UCS	WNH
		Industry	TC	BM	T	T	CS	F	CS	BM	F	I	T	I
		Spot trading volume	H	L	L	M	L	L	H	M	H	M	L	L
		Year of introduction	00	03	05	04	05	04	02	06	00	04	05	06
Price effect	Event study	Market	–	–	–	+	+	+	+	+	–	–	–	+
		Dummy	–	–	–	+	+	+	+	+	–	–	–	+
Volume effect	Normalised volume	t-test	+	–	+	+	–	–	+	+	–	+	+	–
		Trend	–	+	+	+	+	–	–	+	–	–	–	–
Volatility effect	Level	F-test	–	–	–	–	+	–	+	–	–	–	–	+
		Dummy	–	–	–	–	+	–	–	–	–	–	–	–
	Structure	Dissemination	–	+	–	+	+	–	+	–	–	–	–	+
		Duration	+	–	+	–	–	–	–	+	+	–	–	–
		Persistence	+	+	+	–	–	–	–	+	–	–	–	+
	Beta	Shift	–	+	–	+	–	+	+	–	+	–	+	+
		Slope	–	+	+	+	+	–	+	+	–	–	–	+

Statistically significant change

The pattern of significant cumulative average abnormal returns (refer to table 4.2, page 76) implies that no clear evidence exists that SSF trading in general has had any price effect (positive or negative) on the underlying. The diminishing significance exhibited for shorter periods closer to the event is in contrast to the conditions required to conclude a general price effect, namely significant abnormal returns on day zero and possible significant abnormal returns on day -1 and day +1. Significance should be lower as one moves further from the event date and for longer periods or periods that do not include the actual event.

4.5.2 Conclusions on the volume results

The increase in trading volume experienced by the majority of the companies, even allowing for the natural increase in volume over time, is predicted by the complete markets hypothesis, assuming a more complete market as a result of more investor participation. The actions of market makers having to buy or sell the client's full long or short futures exposure in the spot market generate trading. It is reasonable to conclude that increased SSF market activity leads to increased spot market activity. Thus, even speculators who may be moving from the spot to the futures market indirectly generate spot volumes.

4.5.3 Conclusions on the volatility results

The majority of the companies experienced a significant decrease in volatility, while only six companies showed a significant increase in volatility. It is therefore concluded that SSF trading in general leads to a statistically significant decrease in spot price volatility. These results confirm those obtained with the GARCH model, indicating that SSF trading in general does lower spot market volatility, with all three theoretical frameworks holding true, predicting a decrease in volatility after the introduction of derivatives trading.

SSF trading in general did not alter the relationship between company and market pre- to post-futures. Systematic risk remained largely unaffected, with only small changes in the majority of cases reported. No result regarding the general direction of change in systematic risk emerged from this study.

Overall, more companies showed a shortened period of excessive price movements following the incorporation of new news and accounting for the old news effect, compared to those showing an increased persistence to shocks (extended period of volatility). The results pointed to a statistically significant increase in the rate at which news is impounded in the share prices post futures. Although the majority of companies experienced a weakened influence of old news on share price movements, more statistically significant increases in the long-term impact of old news were recorded. It is therefore concluded that SSF trading allows the shock-effect to dissipate more quickly, largely facilitated by the faster dissemination of news and also, to a lesser extent, by the constrained influence of old news on share prices, thereby providing for a more efficient market.

In closing, this study revealed the following about the impact of single stock futures trading on the underlying equity market:

- No statistically significant changes in share prices, that is no price effect
- Statistically significant increases in spot market trading volumes
- Statistically significant reductions in the level of spot market volatility
- Evidence of changes in the structure of spot market volatility
- Evidence of an unaltered company-market relationship (alpha and beta) post futures

In the chapter to follow, these results are compared to previous research done on the introduction of derivatives to the spot market. Various derivative instruments were examined and a diverse range of research methodologies applied in these studies to determine the impact on the underlying market as it relates to the price and/or volume and/or volatility effect.

CHAPTER 5

COMPARISON WITH PAST RESEARCH ON DERIVATIVES TRADING

5.1 Introduction

The impact of derivatives trading on the underlying has been the topic of research in many studies, as indicated in chapter 1. Results and conclusions often apply only to a specific market (country), instrument, or individual underlying. The purpose of this chapter is to offer insight into and position this study relative to past research on this topic.

This chapter discusses a sample of the studies published since 1995, diverse in terms of the market, instrument and underlying but similar in the range of research methodologies, testing procedures and variables investigated. The equity markets in Australia, Canada, Greece, India, Italy, Korea, the United Kingdom (internationally), the United States and South Africa provided the environment and data for these studies. Research on the impact of single stock futures was limited to Australia[1] and the United Kingdom,[2] with this study adding a South African perspective to the collection. All past topical research in South Africa concentrated on the trading effect of index futures.[3]

Actual price-effect results[4] were obtained from the studies on options and warrants, while the volume-effect studies with the exception of that by Clarke et al (2007) all conveyed the same outcome. Although most studies only reported on the level of volatility (variance ratio tests), the GARCH-type studies on the level *and* structure of volatility revealed the most interesting results on the behaviour of the underlying in general, and on any changes in that behaviour since the introduction of derivatives.[5] A generalisation of the thirty-eight individual South African company evaluations matches up (shows similar results) with those done in Australia and the international (UK) markets.[6]

The following derivatives-impact studies are referenced in section 5.2, each with a brief explanation of the methodology followed and the conclusions reached.

---

[1] See Peat & McCorry (1997), Lee & Tong (1998), Dennis & Sim (1999), and McKenzie et al (2001).
[2] See Hung et al (2003), Chau et al (2005), and Mazouz & Bowe (2006).
[3] See Oehley (1995), Parsons (1996), Smit & Nienaber (1997), Vanden Baviere & De Villiers (1997), Swart (1998), and Kruger (2000).
[4] Refer to page 123.
[5] See Butterworth (2000), McKenzie et al (2001), Bologna & Cavallo (2002), Hung et al (2003), Mazouz (2004), Kumar & Mukhopadhyay (2004), Robbani & Bhuyan (2005), Chau et al (2005), Mazouz & Bowe (2006).
[6] Refer to page 124.

Study titles:

- The effect of the introduction of index future trading on underlying index volatility
- The volatility effect of option listing: some Canadian evidence
- Has futures trading activity caused stock price volatility?
- Does option trading lead to greater cash market volatility?
- Futures trading and cash market volatility
- Individual share futures contracts: the economic impact of their introduction on the underlying equity market
- Futures-trading activity and share price volatility in South Africa
- Share volatility after the introduction of index futures
- Stock futures: the effects of their trading on the underlying stocks in Australia
- The impact of share index futures trading on the volatility and liquidity of the underlying assets on the Johannesburg Stock Exchange
- Share price volatility with the introduction of individual share futures on the Sydney Futures Exchange
- Equity index futures contracts and share price volatility: a South African perspective
- The impact of futures trading on underlying index volatility: the case of the FTSE Mid 250 contract
- New insights into the impact of the introduction of futures trading on stock price volatility
- Does the introduction of stock index futures effectively reduce stock market volatility? Is the "futures effect" immediate? Evidence from the Italian stock exchange using GARCH
- Impact of foreign-listed single stock futures on the domestic underlying stock markets
- Complete markets, informed trading and equity option introductions
- Impact of futures introduction on underlying index volatility: evidence from India
- Futures trading, spot market volatility, and market efficiency: the case of the Korean index futures markets
- The effect of CBOE option listing on the volatility of NYSE traded stock: a time-varying approach
- Introduction of futures and options on a stock index and their impact on the trading volume and volatility: empirical evidence from DJIA components
- Impact of warrant introductions on the behaviour of underlying stocks: Australian evidence
- The impact of single stock futures on feedback trading and the market dynamics of the cash market
- The volatility effect of futures trading: evidence from LSE traded stocks listed as individual equity futures contracts on LIFFE
- The effect of derivatives trading on volatility of the underlying asset: evidence from the Greek stock market
- The impact of warrant introduction: Australian experience
- The impact of single stock futures on the South African equity market

5.2 Studies on the introduction of derivatives trading: 1995-2008

Condensed versions of twenty-seven derivatives-impact studies, similar in approach and purpose (i.e., effect on price and/or volume and/or volatility), are presented in chronological order from 1995 to 2008.

Study	The effect of the introduction of index future trading on underlying index volatility
Year	1995
Researcher(s)	Oehley, D.J.
Country	South Africa
Period	1985-1989
Instrument	Index futures
Underlying	All Share Index; Gold Share Index; Industrial Index
Feature	Volatility
Methodology	F-test for difference in variance
Result	No evidence found which links the introduction of index futures trading (1987) to an increase in general market volatility. The effects observed were attributed to the 1987 market crash and concluded not to be as a direct result from the introduction of futures trading.

Study	The volatility effect of option listing: some Canadian evidence
Year	1995
Researcher(s)	Elfakhani, S. & Chaudhury, M.
Country	Canada
Period	1975-1990
Instrument	Equity options
Underlying	Individual equity shares (optioned shares – 119 first ever option listing events)
Feature	Volatility
Methodology	Moses test for change in variance;[7] regression analysis (beta – Blume's technique)[8]
Result	Option listing had a stabilising effect on the underlying shares in a total risk and a non-diversifiable (systematic) risk sense in the early years (1970s). Since late 1985 (surrounding the market crash in 1987) options listings appear to have increased the non-diversifiable risk of the underlying shares. Although no significant average effect was found, many optioned shares were affected individually, especially in a total risk sense. Overall, it was found that options listings had a risk-reducing effect on the underlying shares except in the destabilising environment surrounding the 1987 market crash.

[7] Distribution-free non-parametric test, that is, no reliance on assumptions that data are drawn from a given probability distribution.

[8] Measure and adjusts for the tendency of betas to regress toward one by regressing betas on the betas from the previous period.

Study	Has futures trading activity caused stock price volatility?
Year	1995
Researcher(s)	Darrat, A.F. & Rahman, S.
Country	United States of America
Period	1982-1991
Instrument	Index futures
Underlying	S&P 500
Feature	Volatility
Methodology	Jump volatility;[9] FPE/multivariate Granger-causality modelling[10]
Result	Concluded that futures trading activity was not the force behind the jump volatility episodes experienced during the study period. Instead, the evidence indicated that the volatility of the term structure and the volatility of the OTC index caused share price volatility.

Study	Does option trading lead to greater cash market volatility?
Year	1995
Researcher(s)	Chatrath, A., Ramchander, S. & Song, F.
Country	United States of America
Period	1984-1993
Instrument	Index options
Underlying	S&P 100
Feature	Volatility
Methodology	Vector autoregressive (VAR) system[11]
Result	An increase in the volatility in the cash market is followed by an increase in the level of options trading, and an increase in options trading is followed by a decline in cash market variability, that is, there is evidence of lower cash market volatility after the introduction of options trading. No evidence to indicate that options trading intensifies the rate of change of cash market prices. Concluded that options trading has a stabilising influence on the cash market.

The most notable conclusion to emerge from the 1995 studies (refer to pages 108-109) is that the listing and trading of options have a risk-reducing and stabilising influence on the cash market.

[9] Jump (not normal) or spike volatility refers to the occasional and sudden extreme changes in share prices.

[10] The multivariate Granger causality tests regress the dependent variable (jump volatility of share prices) on its own lagged values and the lagged values of other possible independent variables. Akaike's Final Prediction Error (FPE) criterion is employed to specify the appropriate lag lengths, and F-tests are performed on the final models to generate the multivariate Granger-causality inferences. Granger-caused jump volatility factors examined included volatility in the term structure of interest rates, volatility of the OTC Index (control variable – a market without active futures trading), volatility of the risk premium, volatility of the inflation rate, and futures market activity (trading volume and open interest).

[11] An econometric model used to capture the evolution and interdependence between multiple time series. All the variables in a VAR are treated symmetrically by including for each variable an equation explaining its evolution based on its own lags and the lags of all the other variables in the model.

Study	Futures trading and cash market volatility
Year	1996
Researcher(s)	Parsons, J.
Country	South Africa
Period	1986-1996
Instrument	Index futures
Underlying	All Share Index; All Gold Index; Industrial Index; Eskom168 Index; 3-month BA rate
Feature	Volatility
Methodology	F-test for difference in variance
Result	No evidence was found that links the introduction of futures trading to an increase in general market volatility

The abovementioned 1996 study investigating the South African market found no evidence of an increase in spot volatility as a result of the introduction of index futures trading. Peat and McCorry (1997) pioneered research on the impact of introducing single stock futures to a market and found that although the initial ten SSF listings in Australia had no significant effect on the price level of the underlying shares there was evidence of an increase in both spot trading volume and volatility.

Study	Individual share futures contracts: the economic impact of their introduction on the underlying equity market
Year	1997
Researcher(s)	Peat, M., McCorry , M.
Country	Australia
Period	1994-1995
Instrument	Single stock futures
Underlying	Individual equity shares (10)
Feature	Price
Methodology	Event study – abnormal returns (market-adjusted model)
Result	No significant change in the underlying price level or level of returns
Feature	Volume
Methodology	t-test for change in mean
Result	Significant increase in trading volume in the underlying market
Feature	Volatility
Methodology	Regression analysis (incorporating a volume effect); t-test for change in mean[12]
Result	Increase in underlying volatility

[12] The average volatility and excess volatility were calculated before and after the SSF listing and compared using a t-test.

Study	Futures-trading activity and share price volatility in South Africa[13]
Year	1997
Researcher(s)	Smit, E.vdM. & Nienaber, H.
Country	South Africa
Period	1991-1994
Instrument	Index futures
Underlying	All Share Index; Gold Index; Industrial Index
Feature	Volatility
Methodology	Regression analysis
Result	Greater futures trading activity (volume and open interest) leads to greater volatility in the underlying equity market

Study	Share volatility after the introduction of index futures
Year	1997
Researcher(s)	Vanden Baviere, L. & De Villiers, J.U.
Country	South Africa
Period	1988-1994
Instrument	Index futures
Underlying	Individual top 40 index constituents
Feature	Volatility
Methodology	Regression analysis (ratio of annual to average; matched pairs)
Result	No statistically significant increasing trend in volatility of the index constituents during the period that included the listing of index futures contracts or relative to non-constituents

The following year produced two additional South African studies, one (Vanden Baviere & De Villiers 1997) confirming the Parsons (1996) result of no increase in volatility, and the Smit and Nienaber (1997) result that attributed the increase in spot volatility to futures-trading activity.

The 1998 study by Lee and Tong (1998) to follow (refer to page 112), in contrast to Peat and McCorry (1997), found no evidence (confirmed by means of a control sample) of an increase in volatility post those ten Australian SSF listings. However, they did report higher average but less variable post-futures spot volumes. Swart (1998) contributed to the research on the South African market, stating that increased index futures trading can be linked to greater volume and increased volatility in the underlying market (refer to page 112).

[13] This published article was based on an MBA dissertation by Nienaber (1994).

Study	Stock futures: the effects of their trading on the underlying stocks in Australia
Year	1998
Researcher(s)	Lee, C.I. & Tong, H.C.
Country	Australia
Period	1990-1995
Instrument	Single stock futures
Underlying	Individual equity shares (7)
Feature	Volume
Methodology	Equal means and equal variances with t-test and rank sum tests,[14] accounting for the (G)ARCH effect,[15] using a control group to rule out confounding events
Result	The evidence on volume suggests that volume distributions have significantly changed after the inception of single stock futures. Post-futures volumes have higher means but smaller variation.
Feature	Volatility
Methodology	Equal means and equal variances with t-test and rank sum tests, accounting for the (G)ARCH effect, using a control group to rule out confounding events
Result	The introduction of futures found not to have caused the distribution of returns to change significantly. A control sample confirmed that there was no evidence of returns becoming more volatile after futures trading.

Study	The impact of share index futures trading on the volatility and liquidity of the underlying assets on the Johannesburg Stock Exchange
Year	1998
Researcher(s)	Swart, A.
Country	South Africa
Period	1990-1997
Instrument	Index futures
Underlying	All Share Index; All Gold Index; Industrial Index
Feature	Volume
Methodology	Regression analysis (spot volume regressed on futures volume/value)
Result	Finding that index futures trading is associated with greater volume (liquidity) in the underlying market
Feature	Volatility
Methodology	Regression analysis (spot volatility regressed on futures volume/value)
Result	Increased volatility in the underlying market attributed to increased futures trading

[14] Non-parametric significance tests assessing whether two samples of observations come from the same distribution.
[15] Heteroscedasticity – time-varying volatility (refer to chapter 3, section 3.4.2.2).

1999 produced a third study on SSF listings in Australia which concurred with Lee and Tong (1997) that futures trading had no significant effect on cash market volatility.

Study	Share price volatility with the introduction of individual share futures on the Sydney Futures Exchange
Year	1999
Researcher(s)	Dennis, S.A. & Sim, A.B.
Country	Australia
Period	1993-1995
Instrument	Single stock futures
Underlying	Individual equity shares (10)
Feature	Volatility
Methodology	Asymmetric exponential ARCH model[16]
Result	Share futures trading has not had any significant effect on the volatility of the underlying share price for most shares and it was concluded that the impact of futures trading on cash market volatility is no greater than, and in many cases less than, the impact of cash market trading itself.

Kruger (2000) offered the final index-futures-impact study on the South African market, concluding that the volatility of the underlying spot indices did not increase owing to increased futures trading. Butterworth (2000) employed GARCH methodology (similar to this study) and detected changes in the structure (slower dissemination but longer lasting impact of information) and level (higher) of index volatility since the introduction of futures trading (refer to page 114).

Study	Equity index futures contracts and share price volatility: a South African perspective
Year	2000
Researcher(s)	Kruger, WdK.
Country	South Africa
Period	1995-1999
Instrument	Index futures
Underlying	All Share Index Top 40 (ALSI40); Industrial Index Top 25 (INDI25)
Feature	Volatility
Methodology	F-test for difference in variance
Result	Concluded that the volatility of the underlying spot indices did not increase in the period leading up to the expiration of a futures contract (expiration period inducing more frequent futures contract trading)

[16] Similar to the exponential GARCH (EGARCH) model, allowing for an asymmetric response to positive and negative shocks, except that the GARCH term is excluded.

Study	The impact of futures trading on underlying index volatility: the case of the FTSE Mid 250 contract
Year	2000
Researcher(s)	Butterworth, D.
Country	United Kingdom
Period	1992-1995
Instrument	Index futures
Underlying	FTSE Mid 250 Index
Feature	Volatility
Methodology	GARCH (symmetric) model; GJR-GARCH (asymmetric) model[17]
Result	Results reported indicate that the existence of futures trading significantly altered the structure of spot market volatility. Evidence of more information flowing into the spot market following the onset of futures trading, with this new information being assimilated into prices less rapidly than before but having a longer-lasting impact, leading to an increase in the persistence of volatility. In addition, due to a substantial increase in the constant term of the variance equation, and together with the changes in the news parameter (ARCH term) and persistence coefficient (GARCH term), a large increase in the unconditional variance of the underlying was evidenced.

McKenzie et al (2001) presented new insights into the impact of SSF listings in Australia reporting a decline in unconditional volatility and some changes in the evolution of conditional volatility.

Study	New insights into the impact of the introduction of futures trading on stock price volatility
Year	2001
Researcher(s)	McKenzie, M.D., Brailsford, T.J. & Faff, R.W.
Country	Australia
Period	1990-1998
Instrument	Single stock futures
Underlying	Individual equity shares (10)
Feature	Volatility
Methodology	Threshold GARCH (TGARCH) model;[18] control sample
Result	A general reduction in systematic risk in post-SSF periods for underlying shares (trend not evident in control group without any SSF-contract trading). Evidence of a decline in unconditional volatility and some changes in the dynamics by which the conditional volatility evolves (decline in ARCH and GARCH terms). Some evidence (weak and difficult to interpret i.e., no clear and consistent response across all shares) to support a change in the asymmetric response in individual shares following futures listing.

[17] The Glosten-Jagannathan-Runkle (GJR) model is a simple extension of GARCH with an additional term added to account for possible asymmetries. The EGARCH model is another popular asymmetric formulation.
[18] Similar to the GJR-GARCH model. An augmented market model incorporating a dummy variable in the conditional mean equation, designed to capture the impact on both the intercept and slope coefficients.

A 2002 study once again featured index futures introduction, index volatility, and the GARCH model used by Butterworth (2000). The findings contradicted those of the former study, however, and reported a stabilising effect on the underlying Italian market.

Study	Does the introduction of stock index futures effectively reduce stock market volatility? Is the "futures effect" immediate? Evidence from the Italian stock exchange using GARCH
Year	2002
Researcher(s)	Bologna, P. & Cavallo, L.
Country	Italy
Period	1990-1997
Instrument	Index futures
Underlying	MIB Index (as proxy for the MIB30 Index)
Feature	Volatility
Methodology	GARCH model
Result	The Fib30 futures contract had a stabilising effect on the underlying share market. The findings were that futures trading had a prevalent effect in reducing the unconditional volatility of the share market even adjusting for market factors. The increase in the speed at which information is incorporated into share prices (increased ARCH value), the reduced uncertainty about previous news (reduced GARCH value), and the reduced persistence of shocks (smaller AR root) pre- to post-futures are indicative of increased market efficiency owing to futures trading.

Study	Impact of foreign-listed single stock futures on the domestic underlying stock markets
Year	2003
Researcher(s)	Hung, M.W., Lee, C.F. & So, L.C.
Country	International[19]
Period	1990-1997
Instrument	Single stock futures
Underlying	Individual equity shares (9)
Feature	Volatility
Methodology	GARCH model; GJR-GARCH model
Result	Concluded that the introduction of foreign-listed SSF contracts induced structural changes in the conditional variances of their domestic spot markets. Daily activity shocks of the foreign listed futures raised the conditional volatility of the home underlying shares, while forecastable but highly variable activity across days lessened the conditional volatility of the underlying. The nine individual results favoured a slower dissemination and shortened impact of information, leading to a lower persistence of volatility in general. The variances (unconditional volatility) of the underlying share returns showed no significant differences between the pre- and post-introduction groups.

[19] SSF contracts listed on the London International Financial Future and Options Exchange (LIFFE), also called universal stock futures, trading outside England (i.e., foreign listed on domestic equity markets).

Study	Complete markets, informed trading and equity option introductions
Year	2003
Researcher(s)	Faff, R. & Hillier, D.
Country	United Kingdom
Period	1978-1999
Instrument	Equity options
Underlying	Individual equity shares (optioned shares – 86 first ever options-listing events)
Feature	Price
Methodology	Event study – abnormal returns (market model)
Result	Positive abnormal returns experienced by newly optioned shares, but no discernible trend in the magnitude of these returns recorded over time
Feature	Volume
Methodology	Regression analysis (dummy variable)
Result	Trading volume increased in the ten-day period immediately subsequent to options introductions (statistically significant)
Feature	Volatility
Methodology	Regression analysis (dummy variable)[20]
Result	On average, shares experienced a statistically significant increase in volatility in the ten days following an options introduction

The two abovementioned 2003 studies reported changes in price, volume, and volatility due to UK-listed single stock futures (volatility only – refer to page 115) and equity options.

Study	Impact of futures introduction on underlying index volatility: evidence from India
Year	2004
Researcher(s)	Kumar, K.K. & Mukhopadhyay, C.
Country	India
Period	1999-2001
Instrument	Index futures
Underlying	NSE Nifty Index
Feature	Volatility
Methodology	F-test for difference in variance; GARCH model
Result	Results indicated that while the introduction of index futures trading had no effect on the mean level of returns[21] and marginal (i.e., additional or extra) volatility, it significantly altered the structure of spot market volatility. This study provided evidence that new information is assimilated and the effect of old information on volatility is reduced at a faster rate in the period following the onset of futures trading, bringing about a less persistent shock effect.

[20] A standardised GARCH(1,1) variance series of the underlying returns featured as the dependent variable.
[21] Concluded from a statistically insignificant dummy variable (included in the conditional mean equation) coefficient.

Study	Futures trading, spot market volatility, and market efficiency: the case of the Korean index futures markets
Year	2004
Researcher(s)	Bae, S.C., Kwon, T.H. & Park, J.W.
Country	Korea
Period	1990-1998
Instrument	Index futures
Underlying	Individual KOSPI 200 Index constituents
Feature	Volatility
Methodology	Matching-sample approach; regression analysis (dummy variables)
Result	The introduction of index futures trading linked to greater spot price volatility

Study	The effect of CBOE option listing on the volatility of NYSE traded stock: a time-varying approach
Year	2004
Researcher(s)	Mazouz, K.
Country	United States of America
Period	1973-2001
Instrument	Equity options
Underlying	Individual equity shares (optioned shares – 144 first ever options-listing events)
Feature	Volatility
Methodology	GARCH model; control sample; Mann-Whitney test[22]
Result	Options listing had impacted neither on the volatility nor on the speed of share price adjustment to information (confirmed by non-optioned control group).

Two studies on the introduction of index futures in two different markets were published in 2004. The Indian market (Kumar & Mukhopadhyay 2004) provided evidence of new information being disseminated faster and having a shorter-lived impact post futures, that is less persistent volatility (refer to page 116). The Korean market displayed higher spot volatility according to Bae et al (2004).

Mazouz (2004), employing GARCH methodology along with a control sample, determined that the listing of equity options had no impact on either the unconditional or the conditional volatility of the underlying index.

[22] A non-parametric Mann-Whitney test determined whether the pre-listing variance and the volatility changes, identified by the GARCH procedure, of the optioned shares are the same as or different to those from the control sample without assuming any distribution shape.

Study	Introduction of futures and options on a stock index and their impact on the trading volume and volatility: empirical evidence from DJIA components
Year	2005
Researcher(s)	Robbani, M.G. & Bhuyan, R.
Country	United States of America
Period	1989-1994
Instrument	Index futures and options
Underlying	Individual Dow Jones Industrial Average (DJIA) Index constituents (30)
Feature	Price
Methodology	Two-sample (pair-wise) t-test; Wilcoxon signed-rank test[23]
Result	Evidence that the average daily rate of return on the 30 underlying shares decreased significantly
Feature	Volume
Methodology	Two-sample (pair-wise) t-test; Wilcoxon signed-rank test
Result	A significant increase in the daily trading volume found for 23 shares in the index
Feature	Volatility
Methodology	F-test for difference in variance; two-sample (pair-wise) t-test; Wilcoxon signed-rank test; Parkinson's efficient high-low variance estimator,[24] GARCH model
Result	The volatility of the market (majority of shares in the index) significantly increased after the start of futures and options trading on the DJIA Index. The researchers attributed this increase to an increase in conditional volatility, rather than unconditional volatility, referring to the GARCH-model results which show that the impact of past news and past variance on the current price is significantly higher during the post-futures period.

The three studies from 2005 featured index futures and options (Robbani & Bhuyan 2005), warrants (Aitken & Segara 2005 – refer to page 119), and single stock futures (Chau et al 2005 – refer to page 119). The introduction of index futures and options in the US market resulted in a decreased return (price) and increased trading volume and conditional volatility. The Australian market experienced similar effects owing to the introduction of warrants although in this instance an increase in unconditional volatility was reported.

The GJR-GARCH model study (Chau et al 2005) in the UK on single (universal) stock futures found that both the SSF and control sample shares behaved in a similar fashion and concluded that any changes were not futures related.

[23] The Wilcoxon sign-ranked test is a non-parametric test for two related samples involving comparisons of differences between measurements. Unlike the t-test, no assumptions regarding the distribution of measurements are required.
[24] A price-volatility estimator combining the high-low range for the day and an estimate of the volatilility which took place over the previous night.

Study	Impact of warrant introductions on the behaviour of underlying stocks: Australian evidence
Year	2005
Researcher(s)	Aitken, M. & Segara, R.
Country	Australia
Period	1991-2000
Instrument	Warrants
Underlying	Individual equity shares
Feature	Price
Methodology	Event study – abnormal returns (market-adjusted model)
Result	The introduction of warrants associated with a negative price effect on the underlying market
Feature	Volume
Methodology	Wilcoxon rank-sum test[25]
Result	The relative trading volume (trading volume divided by total number of securities outstanding) in the underlying share following warrant listing is significantly greater than in the pre-warrant listing period
Feature	Volatility
Methodology	Wilcoxon rank-sum test performed on variance ratios
Result	Volatility found to be higher for the underlying shares post-warrant listing

Study	The impact of single stock futures on feedback trading and the market dynamics of the cash market
Year	2005
Researcher(s)	Chau, F., Holmes, P. & Paudyal, K.
Country	International
Period	2001
Instrument	Single (universal) stock futures
Underlying	Individual equity shares (80)
Feature	Volatility
Methodology	GJR-GARCH model; control sample
Result	Any changes in the GJR-GARCH model parameters (i.e., impact of news on volatility; persistence of innovations; asymmetric response to good and bad news) concluded not to be futures related after examining the control sample. Unconditional volatility also behaved in a similar manner for both SSF and control shares.

[25] The Wilcoxon rank-sum test (also called the Wilcoxon-Mann-Whitney test) is a non-parametric test for assessing whether two samples of observations come from the same distribution (see also the Wilcoxon signed-rank test).

Study	The volatility effect of futures trading: evidence from LSE traded stocks listed as individual equity futures contracts on LIFFE
Year	2006
Researcher(s)	Mazouz, K. & Bowe, M.
Country	United Kingdom
Period	2001-2002
Instrument	Single stock futures
Underlying	Individual equity shares (21)
Feature	Volatility
Methodology	Fama and French three-factor model;[26] GJR-GARCH model; control sample
Result	A decrease in the systematic risk of the sample of futures-listed shares and a decrease in the permanent component of the variance of their prediction errors (unconditional volatility) post futures are attributed to contemporaneous changes in market- and industry-wide conditions and not to the listing event, per se. The evidence, however, pointed to a more efficient (faster) incorporation of current news into the underlying share price owing to futures trading.

Mazouz and Bowe (2006) also investigated UK listed single stock futures employing a GJR-GARCH model and attributed the more efficient (faster) incorporation of current news into share prices to futures trading.

Study	The effect of derivatives trading on volatility of the underlying asset: evidence from the Greek stock market
Year	2007
Researcher(s)	Drimbetas, E., Sariannidis, N. & Porfiris, N.
Country	Greece
Period	1997-2005
Instrument	Index futures
Underlying	FTSE/ASE 20 Index
Feature	Volatility
Methodology	E-GARCH model
Result	The introduction of futures trading lowered the level of volatility in the underlying market[27]

[26] A factor model that expands on the capital asset pricing model (CAPM) by adding size and value factors in addition to the market risk factor.

[27] Although this study employed a GARCH methodology, no results concerning changes in the structure of volatility pre- to post-futures were reported. The dummy variable included in the variance equation only pointed to a decrease in the unconditional volatility of the underlying.

Study	The impact of warrant introduction: Australian experience[28]
Year	2007
Researcher(s)	Clarke, M., Gannon, G. & Vinning, R.
Country	Australia
Period	1997-2003
Instrument	Warrants
Underlying	Individual equity shares (10)
Feature	Price
Methodology	Event study – abnormal returns (mean reversion and market models)
Result	Generally negative cumulative abnormal returns around the issue date
Feature	Volume
Methodology	t-test for change in mean; regression analysis (incorporating a trend)
Result	Call warrant introduction resulted in higher trading volume in the underlying security while other warrant types showed mixed results. Adjusting for the inherent upward trend in volume resulted in findings of warrant introduction generally causing a decrease in trading volume.
Feature	Volatility
Methodology	F-test for difference in variance; GARCH model; regression analysis
Result	The standard measures of risk (variance and beta) generally remained unchanged between the pre-warrant and post-warrant periods

Clarke et al (2007), like Aiken and Segara (2005), studied the impact of warrants on the Australian market and found generally negative cumulative abnormal returns, lower spot trading volumes (adjusted for an upward trend), and a generally unchanged variance and beta. Another 2007 study (Drimbetas et al 2007) reported a lowered level of index volatility following the introduction of futures trading (refer to page 120).

This study adds to previous studies on the impact of single stock futures, offering a South African perspective on the after-effect observed as changes in the price, volume, and volatility of the underlying shares (refer to page 122). Thirty-eight individual JSE-listed companies formed part of this study with the majority of these companies recording an increase in spot trading volume, a decrease in volatility, and a shortened period of excessive price-movements, that is less persistent volatility.[29]

[28] The study done by Clarke et al (2007) provided the basis and structure for this research on the impact of single stock futures trading on the South African market. The GARCH model with dummy variable did not report on any changes in the structure of volatility pre- to post-futures, but confirmed the results from the variance F-tests.
[29] The thirty-eight individual company results are presented in chapter 4.

Study	The impact of single stock futures on the South African equity market
Year	2008 (current study)
Researcher(s)	De Beer, J.S.
Country	South Africa
Period	1999-2006
Instrument	Single stock futures
Underlying	Individual equity shares (38)[30]
Feature	Price
Methodology	Event study – abnormal returns (market model and dummy variable regression)
Result	No statistically significant changes in share prices
Feature	Volume
Methodology	t-test for change in mean; regression analysis (incorporating a trend)
Result	Statistically significant increases in spot market trading volumes
Feature	Volatility
Methodology	F-test for difference in variance; GARCH model; regression analysis (beta)
Result	Statistically significant reductions in the level of spot market volatility. Evidence of changes in the structure of spot market volatility, that is a shortened period of excessive price-movements due to the faster dissemination and passing of news. An unaltered company-market [beta (systematic risk); alpha (minimum return)] relationship

It is clear from all these studies that the individual outcomes are country and also instrument specific. The following section summarises these results further, listing the studies in alphabetical order (author) according to the instrument researched. Studies that made use of a GARCH type model explained the behaviour of prices and the fact that it is linked to a particular volatility structure established by a response to news.[31]

5.3 Summary

Research methodologies and testing procedures aside, different studies involving the same derivative instrument (i.e., index futures, or equity options and warrants, or single stock futures) came to a range of supporting or contradictory conclusions regarding the impact on the underlying spot market. The level and structure of volatility (particularly with single stock futures) were the main focus of the majority of studies.

[30] Refer to Annexure C.

[31] See Butterworth (2000), McKenzie et al (2001), Bologna & Cavallo (2002), Hung et al (2003), Mazouz (2004), Kumar & Mukhopadhyay (2004), Robbani & Bhuyan (2005), Chau et al (2005), Mazouz & Bowe (2006).

A shortened and regrouped (according to derivative instrument) summary of the studies, confirming the diverse results reported on the impact of derivatives trading, is presented in the following sequence:

- Share index futures
- Equity (individual or index) options/warrants
- Single stock futures

Thirteen studies (including all six studies involving the South African market) reported on the effect of share index futures trading on the underlying.

Share Index Futures						
Study	**Price**	**Volume**	***Volatility***	***Structure***		
			Level	New news	Old news	Persistence
Bae et al	—	—	Higher	—	—	—
Bologna & Cavallo	—	—	Lower	Faster	Shorter	Lower
Butterworth	—	—	Higher	Slower	Longer	Higher
Darrat & Rahman	—	—	No effect	—	—	—
Drimbetas et al	—	—	Lower	—	—	—
Kruger	—	—	No effect	—	—	—
Kumar & Mukhopadhyay	—	—	No effect	Faster	Shorter	Lower
Oehley	—	—	No effect	—	—	—
Parsons	—	—	No effect	—	—	—
Robbani & Bhuyan[32]	Lower	Higher	No effect	Faster	Longer	Higher
Smit & Nienaber	—	—	Higher	—	—	—
Swart	—	Higher	Higher	—	—	—
Vd Baviere & De Villiers	—	—	No effect	—	—	—

Share index futures trading, in general, resulted in higher spot volatility and new information being processed at a faster rate. No general change in the enduring influence of processed information on the spot price, reflected in the time span of excessive volatility, was established.

Six studies reported on the effect of equity (individual or index) options and warrants trading on the underlying. These studies suggest a negative price effect and higher trading volume, with no apparent effect on the level and structure of volatility.

[32] Robbani & Bhuyan (2005) reported results on the return, volume, and volatility of the DJIA Index after the start of futures and options trading.

Equity (individual or index) options/warrants						
Study	**Price**	**Volume**	**Volatility**	***Structure***		
			Level	New news	Old news	Persistence
Aitken & Segara	Lower	Higher	Higher	—	—	—
Chatrath et al	—	—	Lower	—	—	—
Clarke et al	Lower	Lower	No effect	—	—	—
Elfakhani & Chaudhury	—	—	Lower	—	—	—
Faff & Hillier	Higher	Higher	Higher	—	—	—
Mazouz	—	—	No effect	No effect	No effect	No effect

Eight studies reported on the effect of single stock futures on the underlying. Findings revealed higher share trading volumes and lower spot volatility (with the exception of that by Peat & McCorry) since the introduction of single stock futures to these markets. In addition, the persistence of volatility declined, mainly as a result of a shortened old-news impact period. The South African market displayed the full benefit, apart from a positive price effect, of futures trading, namely higher trading volumes and a lower level and more restricted period of volatility.

Single Stock Futures						
Study	**Price**	**Volume**	**Volatility**	***Structure***		
			Level	New news	Old news	Persistence
Chau et al	—	—	No effect	No effect	No effect	No effect
De Beer	No effect	Higher	Lower	Faster	Shorter	Lower
Dennis & Sim	—	—	No effect	—	—	—
Hung et al	—	—	No effect	Slower	Shorter	Lower
Lee & Tong	—	Higher	No effect	—	—	—
Mazouz & Bowe	—	—	Lower	Faster	Shorter	Lower
McKenzie et al	—	—	Lower	Slower	Shorter	Lower
Peat & McCorry	No effect	Higher	Higher	—	—	—

In the main, all these studies were in agreement that derivatives trading does not destabilise (i.e., increased price uncertainty and movements) the underlying equity market, but provides for a more complete trading environment.

The concluding chapter presents a summation of the theory and findings of this study along with recommendations for future research.

CHAPTER 6

SUMMARY AND RECOMMENDATIONS

6.1 Introduction

The purpose of this research was to determine the impact of single stock futures on the South African equity market in relation to the following three aspects of the underlying:

- Price (return) of the security, that is the price effect
- Trading volume of the security, that is the volume effect
- Volatility of the security, that is the volatility effect

Any divergence from the non-SSF period in terms of the price (return), trading volume and volatility (level, structure and market-linked volatility) of the individual underlying shares in the period following the introduction (initial trading) of single stock futures was recorded and tested for statistical significance. The individual per company SSF effects were reported and a general market-wide trend deduced.

Single stock futures gave researchers the opportunity to assess an individual company's response to futures trading directly, in contrast to the market-wide impact obtained from index futures studies. Relative to the market for index futures and with regard to country participation (availability) the single stock futures market is still in its infancy, expanding the scope for research on derivative instruments.

Research on the effect of futures trading on the South African market is limited and is confined to index futures trading. This study on the impact on the spot market of single stock futures provides a unique perspective on the contribution of derivatives to a more efficient South African market in general, and the trading behaviour of specific shares in isolation.

The content of this study and the most important conclusions reached are encapsulated in the sections that follow. A brief outline of the background to this study (section 6.2) is followed by a report on the methodologies applied, the results obtained, and the conclusions drawn (section 6.3). Final abridged conclusions are presented in section 6.4 along with the contribution of this study (section 6.5). Recommendations on extending this study and suggestions for possible further research on the effect of futures trading (section 6.6) conclude the study.

6.2 Background

SSF contracts, trading on the South African Futures Exchange (Safex), are future commitments to buy or sell the shares of a particular JSE Limited listed company. Fixing a future sales or purchase price allows for the hedging of an existing long or short equity position. As an indirect investment in the underlying share, single stock futures make it possible to construct a synthetic equity portfolio at a fraction of the actual exposure amount. A real equity portfolio can be modified by synthetically including (long SSF) or excluding (short SSF) specific shares, avoiding the actual spot transaction and higher associated costs (namely brokerage and capital gains tax). In addition, speculating in either a bull or a bear market on the movement (up or down) of a share price, single stock futures provide for a leveraged holding and an amplified potential profit or loss.

This particular single equity derivative was introduced (available for trade) to the South African market in 1999 and since then the growth in single stock futures in terms of the number of transactions (trades) and number of contracts (volume) has outstripped that of index futures, accounting for fifty-nine percent of all futures transactions and ninety percent of all futures volume in 2007.[1] Other single equity derivatives available in the South African market are equity warrants, protected share investments, share instalments, can-do derivatives, and contracts for difference.[2] Each of these derivative products has its own payoff profile and application, but the properties of single stock futures provide for the simplest and most straightforward single equity derivative in the market.

Three interconnected conceptual frameworks validate the introduction of single stock futures (and derivative securities in general) to the South African market: the complete markets theory, the diminishing short sales theory, and the improved information environment theory.[3] Adding single stock futures to an existing set of investment opportunities should make a market more complete, allowing investors to achieve potentially higher investment payoffs. Also, the risk transference and price discovery properties of single stock futures (and derivatives in general) stabilise a market, leading to improved market efficiency, thereby providing for a more complete market.

[1] Refer to chapter 2, figures 2.2 and 2.3. In contrast to the number of trades and contracts, index futures accounted for 92% (2007) of futures value traded owing to the differing contract sizes (see figure 2.4).
[2] Refer to chapter 2, section 2.7.
[3] Refer to chapter 2, section 2.5.

Analogous to this are constraints on short sales, and negative information. Derived from the equity market, single stock futures prices are the underlying spot prices adjusted for the applicable interest rates and expected dividend payments. A theoretical or fair SSF contract value is established by this adjustment (cost of carry) and maintained through arbitrage. The concept of arbitrage is essential to maintaining the fair and market-related pricing of tradable securities and relies on the ability to sell assets short. Single stock futures incorporate negative information into share prices by facilitating short selling, that is actively selling (even if not previously owned) and not simply avoiding underperformers, and as a result profiting from negative information and downward trending share prices. Effectively removing any spot market restrictions on selling shares short and aiding the processing of negative information, the introduction of single stock futures should lead to an increase in spot trading volume, lower spot volatility, and more accurate pricing of shares. This in turn will lead to a more stable market, improved market efficiency and a more complete market as observed in a once-off increase in the underlying share price, higher spot trading volume, and a decrease in spot volatility (less risk) with a resultant lower required return.

All previous research on the actual effect of introducing single stock futures to a market relates to the Australian and United Kingdom markets only.[4] The majority of these studies found higher spot trading-volumes, lower spot volatility, and a shortened period of volatility (less persistent shock effect). International research on the impact of index futures, warrants and options provided mixed and inconclusive results. Past South African studies only focused on index futures, failing to provide any decisive evidence on the effect of futures trading on the market in general.

This study investigated the effect of futures trading on thirty-eight individual JSE-listed shares with the majority of the results showing that the South African market displayed the full benefit, apart from a positive price effect, of futures trading, namely higher trading volumes, and a lower level and more restricted period of volatility. A more detailed account of the methodologies used, results obtained, and conclusions drawn is supplied below.

6.3 Methodologies, results and conclusions

Theoretically, the introduction of futures trading should result in an increase in price, higher trading volume, lower volatility, reduced persistence to shocks (i.e., shortened volatile periods), and less systematic risk. A condensed version of all the methodologies, results[5] and conclusions from this study, which investigated the actual impact of single stock futures trading on the thirty-

[4] Refer to chapter 5.
[5] A summary of all the results presented in chapter 4, table 4.7.

eight sampled companies, representing the South African market, is provided in this section. The price effect (section 6.3.1), volume effect (section 6.3.2) and volatility effect (section 6.3.3) to follow.

6.3.1 Price effect

An event study was conducted to determine the effect (if any) caused by the initial trading of a single futures contract on the spot price of the underlying company. A market model approach (event period) and a dummy variable regression (event day) determined the abnormal returns for all the companies included in the sample. The methodologies used (section 6.3.1.1), results obtained (section 6.3.1.2), and conclusions drawn (section 6.3.1.3) are described below.

6.3.1.1 Methodologies

Event study – market model:[6] A pre-SSF (estimation period) regression analysis generated beta coefficients for each of the thirty-eight individual companies and established normal daily returns via the market return during the event period. The difference between this normal return and the actual return of the company represented the abnormal return (AR) on a specified day. Average abnormal returns (AAR) and cumulative average abnormal returns (CAAR) for the sample were also calculated. The abnormal return in excess of the relevant standard deviation (acceptable divergence) determined statistical significance.

Event study – dummy variable regression:[7] An abnormal return for each company was generated as the coefficient of a dummy variable corresponding to the event date. Statistical significance is indicated by the p-value from the regression output.

6.3.1.2 Results

Event study – market model:[8] Fourteen companies (37%) showed a statistically significant abnormal return (AR) on a single day during the event period under investigation. Two companies (5%) exhibited only two days of statistically significant abnormal returns. Three days of sufficiently sized abnormal returns were reported in three instances (8%). Only one company (3%) revealed some share-price impact caused by initial SSF trading, showing abnormal returns on six days (including day zero), and mainly in the five-day period leading up to the availability of SSF contracts on its equity shares. Only three companies (5%) displayed statistically significant

[6] Refer to chapter 3, section 3.2.5.
[7] Refer to chapter 3, section 3.2.6.
[8] Refer to chapter 4, section 4.2, and table 4.1: panel A.

abnormal returns on the day of the event itself. The only significant average abnormal return (AAR) was recorded three days after the event.[9] Significant cumulative average abnormal returns (CAAR) were recorded for longer periods and periods further away from and before the event.[9] The six day pre-event period that included the event day showed statistical significance, but no shorter periods inclusive of day zero displayed any significance.

Event study – dummy variable regression:[10] The dummy variable regression isolating day-zero returns confirmed the results obtained by the market model in all but one instance.

6.3.1.3 Conclusions

Judged on an individual company-by-company basis, the introduction (trading) of single stock futures had little or no impact on the underlying share prices.[11]

In addition, the pattern of significant cumulative average abnormal returns implies that no clear evidence exists that SSF trading in general has had any price effect (positive or negative) on the underlying.[11] The diminishing significance exhibited for shorter periods closer to the event is in contrast to the conditions required to conclude a general price effect, namely significant abnormal returns on day zero and possible significant abnormal returns on day -1 and day +1. Significance should be lower with increasing distance from the event date and for longer periods or periods not including the actual event.

It was concluded that the introduction of SSF trading had no significant price effect on the underlying and none of the three theorems (complete markets, short-sales restrictions or improved information) therefore holds.

6.3.2 Volume effect

The effect of SSF trading on the spot market volume of the underlying company before and after the first futures market transaction was tested by comparing the average normalised trading volume pre- and post-SSF. A t-test for change in mean and a dummy variable regression with a trend coefficient were performed. The methodologies used (section 6.3.2.1), results obtained (section 6.3.2.2), and conclusions drawn (section 6.3.2.3) are described below.

---

[9] Refer to chapter 4, section 4.2, and table 4.2.
[10] Refer to chapter 4, section 4.2, and table 4.1: panel B.
[11] Refer to chapter 4, section 4.5.1.

6.3.2.1 Methodologies

Normalised volume – t-test for change in mean:[12] The average normalised (exponentially smoothed) volume in a number of days prior to the event was compared with the average normalised volume in the period subsequent to the event. Significance was determined using a t-test for differences between means.

Normalised volume – dummy variable regression:[13] A dummy variable regression that included a trend coefficient to capture the natural tendency of volume to increase over time and isolate any change due to the introduction of single stock futures was run for each company. The level of significance was determined by the relevant p-values of the statistical output.

6.3.2.2 Results

Normalised volume – t-test for change in mean:[14] The introduction of SSF trading resulted in a highly significant increase in normalised trading volume in the majority (71%) of cases.

Normalised volume – dummy variable regression:[15] Although the results confirmed the significance and general direction of change in trading volume, a smaller majority (56%) of statistically significant outcomes indicated an increase in trading volume following the onset of single stock futures trading.

6.3.2.3 Conclusions

It was concluded that increased SSF market activity led to increased spot market activity.[16] The increase in trading volume experienced by the majority of the companies, even allowing for the natural increase in volume over time, is predicted by the complete markets hypothesis, assuming a more complete market as a result of more investor participation.

6.3.3 Volatility effect

The volatility effect study comprised three different procedures. A ratio test determined changes in the level of spot price volatility; the GARCH methodology detected any changes in the structure and level (dummy variable included) of volatility; and a dummy variable regression tested for

[12] Refer to chapter 3, section 3.3.1.
[13] Refer to chapter 3, section 3.3.2.
[14] Refer to chapter 4, section 4.3, and table 4.3: panel A, and figure 4.2.
[15] Refer to chapter 4, section 4.3, and table 4.3: panel B, and figure 4.2.
[16] Refer to chapter 4, section 4.5.2.

changes in the systematic risk (beta) and minimum return (alpha) of each company after the introduction of SSF trading. The methodologies used (section 6.3.3.1), results obtained (section 6.3.3.2), and conclusions drawn (section 6.3.3.3) are described below.

6.3.3.1 Methodologies

Volatility level – F-test for difference in variance:[17] A ratio of pre-futures variance to post-futures variance per company was calculated and assigned a level of significance corresponding to the F-distribution and specified degrees of freedom. These results were confirmed by the GARCH model with a dummy variable.

Volatility structure and level – GARCH model:[18] A pre-event subsample and a post-event subsample for each share were tested separately for ARCH and GARCH effects. Movements in the ARCH and GARCH coefficient values were related to changes in the securities' conditional volatility (structure). The specific ARCH (increase/decrease) GARCH (increase/decrease) combination pointed to changes in the rate at which information is assimilated, the lasting impact of information, and the period of clustered volatility. In addition, the GARCH model was extended to include a dummy variable in the variance equation and the total sample period tested. A statistically significant (small p-values) dummy variable coefficient (negative or positive) detected any changes in the unconditional volatility (level) of each share.

Systematic risk – dummy variable regression:[19] An ordinary least squares regression model which included a dummy variable was run with the lognormal returns of each security and the lognormal returns of the market index before and after the introduction of SSF trading. The dummy variable tested for an absolute shift in the constant term (alpha) and for a change in the slope coefficient (beta) with the level of significance determined by the relevant p-values of the statistical output.

6.3.3.2 Results

Volatility level – F-test for difference in variance:[20] Thirty-two companies (84%) displayed a significant difference in pre-SSF and post-SSF volatility, with a large majority (68%) of all companies experiencing a statistically significant decrease in volatility and only six (16%) showing an increase. These results largely confirmed those obtained with the GARCH model.

---

[17] Refer to chapter 3, section 3.4.1.
[18] Refer to chapter 3, section 3.4.2.
[19] Refer to chapter 3, section 3.4.3.
[20] Refer to chapter 4, section 4.4.2, and table 4.6: panel A, and figure 4.5.

Volatility structure and level – GARCH model:[21] Regarding the structure or behaviour of volatility, the majority (53% of which 85% were statistically significant) of companies showed an increase in the rate at which news is disseminated and incorporated into their share prices. However, although more companies (55%) displayed a smaller contribution of old news to persistence, more statistically significant increases (42% to 34% significant decreases) in the long-term impact of old news were recorded. The combined outcome (incorporation plus longevity) pointed towards a shortened period of excessive price-movements (persistence of volatility or shocks) following the incorporation of news for a small majority (53%) of companies. The dummy variable included in the GARCH model confirmed that the majority (84% of which 31% were statistically significant) of companies experienced a decrease in the level of spot volatility.

Systematic risk – dummy variable regression:[22] A significant change in beta was recorded in only seven instances (18%), while two results (5%) presented evidence of a shift in the minimum return (constant term).

6.3.3.3 Conclusions[23]

It was concluded that SSF trading in general leads to a statistically significant decrease in spot price volatility. All three theoretical frameworks held true, predicting a decrease in volatility after the introduction of derivative trading.

Overall, results indicated that SSF trading allowed the shock effect to dissipate more quickly, largely facilitated by the faster dissemination of news and also, to a lesser extent, by the constrained influence of old news on share prices, thereby providing for a more efficient market. These results are in line with the complete markets hypothesis (more efficient market owing to futures trading), diminishing short sales restrictions hypothesis (reduced asymmetric response to information), and the improved information environment hypothesis (improved price discovery through futures trading activity).

It was also revealed that the relationship between the market and the individual companies (systematic risk) remained largely unaffected, with only small changes in the majority of cases reported pre to post single stock futures. No result regarding the general direction of change in systematic risk emerged from this study.

[21] Refer to chapter 4, section 4.4.1, and tables 4.4 and 4.5, and figure 4.4.
[22] Refer to chapter 4, section 4.4.2, and table 4.6: panel B.
[23] Refer to chapter 4, section 4.5.3.

6.4 Final conclusions

This study revealed the following about the impact of single stock futures trading on the South African equity market:[24]

- No statistically significant changes in share prices, that is no price effect
- Statistically significant increases in spot market trading volumes
- Statistically significant reductions in the level of spot market volatility
- Evidence of changes in the structure of spot market volatility
- Evidence of an unaltered company-market relationship (alpha and beta) post futures

6.5 Contribution

One contribution made by this study relates to the opportunity provided by the introduction of single stock futures to the South African market, namely the ability to assess an individual company's response to futures trading directly, in contrast to the market-wide impact obtained from index futures studies. This study provided evidence that single stock futures trading activity does impact upon underlying equity shares. Each of the thirty-eight South African companies recorded a distinct response to the introduction of SSF trading in terms of a price effect, volume effect and volatility effect, enabling a comparison with the current (since introduction) behaviour of a specific share, particularly in terms of volatility.[25]

Another contribution involves the application of GARCH methodology to investment analysis and portfolio management. This study detailed the GARCH methodology used in establishing a volatility structure (pattern of behaviour) for a company, allowing the detection of any changes in that structure after an identifiable event or over time. The risk attributes of a share, as defined by its response to information, determine its suitability for inclusion in an investment portfolio, and are therefore fundamental to constructing a portfolio. Investors can therefore diversify not only by considering the correlation between shares and the contribution made to portfolio risk, but also by taking the composition of volatility into account, acknowledging the fact that shares react differently to unexpected news. A defined pattern of persistent volatility clustering would indicate the extent to which a shock may impact upon a share price and the number of subsequent periods that show increased volatility. A share's level of volatility (unconditional volatility) is ultimately a function of that share's volatility structure (conditional volatility) and this study highlighted the need to monitor firm-specific volatility composition.

[24] Individual company results are reported in chapter 4 (also refer to table 4.7).
[25] Eight companies have subsequently delisted on the JSE Limited and have no current trading data.

6.6 Recommendations

The following recommendations on extending this study and other possible further research on the effect of futures trading concentrate on the volatility effect and a more extensive use of GARCH methodology.

- Making use of alternative GARCH models such as the EGARCH, TGARCH or GJR-GARCH, which allow for asymmetric responses to information and differentiate between the effects of positive (good) news or negative (bad) news on volatility.[26]
- Focusing fully on the individual response of a company to futures trading as it relates to a volatility effect, accounting for any possible confounding effects in an attempt to determine a company-specific reason or explanation for the actual outcome.

It is fair to assume that at least in the early stages (shortly after introduction), the futures trading volumes would be fairly low. If a change in volatility is expected as a result of futures trading, then it would be reasonable to expect a bigger effect to be noticed when trading volumes increase. Any further research should thus:

- Account for the trading volumes in both the spot (underlying equity activity) and futures market (SSF contract activity) in interpreting and explaining any outcome (effect, no effect).
- Investigate whether spot volatility was higher in a specific number of days leading up to contract expiration (expiration period) than in the preceding weeks (pre-expiration period).[27]

In addition, the introduction of the Mini FTSE/JSE Top 40 futures (ALMI) contract on Safex provides a further opportunity to research the market-wide impact of futures trading and also determine the effect on index-futures transactions and trading volume.[28]

---

[26] Refer to chapter 6 and the studies done by Dennis and Sim (1999), Butterworth (2000), and McKenzie et al (2001).

[27] Refer to chapter 2, figure 2.6 showing the increased trading activity in the expiration months.

[28] Introduced in June of 2008, the Mini ALSI contract (100th of the size of the ALSI Top 40 futures contract) allows retail investors to invest in the ALSI Top 40 Index at only 1% of the normal exposure (e.g., R3000 vs. R300 000).

BIBLIOGRAPHY

ABSA. 2006. *Share instalments*. ABSA Group Limited, Johannesburg, Gauteng. Available: http://www.absa.co.za/absacoza/generated/files/c9e8cc5ba432b010VgnVCM1000003511060aRCRD/Share%20instalments.pdf (accessed 3 July 2007).

ABSA. 2007. *Dividend accruing retail trading securities*. ABSA Group Limited, Johannesburg, Gauteng. Available: https://securities.standardbank.co.za/ost/nsp/HowToGuides/guide_display.asp?strAction=Open&strFileName=darts.pdf (accessed 3 July 2007).

Aitken, M. & Segara, R. 2005. Impact of warrant introduction on the behaviour of underlying stocks: Australian evidence. *Accounting and Finance*, 45(1):127-144. EBSCOhost. Business Source Complete, AN:15840411 (accessed 3 September 2007).

Ang, J. & Cheng, Y. 2005. Financial innovations and market efficiency: the case for single stock futures. *Journal of Applied Finance,* 15(1):38-51. EBSCOhost. Business Source Complete, AN:17908369 (accessed 15 November 2006).

Antoniou, A. & Holmes, P. 1995. Futures trading, information and spot price volatility: evidence from the FTSE-100 stock index futures contract using GARCH. *Journal of Banking and Finance*, 19(1):117-129. ScienceDirect, doi:10.1016/0378-4266(94)00059-C (accessed 31 August 2007).

Antoniou, A., Holmes, P. & Priestley, R. 1998. The effects of stock index futures trading on stock index volatility: an analysis of the asymmetric response of volatility to news. *The Journal of Futures Markets*, 18(2):151-166. EBSCOhost. Business Source Complete, AN:420026 (accessed 31 August 2007).

ASX. 2007a. *Trading warrants*. ASX Limited, Sidney, NSW. Available: http://www.asx.com.au/investor/warrants/how/trading_warrants.htm (accessed 13 July 2007).

ASX. 2007b. *Types of warrants*. ASX Limited, Sidney, NSW. Available: http://www.asx.com.au/investor/warrants/how/types.htm (accessed 13 July 2007).

ASX. 2007c. *Warrants: understanding trading and investment warrants*. ASX Limited, Sidney, NSW. Available: http://www.asx.com.au/markets/pdf/warrants.pdf (accessed 6 October 2007).

ASX. 2007d. *What are the key differences between options and warrants?* ASX Limited, Sidney, NSW. Available: http://www.asx.com.au/markets/pdf/DiffOptWnts.pdf (accessed 23 August 2007).

Bae, S.C., Kwon, T.H. & Park, J.W. 2004. Futures trading, spot market volatility, and market efficiency: the case of the Korean index futures markets. *The Journal of Futures Markets*, 24(12):1195-1228. EBSCOhost. Business Source Complete, AN:14833623 (accessed 31 August 2007).

Becketti, S. & Roberts, D. 1990. Will increased regulation of stock index futures reduce stock market volatility? *Economic Review – Federal Reserve Bank of Kansas City*, 1990(Nov). Available: http://www.kansascityfed.org/PUBLICAT/ECONREV/EconRevArchive/1990/4q90beck.pdf (accessed 31 August 2007).

Bessembinder, H. & Seguin, P.J. 1992. Futures-trading activity and stock price volatility. *The Journal of Finance*, 47(5):2015-2034. EBSCOhost. Business Source Complete, AN:4653791 (accessed 11 January 2007).

Binder, J.J. 1998. The event study methodology since 1969. *Review of Quantitative Finance & Accounting,* 11(2):111-137. EBSCOhost. Business Source Complete, AN:17308026 (accessed 21 December 2007).

Bollerslev, T. 1986. Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics*, 31(3):307-327. ScienceDirect, doi:10.1016/0304-4076(86)90063-1 (accessed 23 October 2007).

Bologna, P. & Cavallo, L. 2002. Does the introduction of stock index futures effectively reduce stock market volatility? Is the futures effect immediate? Evidence from the Italian stock exchange using GARCH. *Applied Financial Economics*, 12(3):183-192. EBSCOhost. Business Source Complete, AN:5942382 (accessed 4 April 2007).

Booth, G.G., So, R.W. & Tse, Y. 1999. Price discovery in the German equity index derivatives markets. *The Journal of Futures Markets*, 19(6):619-643. EBSCOhost. Business Source Complete, AN:2186083 (accessed 5 September 2007).

Bowman, R.G. 1983. Understanding and conducting event studies. *Journal of Business Finance & Accounting*, 10(4):561-584. EBSCOhost. Business Source Complete, AN:4560047 (accessed 10 December 2007).

Brooks, C. 2002. *Introductory econometrics for finance*. Cambridge: Cambridge University Press.

Brorsen, B.W. 1991. Futures trading, transaction costs, and stock market volatility. *The Journal of Futures Markets*, 11(2):153-163. EBSCOhost. Business Source Complete, AN:5915724 (accessed 31 August 2007).

Brown, S.J. & Warner, J.B. 1980. Measuring security price performance. *Journal of Financial Economics,* 8(3):205-258. EBSCOhost. Business Source Complete, AN:12243380 (accessed 20 December 2007).

Butterworth, D. 2000. The impact of futures trading on underlying stock index volatility: the case of the FTSE Mid 250 contract. *Applied Economics Letters*, 7(7):439-442. EBSCOhost. Business Source Complete, AN:3250526 (accessed 31 August 2007).

Campbell, J.Y., Lo, A.W. & MacKinlay, A.G. 1997. *The econometrics of financial markets*. Princeton, New Jersey: Princeton University Press.

Chance, D.M. 2003. *Analysis of derivatives for the CFA® program*. Charlottesville, Virginia: AIMR.

Chance, D.M. 2006. *A generalization of the cost of carry/futures pricing model*. Cusp Communications Group Inc. Available: http://www.fenews.com/fen49/technical-notes/tech-notes.htm (accessed 22 February 2007).

Chau, F., Holmes, P. & Paudyal, K. 2005. The impact of single stock futures on feedback trading and the market dynamics of the cash market. Working Paper Series No. 05/12. University of Durham. Available: http://www.dur.ac.uk/economics.wp/wp0512.pdf (accessed 14 March 2007).

Chatrath, A., Ramchander, S. & Song, F. 1995. Does options trading lead to greater cash market volatility? *The Journal of Futures Markets*, 15(7):785-803. EBSCOhost. Business Source Complete, AN:9510133910 (accessed 31 August 2007).

Clarke, M., Gannon, G. & Vinning, R. 2007. The impact of warrant introduction: Australian experience. School Working Paper Series No. 2007/11. Deakin University. Available: http://www.deakin.edu.au/buslaw/aef/publications/workingpapers/2007_11aef.pdf (accessed 11 October 2007).

Cobbett, J. 2007a. *Investment insights: Nedbank rattles CFD cages*. Moneyweb Holdings Limited, Rosebank, Gauteng. Available: http://www.moneyweb.co.za/mw/view/mw/en/page66?oid=66669&sn=Detail (accessed 14 August 2007).

Cobbett, J. 2007b. *Investment insights: BJM enters CFD market*. Moneyweb Holdings Limited, Rosebank, Gauteng. Available: http://www.moneyweb.co.za/mw/view/mw/en/page66?oid=150702&sn=Detail (accessed 14 August 2007).

Cortex. 2007. *Why single stock futures?* Cortex Securities, Fourways, Gauteng. Available: http://www.cortex.co.za/Services/FinancialDerivatives/SingleStockFutures/tabid/275/Default.aspx (accessed 4 July 2007).

Darrat, A.F. & Rahman, S. 1995. Has futures trading activity caused stock price volatility? *The Journal of Futures Markets*, 15(5):537-557. EBSCOhost. Business Source Complete, AN:9508223506 (accessed 3 September 2007).

DeFusco, R.A., McLeavey, D.W., Pinto, J.E. & Runkle, D.E. 2004. *Quantitative methods for investment analysis*. 2nd edition. Charlottesville, Virginia: CFA Institute.

Dennis, S.A. & Sim, A.B. 1999. Share price volatility with the introduction of single share futures on the Sydney Futures Exchange. *International Review of Financial Analysis*, 8(2):153-163. EBSCOhost. Business Source Complete, AN:2469360 (accessed 8 February 2007).

Drimbetas, E., Sariannidis, N. & Porfiris, N. 2007. The effect of derivatives trading on volatility of the underlying asset: evidence from the Greek stock market. *Applied Financial Economics*, 17(2):139-148. EBSCOhost. Business Source Complete, AN:23331826 (accessed 8 March 2007).

Eales, B.A. & Choudry, M. 2003. *Derivative instruments: a guide to theory and practice*. Oxford: Butterworh-Heinemann.

Edwards, F.R. 1988. Does futures trading increase stock market voaltility? *Financial Analysts Journal*, 44(1):63-69. EBSCOhost. Business Source Complete, AN:6936191 (accessed 31 August 2007).

Elfakhani, S. & Chaudhury, M. 1995. The volatility effect of option listing: some Canadian evidence. *The Quarterly Review of Economics and Finance*, 35(1):97-116. ScienceDirect, doi:10.1016/1062-9769(95)90065-9 (accessed 31 August 2007).

Engle, R.F. 1982. Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica*, 50(4):987-1007. ProQuest. ABI/INFORM Global, DocID:677757381 (accessed 23 October 2007).

Engle, R.F. 1993. Statistical models for financial volatility. *Financial Analysts Journal*, 49(1):72-78. EBSCOhost. Business Source Complete, AN:6936192 (accessed 3 January 2008).

Engle, R.F. 2001. GARCH 101: the use of ARCH/GARCH models in applied econometrics. *Journal of Economic Perspectives*, 15(4):157-168. EBSCOhost. Business Source Complete, AN:5718017 (accessed 22 October 2007).

Engle, R.F. & Patton, A.J. 2001. What good is a volatility model? *Quantitative Finance*, 1(2):237-245. EBSCOhost. Business Source Complete, AN:20348368 (accessed 3 January 2008).

Euronext. 2003. *Euronext.Liffe to take ownership of NQLX*. EuronextLiffe, London. Available: http://www.euronext.com/news/press_release/press_release-1731-EN.html?docid=59707 (accessed 15 March 2007).

Euronext. 2004. *NQLX to de-list security futures products, retains designated contract market status*. Euronext.Liffe, London. Available: http://www.euronext.com/fic/000/001/868/18689.pdf (accessed 15 March 2007).

EViews. 2007a. *EViews6: users's guide I*. Irvine, California: Quantitative Micro Software, LLC.

EViews. 2007b. *EViews6: users's guide II*. Irvine, California: Quantitative Micro Software, LLC.

Faff, R. & Hillier, D. 2005. Complete markets, informed trading and equity option introductions. *Journal of Banking and Finance*, 29(6):1359-1384. ScienceDirect, doi:10.1016/j.jbankfin.2004.04.009 (accessed 4 September 2007).

Figlewski, S. 1981a. GNMA passthrough securities: futures trading and volatility in the GNMA market. *The Journal of Finance*, 36(2):445-456. EBSCOhost. Business Source Complete, AN:4662272 (accessed 31 August 2007).

Figlewski, S. 1981b. The informational effects of restrictions on short sales: some empirical evidence. *Journal of Financial and Quantitative Analysis*, 16(4):463-476. EBSCOhost. Business Source Complete, AN:5721684 (accessed 12 September 2007).

Figlewski, S. 1987. The interaction between derivative securities on financial instruments and the underlying cash markets: an overview. *Journal of Accounting, Auditing & Finance*, 2(3):299-318. EBSCOhost. Business Source Complete, AN:7256314 (accessed 31 August 2007).

Figlewski, S. & Webb, G.P. 1993. Options, short sales, and market completeness. *The Journal of Finance*, 48(2):761-777. EBSCOhost. Business Source Complete, AN:4653195 (accessed 3 September 2007).

Finweek. 2006. *Trading warrants and share instalments: five pointers to successful trading*. Finweek, Sandown, Gauteng. Available: https://securities.standardbank.co.za/ost/nsp/help/guide_display.asp?strAction=Open&strFileName=fw_SB_11.pdf&strFolderName=Unit1-12 (accessed 26 March 2007).

Floros, C. 2007. The use of GARCH models for the calculation of minimum capital risk requirements: international evidence. *International Journal of Managerial Finance*, 3(4):360-371. Emerald Group Publishing Limited, doi:10.1108/17439130710824361 (accessed 9 May 2008).

Garbade, K.D. & Silber, W.L. 1983. Price movements and price discovery in futures and cash markets. *The Review of Economics and Statistics*, 65(2):289-297. EBSCOhost. Business Source Complete, AN:4648253 (accessed 5 September 2007).

Gorham, M., Thomas, S. & Shah, A. 2005. India: the crouching tiger. *Futures Industry Magazine*, May/June 2005:37-40. Available: http://www.futuresindustry.org/downloads/fimag/india_rev.pdf (accessed 12 May 2006).

Gorton, G.B. & Pennacchi, G.G. 1993. Security baskets and index-linked securities. *Journal of Business*, 66(1):1-27. EBSCOhost. Business Source Complete, AN:9307025062 (accessed 31 August 2007).

Green, R.C. & Jarrow, R.A. 1987. Spanning and completeness in markets with contingent claims. *Journal of Economic Theory*, 41(1):202-210. ScienceDirect, doi:10.1016/0022-0531(87)90014-7 (accessed 3 September 2007).

Gujarati, D.N. 1995. *Basic econometrics*. 3rd edition. Singapore: McGraw-Hill.

Hakansson, N.H. 1982. Changes in the financial market: welfare and price effects and the basic theorems of value conservation. *The Journal of Finance,* 37(4):56. EBSCOhost. Business Source Complete, AN:4655652 (accessed 3 September 2007).

Harris, L. 1989. The October 1987 S&P 500 stock-futures basis. *The Journal of Finance*, 44(1):77-99. EBSCOhost. Business Source Complete, AN:4653769 (accessed 31 August 2007).

HKEx. 2006. *Derivative warrants vs options*. Hong Kong Exchanges and Clearing Limited, Hong Kong. Available: http://www.hkex.com.hk/prod/dwrc/Pages%20from%20brochure_eng5&6.pdf (accessed 23 August 2007).

Ho, K.W. 1996. Short-sales restrictions and volatility: the case of the Stock Exchange of Singapore. *Pacific-Basin Finance Journal*, 4(4):377-391. ScienceDirect, doi:10.1016/S0927-538X(96)00018-2 (accessed 12 September 2007).

Hodgson, A. & Nicholls, D. 1991. The impact of index futures markets on Australian sharemarket volatility. *Journal of Business Finance & Accounting*, 18(2):267-280. EBSCOhost. Business Source Complete, AN:4559755 (accessed 31August 2007).

Hull, J.C. 2006. *Options, futures and other derivatives*. 6th edition. Upper Saddle River, New Jersey: Pearson, Prentice-Hall.

Hung, M.W., Lee, C.F. & So, L.C. 2003. Impact of foreign-listed single stock futures on the domestic underlying stock markets. *Applied Economics Letters*, 10(9):567-574. EBSCOhost. Business Source Complete, AN:10833540 (accessed 8 March 2007).

Investec. 2007a. *Enhanced dividend securities*. Investec South Africa, Sandton, Gauteng. Available: http://www.investec.com/NR/rdonlyres/54706721-A037-4718-A532-543DFF06788A/0/Newsletter2.pdf (accessed 26 March 2007).

Investec. 2007b. *Hot enhanced dividend securities*. Investec South Africa, Sandton, Gauteng. Available: http://www.investec.com/NR/rdonlyres/9BC21800-15C6-4205-9759-FC5BA0C31D5C/6921/HotEDSBrochureAug06.pdf (accessed 26 March 2007).

Investec. 2007c. *Investec single stock futures*. Investec South Africa, Sandton, Gauteng. Available: http://www.investec.com/NR/rdonlyres/DF8930DE-2EA8-4377-9350-E5BA2DE17D76/7285/SSFbrochureOct2006.pdf (accessed 26 March 2007).

Investec. 2007d. *REVS: reverse securities*. Investec South Africa, Sandton, Gauteng. Available: http://www.investec.com/NR/rdonlyres/E36A33BE-DFEC-4F1B-BE19-66CA5262A107/8772/REVSBroch1.pdf (accessed 3 July 2007).

Investec. 2007e. *Warrants*. Investec South Africa, Sandton, Gauteng. Available: http://www.investec.com/NR/rdonlyres/FD7C9FB0-23BD-4094-AF92-58DC137F9C37/0/WarrantsElectronicbrochure.pdf (accessed 26 March 2007).

Jarrow, R. & Turnbull, S. 2000. *Derivative securities*. 2nd edition. Cincinnati, Ohio: Thomson Learning, South-Western College Publishing.

Johnson, P.M. 1999. *Derivatives: a manager's guide to the world's most powerful financial instruments*. New York, NY: McGraw-Hill.

Jones, T. & Brooks, R. 2005. An analysis of single-stock futures trading in the U.S. *Financial Services review,* 14(2):85-95. EBSCOhost. Business Source Complete, AN:17240850 (accessed 8 March 2007).

Joshi, P. & Pandya, K. 2008. Exploring movements of stock price volatility in India. *ICFAI Journal of Applied Finance,* 14(3):5-32. EBSCOhost. Business Source Complete, AN:31207839 (accessed 9 May 2008).

JSE. 2001. *Safex – Equity Derivatives: trading directive*. JSE Limited, Sandton, Gauteng. Available: http://www.safex.co.za/ed/docs/products/Financial%20Directive.doc (accessed 3 August 2007).

JSE. 2005a. *What is the price of an IEF contract?* JSE Limited, Sandton, Gauteng. Available: http://www.jse.co.za/ssf/price_of_ief_contract.jsp (accessed 22 February 2007).

JSE. 2005b. *How does one exit an SSF option position?* JSE Limited, Sandton, Gauteng. Available: http://www.jse.co.za/ssf/how_exit_ief_option.jsp (accessed 19 October 2007).

JSE. 2005c. *Listing a can-do*. JSE Limited, Sandton, Gauteng. Available: http://www.jse.co.za/cdo/listing.jsp (accessed 25 August 2007).

JSE. 2005d. *Why trade SSFs and options on SSFs?* JSE Limited, Sandton, Gauteng. Available: http://www.jse.co.za/ssf/why_trade_iefs.jsp (accessed 19 October 2007).

JSE. 2007a. *Can-do options*. JSE Limited, Sandton, Gauteng. Available: http://www.jse.co.za/cdo/docs/brochure/Can-Do.pdf (accessed 25 August 2007).

JSE. 2007b. *Derivatives rules*. JSE Limited, Sandton, Gauteng. Available: http://www.jse.co.za/docs/regulatory/Derivatives%20Rules%2025%20June%202007.pdf (accessed 3 August 2007).

JSE. 2007c. *JSE Limited annual report 2006*. JSE Limited, Sandton, Gauteng. Available: http://www.jse.co.za/docs/arep/2006/pdf/full.pdf (accessed 17 September 2007).

JSE. 2007d. *SAFEX: single stock futures*. JSE Limited, Sandton, Gauteng.

JSE. 2007e. *Warrants: understanding, trading and investing in warrants*. JSE Limited, Sandton, Gauteng. Available: http://www.jse.co.za/docs/warrants/warrants.pdf (accessed 23 August 2007).

JSE. 2008a. *JSE Limited annual report 2007*. JSE Limited, Sandton, Gauteng. Available: http://www.onlinewebstudio.co.za/jse_ar07/pdf/full.pdf (accessed 23 September 2008).

JSE. 2008b. *List of single stock futures*. JSE Limited, Sandton, Gauteng. Available: http://www.jse.co.za/ssf/docs/Full List of SSF.xls (accessed 8 July 2008).

JSE. 2008c. *New equity derivatives trading system*. JSE Limited, Sandton, Gauteng. Available: http://ir.jse.co.za/phoenix.zhtml?c=198120&p=NewsArticle&id=1188151 (accessed 23 September 2008).

JSE. 2008d. *Single stock futures*. JSE Limited, Sandton, Gauteng. Available: http://www.jse.co.za/ssf/docs/ssf/Single_Stock_Futures.pdf (accessed 23 September 2008).

JSE database. Products & Services, Statistics, Equity Market Profile. JSE Limited, Sandton, Gauteng. Available: http://www.jse.co.za/equity_market.jsp (updated monthly).

JSE Limited. 2005. JSE Limited, Sandton, Gauteng. Available: www.jse.co.za (accessed January 2007 to September 2008).

Kamara, A., Miller, T.W. & Siegel, A.F. 1992. The effect of futures trading on the stability of Standard and Poor 500 returns. *The Journal of Futures Markets*, 12(6):645-658. EBSCOhost. Business Source Complete, AN:5915792 (accessed 31 August 2007).

Kleinman, G. 2002. The elegance of open interest. *Futures: News, Analysis & Strategies for Futures, Options & Derivatives Traders*, 31(4):56-58. EBSCOhost. Business Source Complete, AN:6250569 (accessed 17 September 2007).

Kolb, R.W. 2000. *Futures, options, and swaps*. 3rd edition. Malden, Massachusetts: Blackwell Publishers.

Kothari, S.P. & Warner, J.B. 2006. Econometrics of event studies. Working Paper. Tuck School of Business at Dartmouth. Available: http://mba.tuck.dartmouth.edu/pages/faculty/espen.eckbo/PDFs/Handbookpdf/CH1-EventStudies.pdf (accessed 2 July 2007).

Kruger, WdK. 2000. *Equity index futures contracts and share price volatility: a South African perspective*. MBA dissertation. Potchefstroom University for Christian Higher Education.

Kumar, K.K. & Mukhopadhyay, C. 2004. Impact of futures introduction on underlying NSE Nifty volatility, in *Proceedings of the International Conference 2003 on Business and Finance Volume III*. Editors N. Swain, D.K. Malhotra, B. Roy. India: ICFAI University Press:326-341.

Lafferty, P. 2002. *Single stock futures*. New York, NY: McGraw-Hill.

Lascelles, D. 2002. The futures are bright. *The Banker*, 152(914):10. Gale. Academic OneFile, rn:A84842457 (accessed 25 May 2006).

Lee, S.B. & Ohk, K.Y. 1992. Stock index futures listing and structural changes in time-varying volatility. *The Journal of Futures Markets*, 12(5):493-509. EBSCOhost. Business Source Complete, AN:5925701 (accessed 31 August 2007).

Lee, C.I. & Tong, H.C. 1998. Stock futures: the effects of their trading on the underlying stocks in Australia. *Journal of Multinational Financial Management,* 8(2-3):285-301. ScienceDirect, doi:10.1016/S1042-444X(98)00032-2 (accessed 8 March 2007).

MacKinlay, A.C. 1997. Event studies in economics and finance. *Journal of Economic Literature*, 35(1):13-39. EBSCOhost. Business Source Complete, AN:9704153582 (accessed 10 December 2007).

Marshall, J.F. & Bansal, V.K. 1993. *Financial engineering*. 2nd edition. Miami, Florida: Kolb Publishing Company.

Mathworks. 2006. *GARCH toolbox: user's guide*. The Mathworks, Natick, MA. Available: http://www.mathworks.com/access/helpdesk/help/pdf_doc/garch/garch.pdf (accessed 6 November 2006).

Mattoo, M. 1997. *Structured derivatives*. London: Pitman Publishing.

Mazouz, K. 2004. The effect of CBOE option listing on the volatility of NYSE traded stocks: a time-varying variance approach. *Journal of Empirical Finance*, 11(5):695-708. ScienceDirect, doi:10.1016/j.jempfin.2003.09.003 (accessed 31 August 2007).

Mazouz, K. & Bowe, M. 2006. The volatility effect of futures trading: evidence from LSE traded stocks listed as individual equity futures contracts on LIFFE. *International Review of Financial Analysis*, 15(1):1-20. ScienceDirect, doi:10.1016/j.irfa.2005.07.001 (accessed 31 August 2007).

McGregor-BFA. 2007. McGregor BFA, Sandown, Gauteng. Available: http://secure.mcgbfa.com/Default.aspx (accessed January 2008 to April 2008).

McHattie, A. 2002. *Covered warrants: new opportunities in an exciting market*. Hampshire: Harriman House Ltd.

McKenzie, M.D., Brailsford, T.J. & Faff, R.W. 2000. New insights into the impact of the introduction of futures trading on stock price volatility. *The Journal of Futures Markets*, 21(3):237-255. EBSCOhost. Business Source Complete, AN:4060142 (accessed 8 March 2007).

McKenzie, A.M., Thomsen, M.R. & Dixon, B.L. 2004. The performance of event study approaches using daily commodity futures returns. *The Journal of Futures Markets*, 24(6):533-555. EBSCOhost. Business Source Complete, AN:12990268 (accessed 12 December 2007).

Miles, W. 2008. Volatility clustering in U.S. home prices. *Journal of Real Estate Research,* 30(1):73-90. EBSCOhost. Business Source Complete, AN:31293508 (accessed 9 May 2008).

Mitchell, K. 2003. *Single stock futures: an investor's guide*. Hoboken, New Jersey: John Wiley & Sons.

Miyazaki, H. 2007. Between arbitrage and speculation: an economy of belief and doubt. *Economy and Society*, 36(3):396-415. Informaworld, doi:10.1080/03085140701428365 (accessed 15 September 2007).

Morimune, K. 2007. Volatility models. *Japanese Economic Review,* 58(1):1-23. EBSCOhost. Business Source Complete, AN:23921993 (accessed 9 May 2008).

Mukherjee, A. 2006. *Why India is crazy about single-stock futures*. Bloomberg. Available: http://quote.bloomberg.com/apps/news?pid=10000039&refer=columnist_mukherjee&sid=aZqb_UbMh388 (accessed 12 May 2006).

Nedbank. 2007a. *Contracts for difference*. Nedbank Group Limited, Sandton, Gauteng.

Nedbank. 2007b. *Nedbank equity markets*. Nedbank Group Limited, Sandton, Gauteng. Available: https://www.nedbank.co.za/website/uploads/files/SI_Brochure_in_pdf.pdf (accessed 19 March 2007).

Nedbank. 2007c. *Nedbank protected share investment*. Nedbank Group Limited, Sandton, Gauteng. Available: https://www.nedbank.co.za/website/uploads/files/PSI_brochure.pdf (accessed 19 March 2007).

Nedbank. 2007d. *Nedbank single stock futures*. Nedbank Group Limited, Sandton, Gauteng. Available: https://www.nedbank.co.za/website/uploads/files/SSF_brochure.pdf (accessed 19 March 2007).

Nedbank. 2007e. *Nedbank warrants*. Nedbank Group Limited, Sandton, Gauteng. Available: https://www.nedbank.co.za/website/uploads/files/Warrants_brochure.pdf (accessed 19 March 2007).

Nienaber, H. 1994. *Futures trading activity and share price volatility*. MBA dissertation. University of Stellenbosch.

NIST. 2006. *NIST/SEMATECH e-handbook of statistical methods*. National Institute of Standards and Technology, Gaithersburg, Maryland. Available: http://www.itl.nist.gov/div898/handbook/pmc/section4/pmc431.htm (accessed 19 December 2007).

Norland, E.D., Quintana, J.M. & Wilford, D.S. 2000. Leverage: a very misleading way to measure risk. *Derivatives Quarterly*, 7(1):7-15. EBSCOhost. Business Source Complete, AN:3653228 (accessed 17 September 2007).

Oehley, D.J. 1995. *The effect of the introduction of index future trading on underlying index volatility*. MA dissertation. University of the Witwatersrand.

Parsons, J. 1998. *Futures trading and cash market volatility*. MBA dissertation. University of Stellenbosch.

Paulden P. 2005. Future shock. *Institutional investor*, 39(12):76-80. EBSCOhost. Business Source Complete, AN:19337739 (accessed 25 May 2006).

Peat, M. & McCorry, M. 1997. Individual share futures contracts: the economic impact of their introduction on the underlying equity market. Working Paper Series No.74. University of Technology, Sydney. Available: http://www.business.uts.edu.au/finance/research/wpapers/wp74.pdf (accessed 8 March 2007).

Puttonen, V. 1993. Short sales restrictions and the temporal relationship between stock index cash and derivatives markets. *The Journal of Futures Markets*, 13(6):645-664. EBSCOhost. Business Source Complete, AN:9502013490 (accessed 12 September 2007).

Quan, J. 1992. Two-step testing procedure for price discovery role of futures prices. *The Journal of Futures Markets*, 12(2):139-149. EBSCOhost. Business Source Complete, AN:5853526 (accessed 5 September 2007).

Rajeshwari, C.R. 2004. *From badla to derivatives*. The Hindu Business Line. Available: http://www.thehindubusinessline.com/bl10/stories/2004012800260600.htm (accessed 15 March 2007).

Raul, R.K. 2004. *Stock futures in the derivative family: an evaluation.* The Institute of Cost & Works Accountants of India. Available: http://myicwai.com/knowledgebank/fm42.pdf (accessed 12 May 2006).

Reehl, C.B. 2005. *The mathematics of options trading*. New York, NY: McGraw-Hill.

Rich, S. 2006. Short selling dangerous territory for novices. *Money Management*, 20(23):8. EBSCOhost. Business Source Complete, AN:21699206 (accessed 17 September 2007).

Robbani, M.G. & Bhuyan, R. 2005. Futures-trading activity and stock price volatility. *Derivatives Use, Trading & Regulation*, 11(3):246-260. EBSCOhost. Business Source Complete, AN:20197665 (accessed 9 September 2007).

Sahlström, P. 2001. Impact of stock option listings on return and risk characteristics in Finland. *International Review of Financial Analysis,* 10(1):19-36. EBSCOhost. Business Source Complete, AN:4313788 (accessed 31 August 2007).

Salcedo, Y. 2003a. Grading the growth of single stock futures. *Futures: News, Analysis & Strategies for Futures, Options & Derivatives Traders,* 32(6):56. EBSCOhost. Business Source Complete, AN:9613688 (accessed 15 March 2007).

Salcedo, Y. 2003b. Another look at volume and open interest. *Futures: News, Analysis & Strategies for Futures, Options & Derivatives Traders,* 32(7):60-62. EBSCOhost. Business Source Complete, AN:9929349 (accessed 17 September 2007).

Samanta, P. & Samanta, P.K. 2007. Impact of futures trading on the underlying spot market volatility. *ICFAI Journal of Applied Finance,* 13(10):52-65. EBSCOhost. Business Source Complete, AN:27398033 (accessed 9 May 2008).

Samouilhan, N.L. 2007. The persistence of SA volatility: a component ARCH perspective. *Journal for Studies in Economics and Econometrics,* 31(1):99-118.

Samouilhan, N.L. & Shannon, G. 2008. Forecasting volatility on the JSE. *The Investment Analysts Journal*, 67:19-28.

Sanlam. 2007. *Derivatives: single stock futures and index futures*. Sanlam Private Investments, Belville, Western Cape. Available: http://www.sanlamprivateinvestments.co.za/live/dyn_pdf/SPI%20derivatives-electr%20.pdf (accessed 15 October 2007).

Serra, A.P. 2002. Event study tests: a brief survey. Working Paper. Universidade do Porto. EBSCOhost. Business Source Complete, AN:18278982 (accessed 10 December 2007).

Skinner, D.J. 1989. Options markets and stock return volatility. *Journal of Financial Economics,* 23(1):61-78. ScienceDirect, doi:10.1016/0304-405X(89)90005-6 (accessed 31 August 2007).

Smit, E.vdM. & Nienaber, H. 1997. Futures-trading activity and share price volatility in South Africa. *The Investment Analysts Journal,* 44:51-59.

Standard. 2006. *Single stock futures*. The Standard Bank of South Africa Limited, Johannesburg, Gauteng. Available: https://securities.standardbank.co.za/ost/nsp/help/guide_display.asp?strAction=Open&strFileName=ssfeducationalbrochure.PDF&strFolderName=SSF (accessed 26 March 2007).

Standard. 2007a. *Discount instalments*. The Standard Bank of South Africa Limited, Johannesburg, Gauteng. Available: https://securities.standardbank.co.za/ost/nsp/HowToGuides/guide_display.asp?strAction=Open&strFileName=discountw.pdf (accessed 3 July 2007).

Standard. 2007b. *Share instalments*. The Standard Bank of South Africa Limited, Johannesburg, Gauteng. Available: https://securities.standardbank.co.za/ost/nsp/HowToGuides/guide_display.asp?strAction=Open&strFileName=What_is_an_instalment_warrant.pdf (accessed 3 July 2007).

Standard. 2007c. *Share instalments: turbo series*. The Standard Bank of South Africa Limited, Johannesburg, Gauteng. Available: https://securities.standardbank.co.za/ost/nsp/HowToGuides/guide_display.asp?strAction=Open&strFileName=turbo_brochure.pdf (accessed 3 July 2007).

Standard. 2007d. *Single stock futures: need to know!* The Standard Bank of South Africa Limited, Johannesburg, Gauteng. Available: https://securities.standardbank.co.za/ost/nsp/help/guide_display.asp?strAction=Open&strFileName=needtoknowdoc.pdf&strFolderName=ssf (accessed 3 July 2007).

Standard. 2007e. *Warrants.* The Standard Bank of South Africa Limited, Johannesburg, Gauteng. Available: http://www.warrants.co.za/servlets/za.co.scmb.www.proxy.WarrantsWWW/brochure.pdf (accessed 4 July 2007).

Steeves, G.M. 2002. *Political shocks and abnormal returns during the Taiwan crises: an event study analysis.* MA dissertation. Colorado University at Boulder. Available: http://handle.dtic.mil/100.2/ADA406675 (accessed 21 December 2007).

Strong, R.A. 2005. *Derivatives: an introduction.* 2nd edition. Mason, Ohio: Thomson, South-Western.

Stulz, M.S. 2003. *Risk management and derivatives.* Mason, Ohio: Thomson, South-Western.

Swart, A. 1998. *The impact of share index futures trading on the volatility and liquidity of the underlying assets on the Johannesburg Stock Exchange.* MCom dissertation. University of Cape Town.

Vanden Baviere, L. & De Villiers, J.U. 1997. Share volatility after the introduction of index futures. *The Investment Analysts Journal,* 45:9-15.

Wasendorf, R. & Thompson, E. 2004. *The complete guide to single stock futures: what they are and how to trade them.* New York, NY: McGraw-Hill.

Watt, W.H., Yadav, P.K. & Draper, P. 1992. The impact of option listing on underlying stock returns: the UK evidence. *Journal of Business Finance & Accounting,* 19(4):485-503. EBSCOhost. Business Source Complete, AN:4558616 (accessed 31 August 2007).

Wells, W.H. 2004. A beginner's guide to event studies. *Journal of Insurance regulation,* 22(4):61-70. EBSCOhost. Business Source Complete, AN:14161473 (accessed 10 December 2007).

WFE. 2008. *2007 WFE annual report*. World Federation of Exchanges. Available: http://www.world-exchanges.org/publications/2007%20WFE%20Annual%20Report.pdf (accessed: 4 July 2008).

WFE & Davydoff, D. 2007. *IOMA: derivatives market survey 2006*. World Federation of Exchanges. Available: http://www.world-exchanges.org/publications/IOMA%20derivative%20market%20survey%202006.pdf (accessed: 30 July 2007).

WFE & Wells, S. 2005. *IOMA: derivatives market survey 2004*. World Federation of Exchanges. Available: http://www.world-exchanges.org/publications/2004%20IOMA%20Derivatives%20Market%20Survey.pdf (accessed: 19 May 2006).

Young, P.L. & Sidey, C. 2003. *Single stock futures: a trader's guide*. Chichester, West Sussex: Wiley & Sons, Ltd (UK).

Annexure A: Underlying instrument and single stock futures codes

SSF code	Underlying instrument	Alpha code
ABLQ	AFRICAN BANK INVESTMENT LTD	ABL
ABPQ	AFRICAN BANK INVESTMENT LTD - PREF. SHARE	ABP
ABQQ	AFRICAN BANK INVESTMENT LTD - CASH SETTLED	ABL
ABTQ	AMBIT PROPERTIES LIMITED	ABT
ACCQ	ACC-CROSS HOLDINGS LIMITED	ACC
ACLQ	ARCELOR MITTAL STEEL SOUTH AFRICA LIMITED	ACL
ACPQ	ACUCAP PROPERTIES LTD	ACP
ACQQ	ARCELOR MITTAL STEEL CASH SETTLED FUTURE	ACL
ACTQ	AFROCENTRIC INVESTMENT CORPORATION LTD	ACT
ADHQ	ADVTECH LIMITED	ADH
ADRQ	ADCORP HOLDINGS LIMITED	ADR
ADWQ	AFRICAN DAWN CAPITAL LTD	ADW
AEGQ	AVENG LIMITED	AEG
AEQQ	AVENG LIMITED CASH SETTLED	AEG
AETQ	ALERT STEEL HOLDINGS LIMITED	AET
AFEQ	AECI LIMITED	AFE
AFOQ	AFLEASE GOLD LIMITED	AFO
AFQQ	AECI LIMITED CASH SETTLED FUTURES	AFE
AFRQ	AFGRI LIMITED	AFR
AFTQ	AFRIMAT LIMITED	AFT
AFXQ	AFROX OXYGEN	AFX
AGIQ	AG INDUSTRIES LIMITED	AGI
AGLQ	ANGLO AMERICAN PUBLIC LISTED CO	AGL
AGQQ	ANGLO AMERICAN PUBLIC LISTED CO CASH SETTLED	AGL
ALTQ	ALLIED TECHNOLOGIES LIMITED	ALT
AMAQ	AMALGAMATED APPLIANCE HOLDINGS LIMITED	AMA
AMQQ	AMPLATS CASH SETTLED FUTURE	AMS
AMSQ	AMPLATS	AMS
ANGQ	ANGLOGOLD LIMITED	ANG
ANQQ	ANGLOGOLD LIMITED CASH SETTLED	ANG
APAQ	APEXHI PROPERTIES LIMITED-A	APA
APBQ	APEXHI PROPERTIES LIMITED-B	APB
APKQ	ASTRAPAK LIMITED	APK
APNQ	ASPEN PHARMACARE HOLDINGS LIMITED	APN
APQQ	ASPEN PHARMACARE HOLDINGS LIMITED - CASH SETTLED	APN
APXQ	ASTRAPAK LIMITED- PREFERENCE SHARE	APX
ARHQ	ARB HOLDINGS LIMITED	ARH
ARIQ	AFRICAN RAINBOW MINERAL LIMITED	ARI
ARLQ	ASTRAL FOODS LIMITED	ARL
ARQQ	ASTRAL FOODS LIMITED CASH SETTLED	ARL

SSF code	Underlying instrument	Alpha code
ARTQ	ARGENT INDUSTRIAL LIMITED	ART
ASAQ	ABSA GROUP LIMITED	ASA
ASOQ	AUSTRO GROUP LIMITED	ASO
ASQQ	ABSA GROUP LIMITED - CASH SETTLED	ASA
ASXQ	ABSA BANK LIMITED PREFERENCE SHARES	ASX
ATNQ	ALLIED ELECTRONICS CORP LTD	ATN
ATRQ	AFRICA CELLULAR TOWERS	ATR
AUAQ	AVUSA LIMITED - OLD JCMQ	AUA
AUQQ	AVUSA LIMITED - CASH SETTLED	AUA
AVIQ	ANGLOVAAL INDUSTRIES LIMITED	AVI
AVQQ	ANGLOVAAL INDUSTRIES LIMITED - CASH SETTLED	AVI
AVUQ	AVUSA LIMITED - PREV AUAQ	AVU
AXCQ	APEXHI PROPERTIES LIMITED - C	AXC
AXNQ	ALLIED ELECTRONICS CORP LTD PREFERENCE	AXN
AXQQ	AFROX OXYGEN CASH SETTLED	AFX
BATQ	BRAIT SA	BAT
BAWQ	BARLOWORLD LIMITED	BAW
BCDQ	BRC DIAMOND CORPORATION	BCD
BCFQ	BOWLER METCALF LIMITED	BCF
BCXQ	BUSINESS CONEXTION GROUP LIMITED	BCX
BEGQ	BEIGE HOLDINGS LIMITED	BEG
BELQ	BELL EQUIPMENT LIMITED	BEL
BFSQ	BLUE FINANCIAL SERVICES	BFS
BILQ	BILLITON PLC	BIL
BIQQ	BILLITON PLC CASH SETTLED	BIL
BJMQ	BARNARD JACOBS MELLET HOLDINGS LTD	BJM
BLUQ	BLUE LABEL TELECOMS	BLU
BRNQ	BRIMSTONE INVESTMENT CORPORATION - N - ORDINARY	BRN
BSBQ	THE HOUSE OF BUSBY LIMITED	BSB
BSRQ	BASIL READ HOLDINGS LIMITED	BSR
BVQQ	BIDVEST GROUP LIMITED - CASH SETTLED	BVT
BVTQ	BIDVEST GROUP LIMITED	BVT
BWIQ	B & W INSTRUMENT AND ELECTRONIC	BWI
BWQQ	BARLOWORLD LIMITED - CASH SETTLED	BAW
BXQQ	BUILDMAX LIMITED CASH SETTLED	BDM
CAEQ	CAPE EMPOWERMENT TRUST	CAE
CATQ	CAXTON AND CTP PUBLISHERS AND PRINTERS LIMITED	CAT
CDZQ	CADIZ HOLDINGS LIMITED	CDZ
CLHQ	CITY LODGE HOTELS LIMITED	CLH
CMHQ	COMBINED MOTOR HOLDINGS LIMITED	CMH
CMLQ	CORONATION FUND MANAGERS LIMITED	CML

SSF code	Underlying instrument	Alpha code
CMOQ	CHROMETCO LIMITED	CMO
CNDQ	CONDUIT CAPITAL LIMITED	CND
CNLQ	CONTROL INSTRUMENTS GROUP LTD	CNL
COMQ	COMAIR LIMITED	COM
CPIQ	CAPITEC BANK HOLDINGS LIMITED	CPI
CPLQ	CAPITAL PROPERTY FUND	CPL
CRMQ	CERAMIC INDUSTRIES LIMITED	CRM
CSBQ	CASHBUILD LIMITED	CSB
CVNQ	CONVERGE HOLDINGS LIMITED	CVN
CXPQ	CAPITEC BANK HOLDINGS LTD PREFERENCE SHARES-CPIP	CXP
DAWQ	DISTRIBUTION AND WAREHOUSING NETWORK LTD	DAW
DCTQ	DATACENTRIX HOLDINGS LIMITED	DCT
DDTQ	DIMENSION DATA HOLDINGS LTD	DDT
DELQ	DELTA ELECTRICAL INDUSTRIES LTD	DEL
DGCQ	DIGICORE HOLDINGS LIMITED	DGC
DIVQ	DIVERSIFIED PROPERTY FUND LTD	DIV
DLGQ	DIALOGUE GROUP HOLDINGS LIMITED	DLG
DLVQ	DORBYL LIMITED	DLV
DMRQ	DIAMOND CORE RESOURCES LIMITED	DMR
DONQ	DON GROUP LIMITED	DON
DRDQ	DRD GOLD LIMITED	DRD
DSTQ	DISTELL GROUP LIMITED	DST
DSYQ	DISCOVERY HOLDINGS LIMITED	DSY
DTCQ	DATATEC LIMITED	DTC
DYMQ	DYNAMIC CABLES RSA LIMITED	DYM
ELEQ	ELAMENT ONE LIMITED - PREV AUAQ	ELE
ELRQ	ELB GROUP LIMITED	ELR
EMIQ	EMIRA PROPERTY FUND	EMI
ENLQ	ENALENI PHARMACEUTICAL LTD	ENL
ENVQ	ENVIROSERV HOLDINGS LIMITED	ENV
EOHQ	EOH HOLDINGS LIMITED	EOH
ERMQ	ENTERPRISE RISK MANAGEMENT LIMITED	ERM
ESRQ	ESOR LIMITED	ESR
EXQQ	EXXARRO CASH SETTLED FUTURE	EXX
EXXQ	EXXARO RESOURCES LTD	EXX
FBRQ	FAMOUS BRAND LIMITED	FBR
FOQQ	FOSCHINI LIMITED CASH SETTLED	FOS
FOSQ	FOSCHINI LIMITED	FOS
FPQQ	FOUNTAINHEAD PROPERTY TRUST CASH SETTLED	FPT
FPTQ	FOUNTAINHEAD PROPERTY TRUST	FPT
FRTQ	FARITEC HOLDINGS LIMITED	FRT

SSF code	Underlying instrument	Alpha code
FSPQ	FIRSTRAND LIMITED PREFERENCE SHARES	FSP
FSQQ	FIRSTRAND LIMITED CASH SETTLED	FSR
FSRQ	FIRSTRAND LIMITED	FSR
FWDQ	FREEWORLD COATINGS LIMITED	FWD
GDFQ	GOLD REEF CASINO RESORTS LIMITED	GDF
GFIQ	GOLDFIELDS LIMITED	GFI
GFQQ	GOLDFIELDS LIMITED - CASH SETTLED	GFI
GIJQ	GIJIMA AST GROUP LTD	GIJ
GLDQ	NEW GOLD ISSUER LIMITED	GLD
GMBQ	GLENRAND MIB LIMITED	GMB
GNDQ	GRINROD LIMITED	GND
GOQQ	GROWTHPOINT PROPERTIES LIMITED CASH SETTLED	GRT
GRFQ	GROUP FIVE LIMITED	GRF
GRQQ	GROUP FIVE LIMITED CASH SETTLED	GRF
GRTQ	GROWTHPOINT PROPERTIES LIMITED	GRT
HAQQ	HARMONY GOLD MINING COMPANY LTD - CASH SETTLED	HAR
HARQ	HARMONY GOLD MINING COMPANY LTD	HAR
HCIQ	HOSKEN CONSOLIDATED INVESTMENT LIMITED	HCI
HDCQ	HUDACO INDUSTRIES LIMITED	HDC
HLMQ	HULAMINE LIMITED	HLM
HLQQ	HULAMINE LIMITED CASH SETTLED	HLM
HUGQ	HUGE GROUP LIMITED	HUG
HVLQ	HIGHVELD STEEL & VANADIUM CORP LTD	HVL
HVQQ	HIGHVELD STEEL & VANADIUM CORP LTD CASH SETTLED	HVL
HYPQ	HYPROP INVESTMENTS LIMITED	HYP
IBKQ	INVESTEC BANK LIMITED PREFERENCE SHARES	IBK
IBXQ	IMPERIAL BANK LIMITED PREFERENCE SHARES	IBX
IFRQ	IFOUR PROPERTIES LIMITED	IFR
ILAQ	ILIAD AFRICA LIMITED	ILA
ILQQ	ILLOVO SUGAR LIMITED - CASH SETTLED	ILV
ILVQ	ILLOVO SUGAR LIMITED	ILV
IMPQ	IMPLATS	IMP
IMQQ	IMPLATS CASH SETTLED	IMP
INLQ	INVESTEC LIMITED	INL
INPQ	INVESTEC PLC	INP
INQQ	INVESTEC PLC - CASH SETTLED	INP
INRQ	INVESTEC BANK LIMITED PREFERENCE SHARES (INPR)	INR
IPLQ	IMPERIAL HOLDINGS LIMITED	IPL
IPQQ	IMPERIAL HOLDINGS LIMITED CASH SETTLED	IPL
IRAQ	INFRASORS HOLDINGS LIMITED	IRA
ISAQ	ISA HOLDINGS LIMITED	ISA

SSF code	Underlying instrument	Alpha code
ITEQ	ITALTILE LTD	ITE
IVTQ	INVICTA HOLDINGS LIMITED	IVT
JBLQ	JUBILEE PLATINUM PLC	JBL
JCDQ	JCI LIMITED	JCD
JDGQ	JD GROUP LIMITED	JDG
JNCQ	JOHNNIES INDUSTRIAL CORPORATION LIMITED	JNC
JSCQ	JASCO ELECTRONICS HOLDINGS LIMITED	JSC
JSEQ	JSE LIMITED	JSE
KAPQ	KAP INTERNATIONAL HOLDINGS	KAP
KGMQ	KAGISO MEDIA LIMITED	KGM
KIOQ	KUMBA IRON ORE LIMITED	KIO
KIQQ	KUMBA IRON ORE CASH SETTLED FUTURE	KIO
LBHQ	LIBERTY HOLDINGS	LBH
LBQQ	LIBERTY INTERNATIONAL CASH SETTLED FUTURE	LBH
LBTQ	LIBERTY INTERNATIONAL PLC	LBT
LEWQ	LEWIS GROUP LIMITED	LEW
LGLQ	LIBERTY LIFE ASSOCIATION OF AFRICA LTD	LGL
LMDQ	LEREKO MOBILITY (PTY) LIMITED DEBENTURE	LMD
LONQ	LONMIN PLC	LON
MAFQ	MUTUAL AND FEDERAL	MAF
MCUQ	MCUBED HOLDINGS LIMITED	MCU
MDCQ	MEDI-CLINIC CORPORATION LIMITED	MDC
MDNQ	MADISON PROPERTY FUND MANAGERS	MDN
MDQQ	MEDI-CLINIC CORPORATION LIMITED CASH SETTLED	MDC
METQ	METROPOLITAN HOLDINGS	MET
MFLQ	METROFILE HOLDINGS LIMITED	MFL
MIXQ	TELIMATRIX LIMITED	MIX
MKLQ	MAKALANI HOLDINGS LIMITED	MKL
MMHQ	MIRANDA MINERALS HOLDINGS LIMITED	MMH
MMLQ	METMAR LIMITED	MML
MNDQ	MONDI LIMITED	MND
MNPQ	MONDI PUBLIC LISTED COMPANY	MNP
MNQQ	MONDI LIMITED - CASH SETTLED	MNP
MOBQ	MOBILE INDUSTRIES LTD ORDINARY	MOB
MPCQ	MR PRICE GROUP LIMITED	MPC
MRFQ	MERAFE RESOURCES LIMITED	MRF
MSMQ	MASSMART	MSM
MSTQ	MUSTEK LIMITED	MST
MTAQ	METAIR INVESTMENTS LIMITED	MTA
MTLQ	MERCANTILE BANK HOLDINGS	MTL
MTNQ	MTN GROUP	MTN

SSF code	Underlying instrument	Alpha code
MTQQ	MTN GROUP CASH SETTLED	MTN
MTXQ	METOREX LIMITED	MTX
MTZQ	MATODZI RESOURCES LIMITED	MTZ
MURQ	MURRAY & ROBERTS HOLDINGS LIMITED	MUR
MVGQ	MVELAPHANDA GROUP LIMITED	MVG
MVLQ	MVELAPHANDA RESOURCES LTD	MVL
NCLQ	NEWC CLICKS HOLDINGS LIMITED	NCL
NEDQ	NEDCOR LIMITED	NED
NHMQ	NORTHAM PLATINUM LTD	NHM
NPKQ	NAMPAK LIMITED	NPK
NPNQ	NASPERS LIMITED	NPN
NPQQ	NASPERS LIMITED - CASH SETTLEMENT	NPN
NTCQ	NETWORK HEALTHCARE HOLDINGS LIMITED	NTC
NTQQ	NETWORK HEALTHCARE HOLDINGS LIMITED CASH SETTLED	NTC
NWLQ	NU-WORLD HOLDINGS LIMITED	NWL
NXDQ	NEW NEDCOR LIMITED	NXD
OCEQ	OCEANA GROUP LIMITED	OCE
OCTQ	OCTODEC INVESTMENTS LIMITED	OCT
OMLQ	OLD MUTUAL	OML
OMNQ	OMNIA HOLDINGS LIMITED	OMN
OMQQ	OLD MUTUAL - CASH SETTLED	OML
PAMQ	PALABORA MINNING COMPANY LIMITED	PAM
PAPQ	PANGBOURNE PROPERTIES LIMITED	PAP
PCNQ	PARACON HOLDINGS LIMITED	PCN
PETQ	PETMIN LIMITED	PET
PGQQ	PEREGRINE HOLDINGS LIMITED - CASH SETTLED	PGR
PGRQ	PEREGRINE HOLDINGS LIMITED	PGR
PHMQ	PHUMELELA GAME LEISURE	PHM
PIKQ	PICK N PAY STORES LIMITED	PIK
PIQQ	PICK N PAY STORES LIMITED - CASH SETTLED	PIK
PKHQ	PROTECH KHUTHELE HOLDINGS	PKH
PMMQ	PREMIUM PROPERTIES LTD	PMM
PNCQ	PINNACLE TECHNOLOGY HOLDINGS LIMITED	PNC
PPCQ	PRETORIA PORTLAND CEMENT COMPANY LIMITED	PPC
PPQQ	PPC CEMENT CASH SETTLED FUTURE	PPC
PSGQ	PSG GROUP LIMITED	PSG
PTXQ	PROPERTY INDEX TRACKER COLLECTIVE INVESTMENTS	PTX
PWKQ	PICK N PAY HOLDINGS LIMITED	PWK
PZGQ	PAMODZI GOLD LIMITED	PZG
RAHQ	REAL AFRICA HOLDINGS LIMITED	RAH
RBWQ	RAINBOW CHICKEN LIMITED	RBW

SSF code	Underlying instrument	Alpha code
RBXQ	RAUBEX GROUP LIMITED	RBX
RCHQ	RICHEMONT	RCH
RDFQ	REDEFINE INCOME FUND LIMITED	RDF
REMQ	REMGRO	REM
REQQ	REMGRO - CASH SETTLED	REM
RHQQ	RICHEMONT CASH SETTLED	RCH
RLOQ	REUNERT LIMITED	RLO
RLQQ	REUNERT LIMITED CASH SETTLED	RLO
RMHQ	RMB HOLDINGS	RMH
RMQQ	RMB HOLDINGS CASH SETTLED	RMH
RNGQ	RANDGOLD & EXPLORATION CO. LTD	RNG
SABQ	SAB MILLER PLC	SAB
SACQ	SA CORPORATE REAL ESTATE FUND	SAC
SALQ	SALLIES LIMITED	SAL
SANQ	SANYATI HOLDINGS LIMITED	SAN
SAPQ	SAPPI LIMITED	SAP
SAQQ	SAPPI LIMITED CASH SETTLED	SAP
SBGQ	SIMEKA BSG LTD	SBG
SBKQ	STANDARD BANK INVESTMENTS CORPORATION LTD	SBK
SBPQ	STANDARD BANK GROUP PREFERENCE SHARES	SBP
SBQQ	STANDARD BANK INVESTMENTSCORPORATION LTD CASH SETTLED	SBK
SDHQ	SECUREDATA HOLDINGS LIMITED	SDH
SEQQ	SAB MILLER PLC CASH SETTLED	SAB
SFBQ	STEFANUTTI & BRESSAN HOLDINGS	SFB
SFFQ	STEINHOFF HOLDINGS LIMITED PREF SHARES	SFF
SFNQ	SASFIN HOLDINGS	SFN
SHFQ	STEINHOFF HOLDINGS LIMITED	SHF
SHPQ	SHOPRITE HOLDINGS LTD	SHP
SHQQ	STEINHOFF HOLDINGS LIMITED CASH SETTLED	SHF
SIMQ	SIMMER AND JACK MINES LIMITED	SIM
SKJQ	SEKUNJALO INVESTMENTS LIMITED	SKJ
SKYQ	SEA KAY HOLDINGS LIMITED	SKY
SLMQ	SANLAM	SLM
SLQQ	SANLAM - CASH SETTLED	SLM
SNQQ	SANTAM LTD CASH SETTLED	SNT
SNTQ	SANTAM LTD	SNT
SNUQ	SENTULA MINING LIMITED - OLD SCNQ	SNU
SOHQ	SOUTH OCEAN	SOH
SOLQ	SASOL LIMITED	SOL
SOQQ	SASOL LIMITED CASH SETTLED	SOL
SOVQ	SOVEREIGN FOOD INVESTMENTS LTD	SOV

SSF code	Underlying instrument	Alpha code
SPGQ	SUPER GROUP LIMITED	SPG
SPPQ	THE SPAR GROUP LIMITED	SPP
STDQ	SATRIX DIVIDEND PLUS PORTFOLIO-STXDIV	STD
STRQ	SATRIX RESI	STR
STXQ	SATRIX 40	STX
SUIQ	SUN INTERNATIONAL LIMITED	SUI
SURQ	SPUR CORPORATION LIMITED	SUR
SWXQ	SATRIX SWIX TOP40	SWX
SXFQ	SATRIX FINI	SXF
SXIQ	SATRIX INDI	SXI
SXXQ	SALLIES LIMITED RIGHTS ISSUE - JUN08	SXX
SYAQ	SIYATHENGA PROPERTY FUND	SYA
SYCQ	SYCOM PROERTY FUND	SYC
TASQ	TASTE HOLDINGS LIMITED	TAS
TBQQ	TIGER BRAND LIMITED - CASH SETTLED	TBS
TBSQ	TIGER BRAND LIMITED	TBS
TDHQ	TRADEHOLD LIMITED	TDH
TFXQ	TOP FIX HOLDINGS LIMITED	TFX
TIWQ	TIGER WHEELS LIMITED	TIW
TKGQ	TELKOM SA LIMITED	TKG
TKQQ	TELKOM SA CASH SETTLED FUTURE	TKG
TONQ	TONGAAT HULLET LIMITED	TON
TOQQ	TONGAAT HULLET LIMITED CASH SETTLED	TON
TREQ	TRENCOR LIMITED	TRE
TRTQ	TOURISM INVESTMENT CORPORATION LIMITED	TRT
TRUQ	TRUWORTHS INTERNATIONAL LTD	TRU
TSXQ	TRANS HEX GROUP LIMITED	TSX
TWPQ	TWP HOLDINGS LIMITED	TWP
UCSQ	UCS GROUP LIMITED	UCS
UCXQ	UCS GROUP LIMITED- CORPORATE ACTION	UCX
UUUQ	URANIUM ONE INC	UUU
VKEQ	VUKILE PROPERTY FUND LIMITED	VKE
VLEQ	VALUE GROUP LIMITED	VLE
VMKQ	VERIMARK HOLDINGS LIMITED	VMK
VOXQ	VOXTELECOM LIMITED	VOX
WBOQ	WILSON BAYLY HOLMES-OVCON LIMITED	WBO
WEAQ	W G WEARNE LTD	WEA
WESQ	WESCO INVESTMENTS LIMITED	WES
WEZQ	WESIZWE PLATINUM LIMITED	WEZ
WHLQ	WOOLWORTHS HOLDINGS LIMITED	WHL
WLOQ	WOOLTRU	WLO

SSF code	Underlying instrument	Alpha code
WNHQ	WINHOLD LIMITED	WNH
YRKQ	YORK TIMBER ORGANISATION LIMITED	YRK
ZEDQ	ZEDER INVESTMENTS LIMITED	ZED
ZPLQ	ZSHARES RANDPLAY - ZRNPLY	ZPL

Source: JSE (2008b)

Annexure B: Notices of Single Stock Futures (1999 – 2007)

Notice	Date	Code	Name	Settlement
			1999	
887	8-Feb-99	AACQ	Anglo American Corporation	Physical
		DDTQ	Dimension Data Holdings Limited	Physical
		FSRQ	Firstrand Limited	Physical
		RCHQ	Richemont Securities Limited	Physical
889	9-Feb-99	BOEQ	BOE Limited	Physical
		CPHQ	Comparex Holdings Limited	Physical
			2000	
1001	12-Jun-00	ISCQ	Iscor Limited	Physical
1009	21-Jul-00	OMLQ	Old Mutual	Physical
		SLMQ	Sanlam	Physical
1010	24-Jul-00	IMPQ	Impala Platinum Limited	Physical
1016	7-Aug-00	ABLQ	African Bank Investment Holdings Limited	Physical
1018	8-Aug-00	AGLQ	Anglo American PLC	Physical
		DBRQ	De Beers Consolidated Mines Limited	Physical
		BILQ	Biliton PLC	Physical
		MCEQ	M-Cell Limited	Physical
		AMSQ	Goldfields	Physical
		SABQ	South African Breweries PLC	Physical
		SBCQ	Standard Bank Investment Corporation Limited	Physical
		NEDQ	Nedcor Limited	Physical
		RMTQ	Rembrandt Group Limited	Physical
		ANGQ	Anglo Gold	Physical
		SOLQ	Sasol Limited	Physical
		INTQ	Investec Group Limited	Physical
		LBTQ	Liberty International PLC	Physical
		ASAQ	ABSA Group Limited	Physical
		LGLQ	Liberty Group	Physical
		JNCQ	Johnnies Industrial Corporation Limited	Physical
		BVTQ	Bidvest Group Limited	Physical
		GFIQ	Goldfields Group Limited	Physical
		SAPQ	Sappi Limited	Physical
		IPLQ	Imperial Holdings Limited	Physical
		TBSQ	Tiger Brands Limited	Physical
		RMHQ	RMB Holdings	Physical
		BARQ	Barlow Limited	Physical
		NPNQ	Naspers Limited	Physical
		MHHQ	MIH Holdings Limited/M-Web Holdings Limited	Physical
		NPKQ	Nampak Limited	Physical
		CRNQ	Coronation Holdings Limited	Physical
		GSCQ	Genbel Securities Limited	Physical

Notice	Date	Code	Name	Settlement
		DTCQ	Datatec Limited	Physical
		MTCQ	Metro Cash & Carry Limited	Physical
		PEPQ	Pepcor Limited	Physical
		FDSQ	Fedsure Holdings Limited	Physical
		PONQ	Profurn Limited	Physical
		JDGQ	JD Group Limited	Physical
		ECOQ	Edgars Consolidated Stores Limited	Physical
		TNTQ	Tongaat-Hulett Group Limited	Physical
		RBHQ	Rebhold Limited	Physical
		FOSQ	Foschini Limited	Physical
		SFTQ	Softline Limited	Physical
		WHLQ	Woolworths Holdings Limited	Physical
2001				
1098	20-Jun-01	PIKQ	Pick & Pay Stores Limited	Physical
1111	10-Aug-01	NHMQ	Northam Platinum Limited	Physical
F009	21-Sep-01	HARQ	Harmony Gold Mining Company Limited	Physical
F026	7-Nov-01	DURQ	Durban Roodepoort Deep	Physical
F035	29-Nov-01	AFBQ	Alexander Forbes	Physical
		GMFQ	Gencor Limited	Physical
F038	7-Dec-01	MSMQ	Massmart	Physical
		WLOQ	Wooltru	Physical
2002				
F058	13-Feb-02	SNTQ	Santam Limited	Physical
F079	19-Mar-02	INHQ	Investec Holdings Limited	Physical
F190	7-Nov-02	MESQ	Messina Limited	Physical
F212	28-Nov-02	BPLQ	Barplats Investment Limited	Physical
		MVLQ	Mvelaphanda Resource Limited	Physical
		SHPQ	Shoprite Holdings Limited	Physical
		WARQ	Western Areas Limited	Physical
2003				
F241	6-Feb-03	AFLQ	The Afrikander Lease Limited	Physical
		KERQ	Kersaf Investment Limited	Physical
F244	12-Feb-03	RNGQ	Randgold & Exploration Company Limited	Physical
F245	12-Feb-03	ABIQ	Amalgamated Beverage Industries Limited	Physical
		AEGQ	Aveng Limited	Physical
		AVIQ	Anglovaal Industries Limited	Physical
		NCLQ	New Clicks Holdings Limited	Physical
F250	25-Feb-03	SHFQ	Steinhoff International Holdings Limited	Physical
F258	10-Mar-03	TKGQ	Telkom SA Limited	Physical
F270	2-Apr-03	DELQ	Delta Electrical Industries Limited	Physical
		MPCQ	Mr Price Group Limited	Physical
		MURQ	Murray & Roberts Holdings Limited	Physical

Notice	Date	Code	Name	Settlement
		TRUQ	Truworths International Limited	Physical
F274	16-Apr-03	AODQ	African Rainbow Mineral Gold Limited	Physical
F285	21-May-03	ALTQ	Allied Technologies Limited	Physical
F314	22-Jul-03	OMNQ	Omnia Holdings Limited	Physical
F316	29-Jul-03	AVSQ	Avis Southern Africa Limited	Physical
F319	31-Jul-03	NBKQ	Nedbank Limited Noncumpref	Physical
F320	4-Aug-03	NTCQ	Network Healthcare Holdings Limited	Physical
F329	13-Aug-03	JCDQ	JCI Limited	Physical
F330	19-Aug-03	WETQ	Wetherlys Investment Holdings Limited	Physical
F335	27-Aug-03	APNQ	Aspen Pharmacare Holdings Limited	Physical
		AVGQ	Avgold Limited	Physical
		ILVQ	Illovo Sugar Limited	Physical
		IBKQ	Investec Bank Limited Preference Shares	Physical
		USVQ	United Service Techologies Limited	Physical
F346	17-Sep-03	CPTQ	Capital Alliance Holdings Limited	Physical
F356	6-Oct-03	AFXQ	African Oxygen Limited	Physical
		LBHQ	Liberty Holdings Limited	Physical
		MAFQ	Mutual and Federal Insurance Company Limited	Physical
F363	9-Oct-03	SISQ	Sun International SA Limited	Physical
F378	5-Nov-03	MNSQ	Electronic Media Network Limited	Physical
F381	12-Nov-03	BELQ	Bell Equipment Limited	Physical
F390	19-Nov-03	LONQ	Lonmin PLC	Physical
		AHHQ	Afrox Healthcare Limited	Physical
F397	1-Dec-03	APLQ	Applied Technology Holdings Limited	Physical
		BDEQ	Bidbee Limited	Physical
		BDOQ	Call options to subscribe for Bidvest shares	Physical
F403	12-Dec-03	PAPQ	Pangbourne Properties Limited	Physical
			2004	
F406	12-Jan-04	AFIQ	African Life Assurance	Physical
		AFRQ	AFGRI Limited	Physical
		RDFQ	Redefine Income Fund Limited	Physical
		RLOQ	Reunert Limited	Physical
		ILAQ	Iliad Africa Limited	Physical
		IVTQ	Invicta Holdings Limited	Physical
		PGRQ	Peregrine Holdings Limited	Physical
F410	15-Jan-04	AINQ	Anglovaal Mining Limited	Physical
		PPCQ	Pretoria Portland Cement Company Limited	Physical
		SCEQ	South African Chrome and Alloys Limited	Physical
F413	21-Jan-04	CMLQ	Coronation Fund Managers Limited	Physical
		SGGQ	Sage Group Limited	Physical
F416	29-Jan-04	MDCQ	Medi-Clinic Corporation Limited	Physical
		MPLQ	Metboard Properties Limited	Physical

Notice	Date	Code	Name	Settlement
F434	26-Feb-04	APAQ	Apecxhi Properties Limited-A	Physical
		APBQ	Apecxhi Properties Limited-B	Physical
		AQLQ	Aquila Growth Limited	Physical
		DSYQ	Discovery Holdings Limited	Physical
		GMBQ	Glenrand MIB Limited	Physical
		RBWQ	Rainbow Chicken Limited	Physical
		SPGQ	Super Group Limited	Physical
F453	24-Mar-04	GNDQ	Grindrod Limited	Physical
		HVLQ	Highveld Steel and Vanadium Corporation Limited	Physical
F461	6-Apr-04	TDHQ	Tradehold Limited	Physical
F464	20-Apr-04	SURQ	Spur Corporation Limited	Physical
F473	10-May-04	TRTQ	Tourism Investment Corporation Limited	Physical
F482	2-Jun-04	FBRQ	Famous Brands Limited	Physical
		GDFQ	Gold Reef Casino Resorts Limited	Physical
		GRTQ	Growth Point Properties Limited	Physical
F487	15-Jun-04	PSGQ	PSG Group Limited	Physical
F492	28-Jun-04	AFEQ	AECI Limited	Physical
F502	19-Jul-04	SBPQ	Standard Bank Group Preference Shares	Physical
		MSTQ	Mustek Limited	Physical
F503	19-Jul-04	CLHQ	City Lodge Hotels Limited	Physical
		GRYQ	Allan Gray Property Trust Limited	Physical
		OCEQ	Oceana Group Limited	Physical
		TIWQ	Tiger Wheels Limited	Physical
		TSXQ	Trans Hex Group Limited	Physical
F506	23-Jul-04	JCMQ	Johnnic Communications Limited	Physical
F517	5-Aug-04	GRFQ	Group Five Limited	Physical
F522	19-Aug-04	APKQ	Astrapak Limited	Physical
		ARLQ	Astral Foods Limited	Physical
F528	1-Sep-04	DLVQ	Dorbyl Limited	Physical
F540	22-Sep-04	ARTQ	Argent Industrial Limited	Physical
		FROQ	Frontrange Limited	Physical
		TREQ	Trencor Limited	Physical
F544	29-Sep-04	NWLQ	Nu-World Holdings Limited	Physical
F550	13-Oct-04	EMIQ	Emira Property Fund	Physical
		GNKQ	Grintek Limited	Physical
F551	14-Oct-04	LEWQ	Lewis Group Limited	Physical
		PTGQ	Peermont Global Limited	Physical
F555	18-Oct-04	SPPQ	The Spar Group Limited	Physical
F573	10-Nov-04	ADRQ	Adcorp Holdings Limited	Physical
		BATQ	Brait SA	Physical
		PIMQ	Prism Holdings Limited	Physical
F574	11-Nov-04	MTAQ	Metair Investments Limited	Physical

Notice	Date	Code	Name	Settlement
		UTRQ	Unitrans Limited	Physical
F578	17-Nov-04	CATQ	Caxton and CTP Publishers and Printers Limited	Physical
F580	22-Nov-04	BRCQ	Brandcorp Holdings Limited	Physical
		COMQ	Comair Limited	Physical
		FSPQ	Firstrand Limited Preference Shares	Physical
F589	30-Nov-04	MTPQ	Martprop Property Fund	Physical
F605	21-Dec-04	GLDQ	New Gold Issuer Limited	Physical
2005				
F613	18-Jan-05	KAPQ	KAP International Holdings	Physical
F619	21-Jan-05	CPAQ	Corpcapital Limited	Physical
F629	3-Feb-05	SFNQ	Sasfin Holdings	Physical
F636	22-Feb-05	CPLQ	Capital Propery Fund	Physical
		CSBQ	Cashbuld Limited	Physical
		HYPQ	Hyprop Investments Limited	Physical
		INRQ	Investec Bank Limited Preference Shares - INPR	Physical
		MCPQ	MICC Property Income Fund	Physical
		OCTQ	Octodec Investments Limited	Physical
		RAHQ	Real Africa Holdings Limited	Physical
		VKEQ	Vukile Property Fund Limited	Physical
F641	5-Mar-05	DAWQ	Distribution and Warehouse Network Limited	Physical
		SRLQ	SA Retail Properties Limited	Physical
		SYCQ	Sycom Propertes Fund	Physical
F651	4-Apr-05	HDCQ	Hudaco Industries Limited	Physical
		MTXQ	Metorex Limited	Physical
F660	16-Apr-05	PWKQ	Pick and Pay Holdings Limited	Physical
F665	21-Apr-05	PAMQ	Palabora Mining Company Limited	Physical
F671	28-Apr-05	PMDQ	Palamin Mining Company Debentures	Physical
F676	12-May-05	RESQ	Resilient Property Income Fund Limited	Physical
F677	13-May-05	KCMQ	Kagiso Media Limited	Physical
F693	13-Jun-05	DXDQ	DRD Gold Limited	Physical
F699	21-Jun-05	BJMQ	Barnard Jacobs Mellet Holdins Limited	Physical
		SFFQ	Steinhoff International Holdings Limited Pref Shares	Physical
F705	29-Jun-05	NCAQ	New Corpcapital Limited	Physical
F709	5-Jul-05	AMAQ	Amalgamated Appliance Holdings Limited	Physical
		CCTQ	Connection Group Holdings	Physical
		LMDQ	Lereko Mobility (Pty) Limited Debenture	Physical
		WESQ	Wesco Investments Limited	Physical
F713	8-Jul-05	BTGQ	Bytes Technology Group Limited	Physical
F714	13-Jul-05	CMHQ	Combined Motor Holdings Limited	Physical
F716	14-Jul-05	WBOQ	Wilson Nayly Holmes-Ovcon Limited	Physical
F725	26-Jul-05	PHMQ	Phumelela Game Leisure	Physical
F733	3-Aug-05	CDZQ	Cadiz Holdings Limited	Physical

Notice	Date	Code	Name	Settlement
F737	11-Aug-05	ABPQ	African Bank Investment Limited	Physical
		PMNQ	Primedia Limited N-Ordinary	Physical
		SCNQ	Scharrig Mining Limited	Physical
		VMKQ	Verimark Holdings Limited	Physical
F745	22-Aug-05	DGCQ	Digicore Holdings Limited	Physical
		DSTQ	Distell Group Limited	Physical
F747	24-Aug-05	AQPQ	Aquarius Platinum Limited	Physical
		HCIQ	Hosken Consolidated Invesment Limited	Physical
F749	29-Aug-05	SBNQ	Sub Nigel Gold Mining Company Limited	Physical
F751	31-Aug-05	FXPQ	Freestone Property Holdings	Physical
F752	1-Sep-05	IFRQ	Ifour Properties Limited	Physical
		CPIQ	Capitec Bank Holdings Limited	Physical
F763	12-Sep-05	GIJQ	Gijima AST Group Limited	Physical
F769	22-Sep-05	ATSQ	Atlas Properties Limited	Physical
F771	27-Sep-05	ENLQ	Enaleni Pharmaceutical	Physical
F772	28-Sep-05	ATNQ	Allied Electronics Corporation Limited	Physical
		AXNQ	Allied Electronics Corporation Limited Preference	Physical
F776	4-Oct-05	ERMQ	Enterprse Risk Management Limited	Physical
F777	5-Oct-05	DTPQ	Datapro Group Limited	Physical
F779	5-Oct-05	STXQ	SATRIX 40	Physical
		SXFQ	SATRIX FINI	Physical
		SXIQ	SATRIX INDI	Physical
F784	11-Oct-05	BRNQ	Brimstone Investment Corporation N-Ordinary	Physical
		ERPQ	ERP.Com Holdings Limited	Physical
F810	22-Nov-05	WXRQ	Western Areas Limited	Physical
F809	23-Nov-05	MVXQ	Mvelaphanda Group Limited Preference Shares	Physical
		PCNQ	Paragon Holdings Limited	Physical
F822	1-Dec-05	BSBQ	The House of Busby Limited	Physical
F831	14-Dec-05	UCSQ	UCS Group Limited	Physical
F837	19-Dec-05	SXRQ	Southern Cross Resources Incorporated	Physical
			2006	
F844	9-Jan-06	SIMQ	Simmer and Jack Mines Limited	Physical
		ACHQ	ARCH Equity Limited	Physical
F848	16-Jan-06	VLEQ	Value Group Limited	Physical
		CNLQ	Control Instruments Group Limited	Physical
		GNPQ	Grindrod Limited Preference Shares	Physical
F851	23-Jan-06	AFOQ	Aflease Gold Limited	Physical
		DMRQ	Diamond Core Resources Limited	Physical
		JSCQ	Jasco Electronics Holdings	Physical
		PETQ	Petra Mining Limited	Physical
		SALQ	Sallies Limited	Physical
F860	7-Feb-06	BSRQ	Basil Read Holdings Limited	Physical

Notice	Date	Code	Name	Settlement
		EOHQ	EOH Holdings Limited	Physical
		SKJQ	Sekunjalo Investments Limited	Physical
F863	13-Feb-06	VNXQ	New Venfin Limited	Physical
F865	16-Feb-06	ADHQ	Advtech Limited	Physical
		HPAQ	Hospitality Property Fund Limited linked unit A	Physical
		HPBQ	Hospitality Property Fund Limited linked unit B	Physical
		NRDQ	New Rand	Physical
F868	20-Feb-06	AGIQ	AG Industries Limited	Physical
		MMHQ	Miranda Minerals Holdings Limited	Physical
F871	21-Feb-06	SOVQ	Sovereign Food Investments Limited	Physical
F872	22-Feb-06	MTZQ	Matodzi Resources	Physical
		SPEQ	Spearhead Property Holdings	Physical
F891	24-Mar-06	PRAQ	Paramount Property Fund Limited	Physical
		PXPQ	PSG Financial Services Preference Shares - PGFP	Physical
F895	30-Mar-06	ELDQ	Eland Platinum Holdings Limited	Physical
F900	3-Apr-06	ACCQ	ACC-ROSS Holdings Limited	Physical
F908	12-Apr-06	SWXQ	SATRIX SWIX Top 40	Physical
		STRQ	SATRIX RESI Top 40	Physical
F915	26-Apr-06	ASXQ	ABSA Bank Limited Preference Shares	Physical
F917	11-May-06	WGRQ	Witwatersrand Consolidated Gold Resources	Physical
F920	17-May-06	PMXQ	Primedia Limited Preference Shares	Physical
F923	22-May-06	MBNQ	Mobile Industries Limited N-Ordinary Shares	Physical
		MOBQ	Mobile Industries Limited Ordinary Shares	Physical
		WEZQ	Wesizwe Platinum Limited	Physical
F932	30-May-06	ENVQ	Enviroserv Holdings Limited	Physical
F933	30-May-06	SXLQ	Sallies Limited - Rights Issue	Physical
F935	6-Jun-06	JSEQ	JSE Limited	Physical
F936	9-Jun-06	CBSQ	CBS Property Portfolio	Physical
		MDNQ	Madison Property Fund Managers	Physical
F948	23-Jun-06	CRMQ	Ceramic Industries Limited	Physical
F949	26-Jun-06	IBXQ	Imperial Bank Limited Preference Shares	Physical
F957	5-Jul-06	BEGQ	Beige Holdings Limited	Physical
F964	18-Jul-06	BCFQ	Bowler Metcalf Limited	Physical
		PMAQ	Primedia Limited	Physical
F966	20-Jul-06	ABTQ	Ambit Properties Limited	Physical
		NTXQ	Network Healthcare Holdings Limited Pref Shares	Physical
F972	8-Aug-06	SYAQ	Siyathenga Property Fund	Physical
F979	14-Aug-06	WNHQ	Winhold Limited	Physical
F983	18-Aug-06	CNDQ	Conduit Capital Limited	Physical
		MMLQ	Metmar Limited	Physical
		WEAQ	W G Wearne Limited	Physical
F1025	28-Sep-06	ACTQ	Afrocentric Investment Corporation Limited	Physical

Notice	Date	Code	Name	Settlement
		CLOQ	Calulo Property Fund Limited	Physical
F1030	3-Oct-06	PXGQ	PSG Group Limited - Rights Issue	Physical
F1041	9-Oct-06	AXCQ	Apexhi Properties Limited - C	Physical
		SBGQ	Simeka BSG Limited	Physical
F1043	10-Oct-06	BXRQ	Basil Read Holdings Limited - Rights Issue	Physical
F1051	17-Oct-06	CAEQ	Cape Empowerment Trust Limited	Physical
F1055	26-Oct-06	ADWQ	African Dawn Capital Limited	Physical
		DIVQ	Diversified Property Fund Limited	Physical
F1059	1-Oct-06	MXLQ	Metrofile Holdings Limited	Physical
F1065	8-Nov-06	ACCQ	ACC-ROSS Holdings Limited	Physical
		AFTQ	Afrimat Limited	Physical
		BRTQ	Brimstone Investment Corporation	Physical
		DYMQ	Dynamic Cables RSA Limited	Physical
		SANQ	Sanyati Holdings Limited	Physical
F1069	14-Nov-06	APXQ	Astrapak Limited Prefernce Shares	Physical
		KWVQ	KWV Investments Limited	Physical
F1075	20-Nov-06	KIOQ	Kumba Iron Ore Limited	Physical
F1076	20-Nov-06	BFSQ	Blue Financial Services	Physical
		ELRQ	ELB Group Limited	Physical
F1081	22-Nov-06	WKFQ	Workforce Holdings Limited	Physical
F1084	27-Nov-06	EXXQ	Exxaro Resources Limited	Physical
F1088	29-Nov-06	CXPQ	Capitec Bank Holdings Limited Preference Shares	Physical
		ESRQ	Esor Limited	Physical
		MNYQ	Moneyweb Holdings Limited	Physical
		TASQ	Taste Holdings Limited	Physical
F1092	4-Dec-06	DONQ	Don Group Limited	Physical
		ZEDQ	Zeder Investments Limited	Physical
F1100	11-Dec-06	TFXQ	Top Fix Holdings Limited	Physical
F1106	12-Dec-06	SACQ	SA Corporate Real Estate Fund	Physical
		TALQ	Tiger Automotive Limited	Physical
F1107	13-Dec-06	PZGQ	Pamodzi Gold Limited	Physical
2007				
F1120	17-Jan-07	FRTQ	Faritec Holdings Limited	Physical
		MTLQ	Mercantile Bank Holdings	Physical
F1124	25-Jan-07	GBGQ	Great Basin Gold Limited	Physical
F1128	26-Jan-07	ITEQ	Italtile Limited	Physical
F1132	30-Jan-07	ATRQ	Africa Cellular Towers	Physical
F1136	1-Feb-07	NPQQ	Naspers Limited	Cash
F1140	1-Feb-07	ITEQ	Italtile Limited	Physical
F1142	5-Jan-07	ASOQ	Austro Group Limited	Physical
		ISAQ	ISA Holdings Limited	Physical
F1145	12-Feb-07	DLGQ	Dialogue Group Holdings Limited	Physical

Notice	Date	Code	Name	Settlement
		IPSQ	IPSA Group PLC	Physical
F1152	14-Feb-07	SHQQ	Steinhoff International Holdings Limited	Cash
F1153	14-Feb-07	DCTQ	Datacentrix Holdings Limited	Physical
F1160	21-Feb-07	CELQ	Celcom Group Limited	Physical
		IMUQ	Imunity Holdings Limited	Physical
		SNVQ	Santova Logistics Limited	Physical
		CCLQ	Comp-Clearing Outsourcing Limited	Physical
F1161	21-Feb-07	AQPQ	Aquarius Platinum Limited	Inward listed
F1180	8-Mar-07	ELQQ	Ellerine Holdings Limited	Cash
F1181	9-Mar-07	AEQQ	Aveng Limited	Cash
F1189	14-Mar-07	SOQQ	Sasol Limited	Cash
F1198	20-Mar-07	ASQQ	ABSA Bank Limited	Cash
		REQQ	Remgro Limited	Cash
F1212	29-Mar-07	RBXQ	Raubex Group Limited	Physical
		SOHQ	South Ocean Holdings Limited	Physical
F1217	30-Mar-07	SAQQ	Sappi Limited	Cash
F1232	16-Apr-07	HAQQ	Harmony Gold Mining Limited	Cash
F1255	3-May-07	TBQQ	Tiger Brands	Cash
F1261	16-May-07	AGQQ	Anglo American PLC	Cash
		BIQQ	BHP Billiton PLC	Cash
		FSQQ	Firtsrand Limited	Cash
		IMQQ	Impala Platinum Holdings Limited	Cash
		MTQQ	MTN Group	Cash
		SBQQ	Standard Bank Group	Cash
F1268	21-May-07	EPSQ	Eastern Platinum Limited	Inward listed
F1284	4-Jun-07	FPTQ	Fountainhead Property Trust	Old GRYQ
F1287	6-Jun-07	SXXQ	Sallies Limited - Rights Issue	Physical
F1296	19-Jun-07	NTQQ	Network Healthcare Holdings Limited	Cash
F1297	20-Jun-07	AFQQ	AECI Limited	Cash
F1301	22-Jun-07	AMQQ	Anglo Platinum Limited	Cash
		EXQQ	Exxaro Resources Limited	Cash
		KIQQ	Kumba Iron Ore Limited	Cash
		LBQQ	Liberty International PLC	Cash
		MLQQ	Mittal Steel South Africa Limited	Cash
		NEQQ	Nedbank Group Limited	Cash
		PPQQ	Pretoria Portland Cement Company Limited	Cash
		TKQQ	Telkom SA Limited	Cash
F1304	25-Jun-07	NKQQ	Nampak Limited	Cash
F1305	25-Jun-07	HLMQ	Hulamin Limited	Physical
		TONQ	Tongaat-Hullet Limited	Physical
F1315	2-Jul-07	AGMQ	Anglo American - Mondi Basket	Physical
		MNDQ	Mondi Limited	Physical

Notice	Date	Code	Name	Settlement
		MNPQ	Mondi PLC	Physical
F1326	11-Jul-07	ARQQ	Astral Foods Limited	Cash
		DDQQ	Dimension Data Holdings Limited	Cash
		GDQQ	Godl Reef Resorts Limited	Cash
		MSQQ	Massmart Holdings Limited	Cash
		MUQQ	Murray and Roberts Holdings Limited	Cash
		RBQQ	Rainbow Chicken Limited	Cash
		WBQQ	Wilson Bayly Holmes - Ovcon Limited	Cash
F1344	6-Aug-07	CMOQ	Chrometrco Limited	Physical
		SFBQ	Stefanutti & Bressan Holdings	Physical
		YRKQ	York Timer Organisastion Limited	Physical
F1363	30-Aug-07	ABQQ	African Bank Investments Limited	Cash
		APQQ	Aspen Pharmacare Holdings Limited	Cash
		AVQQ	AVI Limited	Cash
		BAQQ	Brait SA	Cash
		BWQQ	Barloworld Limited	Cash
		BEQQ	Bell Equipment Limited	Cash
		BJQQ	Barnard Jacobs Mellet Holdings Limited	Cash
		BVQQ	The Bidvest Group Limited	Cash
		CDQQ	Cadiz Holdings Limited	Cash
		GFQQ	Gold Fields Limited	Cash
		ILQQ	Illovo Sugar Limited	Cash
		JCQQ	Johnnic Communications Limited	Cash
		JDQQ	JD Group Limited	Cash
		LGQQ	Liberty Group Limited	Cash
		MEQQ	Metropolitan Holdings Limited	Cash
		MKQQ	Mustek Limited	Cash
		NCQQ	New Clcks Holdings Limited	Cash
		NHQQ	Northam Platinum Limited	Cash
		OMQQ	Old Mutual PLC	Cash
		PGQQ	Peregrine Holdings Limited	Cash
		PIQQ	Pick 'n Pay Stores Limited	Cash
		SLQQ	Sanlam Limited	Cash
		WHQQ	Woolworths Holdings Limited	Cash
F1365	3-Sep-07	MKLQ	Makalani Holdings Limited	Physical
		STDQ	SATRIX Dividend Plus Portfolio	Physical
		VERQ	Vestor Investments Limited	Physical
F1378	13-Sep-07	AXQQ	African Oxygen Limited	Cash
		ANQQ	Anglo Gold Ashanti Limited	Cash
		AIQQ	African Rainbow Minerals Limited	Cash
		BCQQ	Business Connexion Group Limited	Cash
		GRQQ	Group Five Limited	Cash

Notice	Date	Code	Name	Settlement
		MVQQ	Mvelaphanda Resources Limited	Cash
		SRQQ	Shoprite Holdings Limited	Cash
		SPQQ	The Spar Group Limited	Cash
F1384	19-Sep-07	FOQQ	Foschini Limited	Cash
		FPQQ	Fountainhead Property Trust	Cash
		HLQQ	Hulamin Limited	Cash
		RMQQ	RMB Holdings Limited	Cash
		SEQQ	SABMiller PLC	Cash
F1386	18-Sep-07	UCXQ	UCS Group Limited	Physical
F1385	19-Sep-07	CBHQ	Country Bird Holdings	Physical
		IRAQ	Infrasors Holdings Limited	Physical
F1406	4-Oct-07	AETQ	Alert Steel Holdings Limited	Physical
F1434	10-Oct-07	PTXQ	Property Index Tracker Collective Investments	Physical
F1437	11-Oct-07	SKYQ	Sea Kay Holdings Limited	Physical
F1442	12-Oct-07	ALQQ	Afgri Limited	Cash
		AKQQ	Astrapak Limited	Cash
		CLQQ	City Lodge Hotels Limited	Cash
		DTQQ	Datatec Limited	Cash
		GOQQ	Growthpoint Properties Limited	Cash
		HVQQ	Highveld Steel and Vanadium	Cash
		IPQQ	Imperial Holdings Limited	Cash
		MDQQ	Medi-Clinic Corporation Limited	Cash
		MAQQ	Makalani Holdings Limited	Cash
		MXQQ	Metorex Limited	Cash
		RXQQ	Raubex Group Limited	Cash
		RHQQ	Richemont Securities AG	Cash
		SCQQ	Scharrig Mining Limited	Cash
		SIQQ	Simmer and Jack Mines Limited	Cash
		SNQQ	Santam Limited	Cash
		SGQQ	Super Group Limited	Cash
		SYQQ	Sycom Property Fund	Cash
		TOQQ	Tongaat-Hullet Limited	Cash
F1444	15-Oct-07	ATQQ	Allied Technologies Limited	Cash
		LEQQ	Lewis Group Limited	Cash
		TWQQ	Truworths International Limited	Cash
F1465	1-Nov-07	INQQ	Investec PLC	Cash
		MNQQ	Mondi Limited	Cash
F1479	15-Nov-07	BLUQ	Blue Label Telecoms	Physical
F1480	16-Nov-07	ONQQ	Omnia Holdings Limited	Cash
		SUQQ	Sun International Limited	Cash
		RLQQ	Reunert Limited	Cash
		AHQQ	Allied Electronics	Cash

Notice	Date	Code	Name	Settlement
F1485	20-Nov-07	DSQQ	Discovery Holdings Limited	Cash
F1497	26-Nov-07	ARHQ	ARB Holdings Limited	Physical
		HUGQ	Huge Group Limited	Physical
F1508	3-Dec-07	FWDQ	Freeworld Coatings Limited	Physical
F1512	5-Dec-07	PKHQ	Protech Khuthele	Physical
		VUNQ	Vunani Limited	Physical
F1517	6-Dec-07	IVQQ	Investec Limited	Cash

Source: JSE Limited (2005)

Annexure C: Industry and trading date information

Nr	INDUSTRY (abbreviation): Supersector – Sector – Subsector		Introduction	Trade date
	BASIC MATERIALS (BM)			
	Basic Resources – Mining – Gold Mining			
2	AFLQ	The Afrikander Lease Limited	06/02/2003	10/02/2003
13	DURQ	Durban Roodepoort Deep	07/11/2001	08/11/2001
20	JCDQ	JCI Limited	13/08/2003	14/08/2003
34	SIMQ	Simmer and Jack Mines Limited	09/01/2006	09/01/2006
	Basic Resources – Mining – Platinum & Precious Metals			
26	LONQ	Lonmin PLC	19/11/2003	19/11/2003
	Chemicals – Chemicals – Speciality Chemicals			
1	AFEQ	AECI Limited	28/06/2004	13/07/2004
28	OMNQ	Omnia Holdings Limited	22/07/2003	22/07/2003
	CONSUMER GOODS (CG)			
	Food & Beverage – Beverages – Distillers & Vintners			
24	KWVQ	KWV Investments Limited	14/11/2006	14/11/2006
	Personal & Household Goods – Leisure Goods – Consumer Electronics			
4	AMAQ	Amalgamated Appliance Holdings Limited	05/07/2005	06/07/2005
	CONSUMER SERVICES (CS)			
	Media – Media – Broadcasting & Entertainment			
23	KGMQ	Kagiso Media Limited	13/05/2005	13/05/2005
	Retail – Food & Drug Retailers – Food Retailers & Wholesalers			
31	PWKQ	Pick and Pay Holdings Limited	16/04/2005	19/04/2005
33	SHPQ	Shoprite Holdings Limited	28/11/2002	28/11/2002
	Retail – General Retailers – Broadline Retailers			
7	BRCQ	Brandcorp Holdings Limited	22/11/2004	23/11/2004
	Retail – General Retailers – Home Improvement Retailers			
10	CSBQ	Cashbuild Limited	22/02/2005	23/02/2005
	Travel & Leisure – Travel & Leisure – Gambling			
16	GDFQ	Gold Reef Casinos Resorts Limited	02/06/2004	04/06/2004
	FINANCIALS (F)			
	Financial Services – General Financial – Investment Services			
8	CDZQ	Cadiz Holdings Limited	03/08/2005	04/08/2005
	Financial Services – General Financial – Speciality Finance			
15	ERMQ	Enterprise Risk Management Limited	04/10/2005	06/10/2005
	Insurance – Life Insurance – Life Insurance			
9	CPTQ	Capital Alliance Holdings Limited	17/09/2003	17/09/2003
25	LBHQ	Liberty Holdings Limited	06/10/2003	06/10/2003
32	SGGQ	Sage Group Limited	21/01/2004	23/01/2004
35	SLMQ	Sanlam	21/07/2000	03/08/2000

Nr	INDUSTRY (abbreviation): Supersector – Sector – Subsector		Introduction	Trade date
	INDUSTRIALS (I)			
	Industrial Goods & Services – Electronic & Electrical Equipment – Electrical Components & Equipment			
21	JSCQ	Jasco Electronics Holdings	23/01/2006	23/01/2006
	Industrial Goods & Services – Electronic & Electrical Equipment – Electronic Equipment			
12	DGCQ	Digicore Holdings Limited	22/08/2005	22/08/2005
	Industrial Goods & Services – General Industrials – Containers & Packaging			
5	APKQ	Astrapak Limited	19/08/2004	19/08/2004
	Industrial Goods & Services – General Industrials – Diversified Industrials			
6	ARTQ	Argent Industrial Limited	22/09/2004	27/09/2004
22	KAPQ	KAP International Holdings	18/01/2005	28/01/2005
	Industrial Goods & Services – Industrial Engineering – Industrial Machinery			
19	HDCQ	Hudaco Industries Limited	04/04/2005	04/04/2005
	Industrial Goods & Services – Industrial Transportation – Marine Transportation			
18	GNDQ	Grindrod Limited	24/03/2004	24/03/2004
	Industrial Goods & Services – Industrial Transportation – Trucking			
36	SPGQ	Super Group Limited	26/02/2004	26/02/2004
	Industrial Goods & Services – Support Services – Industrial Suppliers			
38	WNHQ	Winhold Limited	14/08/2006	14/08/2006
	TECHNOLOGY (T)			
	Technology – Software & Computer Services – Computer Services			
11	DDTQ	Dimension Data Holdings Limited	08/02/1999	08/02/1999
14	EOHQ	EOH Holdings Limited	07/02/2006	10/02/2006
17	GIJQ	Gijima AST Group Limited	12/09/2005	13/09/2005
29	PCNQ	Paracon Holdings Limited	23/11/2005	23/11/2005
	Technology – Software & Computer Services – Software			
30	PIMQ	Prism Holdings Limited	10/11/2004	10/11/2004
37	UCSQ	UCS Group Limited	14/12/2005	14/12/2005
	Technology – Technology Hardware & Equipment – Computer Hardware			
3	ALTQ	Allied Technologies Limited	21/05/2003	22/05/2003
	TELECOMMUNICATIONS (TC)			
	Telecommunications – Mobile Telecommunications – Mobile Telecommunications			
27	MCEQ	M-Cell Limited	08/08/2000	22/08/2000

Source: JSE Limited (2005)

Annexure D: Statistical output (DDT)

Table D.1

GARCH model: Pre-SSF

Dependent Variable: DLOG(SHARE)
Method: ML – ARCH (Marquardt) – Normal distribution
Date: 06/17/08 Time: 08:43
Sample: 7 256
Included observations: 250
Estimation settings: tol= 0.00010, derivs=accurate mixed (linear)
Initial Values: C(1)=0.00024, C(2)=0.10709, C(3)=0.00082, C(4)=0.15000, C(5)=0.60000
Convergence achieved after 15 iterations
Bollerslev-Wooldrige robust standard errors & covariance
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.002339	0.001791	1.306464	0.1914
DLOG(SHARE(-1))	0.124222	0.069157	1.796231	0.0725
Variance Equation				
C	4.64E-05	3.20E-05	1.449756	0.1471
RESID(-1)^2	0.080209	0.041434	1.935843	0.0529
GARCH(-1)	0.886329	0.051626	17.16816	0.0000

R-squared	0.007737	Mean dependent var	0.000291
Adjusted R-squared	-0.008464	S.D. dependent var	0.035894
S.E. of regression	0.036046	Akaike info criterion	-3.942270
Sum squared resid	0.318328	Schwarz criterion	-3.871840
Log likelihood	497.7837	Hannan-Quinn criter.	-3.913924
F-statistic	0.477556	Durbin-Watson stat	2.015423
Prob(F-statistic)	0.752205		

Table D.2

GARCH model: Post-SSF

Dependent Variable: DLOG(SHARE)
Method: ML – ARCH (Marquardt) – Normal distribution
Date: 07/03/08 Time: 14:09
Sample: 258 507
Included observations: 250
Estimation settings: tol= 0.00010, derivs=accurate mixed (linear)
Initial Values: C(1)=0.00224, C(2)=0.08797, C(3)=0.00046, C(4)=0.15000, C(5)=0.60000
Convergence achieved after 30 iterations
Bollerslev-Wooldrige robust standard errors & covariance
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001420	0.001581	0.897671	0.3694
DLOG(SHARE(-1))	0.089562	0.057901	1.546801	0.1219
Variance Equation				
C	9.35E-06	3.48E-05	0.268606	0.7882
RESID(-1)^2	0.040647	0.022545	1.802954	0.0714
GARCH(-1)	0.951539	0.062326	15.26706	0.0000

R-squared	0.006804	Mean dependent var	0.002452
Adjusted R-squared	-0.009412	S.D. dependent var	0.026644
S.E. of regression	0.026769	Akaike info criterion	-4.428920
Sum squared resid	0.175561	Schwarz criterion	-4.358491
Log likelihood	558.6151	Hannan-Quinn criter.	-4.400575
F-statistic	0.419592	Durbin-Watson stat	1.987798
Prob(F-statistic)	0.794446		

Table D.3

GARCH model: Total period (Dummy variable)

Dependent Variable: DLOG(SHARE)
Method: ML – ARCH (Marquardt) – Normal distribution
Date: 06/17/08 Time: 08:40
Sample: 7 507
Included observations: 501
Estimation settings: tol= 0.00010, derivs=accurate numeric (linear)
Initial Values: C(1)=0.00124, C(2)=0.10110, C(3)=0.00098, C(4)=0.15000, C(5)=0.60000, C(6)=0.00000
Convergence achieved after 15 iterations
Bollerslev-Wooldrige robust standard errors & covariance
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1) + C(6)*DUMGAR

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001908	0.001201	1.588606	0.1121
DLOG(SHARE(-1))	0.112825	0.045540	2.477510	0.0132
Variance Equation				
C	4.58E-05	2.92E-05	1.567298	0.1170
RESID(-1)^2	0.070521	0.025437	2.772337	0.0056
GARCH(-1)	0.892811	0.039248	22.74811	0.0000
DUMGAR	-1.53E-05	1.67E-05	-0.920050	0.3575

R-squared	0.009619	Mean dependent var	0.001380
Adjusted R-squared	-0.000385	S.D. dependent var	0.031565
S.E. of regression	0.031571	Akaike info criterion	-4.198404
Sum squared resid	0.493382	Schwarz criterion	-4.147905
Log likelihood	1057.700	Hannan-Quinn criter.	-4.178590
F-statistic	0.961504	Durbin-Watson stat	2.010125
Prob(F-statistic)	0.440926		

Table D.4

Correlogram of residuals (Pre-GARCH model)

Date: 07/09/08 Time: 07:44
Sample: 7 256
Included observations: 250

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | .	. | .	1	0.005	0.005	0.0058	0.939
. | .	. | .	2	-0.036	-0.036	0.3286	0.848
. | .	. | .	3	-0.022	-0.022	0.4565	0.928
. | .	. | .	4	-0.028	-0.029	0.6566	0.957
. | .	. | .	5	-0.031	-0.032	0.9042	0.970
. | *	. | *	6	0.143	0.142	6.2170	0.399
. | .	. | .	7	0.063	0.059	7.2344	0.405
. | .	. | .	8	-0.056	-0.050	8.0570	0.428
. | *	. | *	9	0.088	0.099	10.075	0.344
. | *	. | *	10	0.070	0.078	11.349	0.331
. | .	. | .	11	0.023	0.039	11.483	0.404
. | .	. | .	12	-0.041	-0.053	11.930	0.451
* | .	* | .	13	-0.100	-0.115	14.570	0.335
. | .	. | *	14	0.059	0.083	15.484	0.346
. | .	. | .	15	-0.027	-0.052	15.675	0.404
. | .	. | .	16	-0.000	-0.043	15.675	0.476
. | .	. | .	17	0.002	-0.014	15.676	0.547
. | *	. | *	18	0.071	0.080	17.040	0.520
* | .	. | .	19	-0.067	-0.041	18.277	0.504
. | .	* | .	20	-0.038	-0.069	18.681	0.543
* | .	* | .	21	-0.074	-0.086	20.207	0.508
* | .	* | .	22	-0.160	-0.124	27.288	0.200
. | *	. | *	23	0.150	0.168	33.551	0.072
. | .	. | .	24	0.002	-0.047	33.552	0.093

Table D.5

Correlogram of standardised residuals (GARCH model)

Date: 07/09/08 Time: 07:04
Sample: 7 256
Included observations: 250

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | .	. | .	1	0.024	0.024	0.1508	0.698
. | .	. | .	2	-0.019	-0.019	0.2378	0.888
. | .	. | .	3	0.002	0.003	0.2384	0.971
. | .	. | .	4	-0.018	-0.018	0.3170	0.989
. | .	. | .	5	-0.046	-0.045	0.8574	0.973
. | *	. | *	6	0.111	0.113	4.0464	0.670
. | .	. | .	7	0.020	0.013	4.1504	0.762
. | .	. | .	8	-0.029	-0.027	4.3713	0.822
. | *	. | *	9	0.092	0.093	6.5634	0.682
. | *	. | *	10	0.074	0.071	8.0132	0.628
. | .	. | .	11	0.013	0.023	8.0552	0.708
* | .	* | .	12	-0.106	-0.119	11.020	0.527
. | .	. | .	13	-0.046	-0.045	11.581	0.562
. | *	. | *	14	0.070	0.091	12.878	0.536
. | .	. | .	15	-0.021	-0.040	12.995	0.603
. | .	. | .	16	0.024	0.002	13.150	0.662
. | .	. | .	17	0.003	-0.012	13.152	0.726
. | .	. | .	18	0.029	0.054	13.383	0.768
* | .	* | .	19	-0.075	-0.073	14.928	0.727
. | .	. | .	20	-0.007	-0.043	14.942	0.780
* | .	* | .	21	-0.079	-0.061	16.678	0.730
* | .	* | .	22	-0.114	-0.086	20.260	0.567
. | *	. | *	23	0.126	0.136	24.695	0.366
. | .	. | .	24	0.034	-0.008	25.022	0.405

Table D.6

Correlogram of residuals squared (Pre-GARCH model)

Date: 07/09/08 Time: 08:03
Sample: 7 256
Included observations: 250

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | *	. | *	1	0.108	0.108	2.9783	0.084
. | *	. | *	2	0.102	0.091	5.5977	0.061
. | *	. | *	3	0.087	0.069	7.5423	0.056
. | *	. | .	4	0.087	0.065	9.4843	0.050
. | *	. | *	5	0.173	0.150	17.213	0.004
. | *	. | *	6	0.191	0.153	26.592	0.000
. | .	. | .	7	0.029	-0.033	26.806	0.000
. | *	. | .	8	0.069	0.021	28.051	0.000
. | .	. | .	9	0.029	-0.018	28.270	0.001
. | *	. | .	10	0.082	0.034	30.048	0.001
. | .	. | .	11	0.027	-0.040	30.239	0.001
. | .	. | .	12	0.048	0.010	30.852	0.002
. | *	. | *	13	0.085	0.070	32.752	0.002
. | *	. | *	14	0.148	0.126	38.589	0.000
. | *	. | .	15	0.071	0.031	39.941	0.000
. | *	. | *	16	0.141	0.102	45.289	0.000
. | .	. | .	17	0.015	-0.028	45.351	0.000
. | **	. | *	18	0.223	0.181	58.857	0.000
. | *	. | .	19	0.104	0.010	61.790	0.000
. | **	. | *	20	0.230	0.161	76.310	0.000
. | .	* | .	21	-0.036	-0.149	76.666	0.000
. | *	. | .	22	0.067	0.014	77.919	0.000
. | .	. | .	23	0.058	-0.026	78.856	0.000
. | .	* | .	24	0.027	-0.074	79.063	0.000

Table D.7

Correlogram of standardised residuals squared (GARCH model)

Date: 07/09/08 Time: 08:05
Sample: 7 256
Included observations: 250

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | .	. | .	1	-0.028	-0.028	0.1970	0.657
. | .	. | .	2	0.000	-0.000	0.1970	0.906
. | .	. | .	3	0.001	0.001	0.1971	0.978
. | .	. | .	4	-0.025	-0.025	0.3606	0.986
. | .	. | .	5	0.050	0.049	1.0039	0.962
. | *	. | *	6	0.085	0.088	2.8628	0.826
* | .	* | .	7	-0.067	-0.063	4.0391	0.775
. | .	. | .	8	-0.032	-0.037	4.3079	0.828
* | .	* | .	9	-0.059	-0.059	5.2309	0.814
. | .	. | .	10	0.007	0.006	5.2454	0.874
. | .	. | .	11	-0.019	-0.031	5.3428	0.913
. | .	. | .	12	0.007	0.003	5.3557	0.945
* | .	* | .	13	-0.072	-0.061	6.7359	0.915
. | .	. | .	14	0.016	0.021	6.8051	0.942
. | .	. | .	15	-0.005	0.000	6.8110	0.963
. | .	. | .	16	0.063	0.058	7.8779	0.952
. | .	. | .	17	-0.004	-0.004	7.8829	0.969
. | *	. | *	18	0.071	0.074	9.2697	0.953
. | .	. | .	19	-0.003	0.009	9.2730	0.969
. | *	. | *	20	0.133	0.128	14.148	0.823
. | .	. | .	21	-0.039	-0.043	14.567	0.844
. | .	. | .	22	0.009	-0.004	14.591	0.879
. | .	. | .	23	0.016	0.017	14.663	0.906
. | .	. | .	24	0.003	0.001	14.666	0.930

Table D.8

Heteroskedasticity test (Pre-GARCH model)

Heteroskedasticity Test: ARCH				
F-statistic	2.945848	Prob. F(1,247)		0.0874
Obs*R-squared	2.934701	Prob. Chi-Square(1)		0.0867
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Date: 07/09/08 Time: 09:14				
Sample (adjusted): 8 256				
Included observations: 249 after adjustments				
	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001135	0.000196	5.780692	0.0000
RESID^2(-1)	0.108556	0.063248	1.716347	0.0874
R-squared	0.011786	Mean dependent var		0.001273
Adjusted R-squared	0.007785	S.D. dependent var		0.002837
S.E. of regression	0.002826	Akaike info criterion		-8.891783
Sum squared resid	0.001973	Schwarz criterion		-8.863530
Log likelihood	1109.027	Hannan-Quinn criter.		-8.880411
F-statistic	2.945848	Durbin-Watson stat		2.020013
Prob(F-statistic)	0.087352			

Table D.9

Heteroskedasticity test (GARCH model)

Heteroskedasticity Test: ARCH				
F-statistic	0.192594	Prob. F(1,247)		0.6611
Obs*R-squared	0.194003	Prob. Chi-Square(1)		0.6596
Test Equation:				
Dependent Variable: WGT_RESID^2				
Method: Least Squares				
Date: 07/09/08 Time: 09:12				
Sample (adjusted): 8 256				
Included observations: 249 after adjustments				
White Heteroskedasticity-Consistent Standard Errors & Covariance				
	Coefficient	Std. Error	t-Statistic	Prob.
C	1.025899	0.139387	7.360092	0.0000
WGT_RESID^2(-1)	-0.027919	0.032924	-0.847964	0.3973
R-squared	0.000779	Mean dependent var		0.997997
Adjusted R-squared	-0.003266	S.D. dependent var		1.943180
S.E. of regression	1.946351	Akaike info criterion		4.177789
Sum squared resid	935.7054	Schwarz criterion		4.206042
Log likelihood	-518.1347	Hannan-Quinn criter.		4.189161
F-statistic	0.192594	Durbin-Watson stat		1.999229
Prob(F-statistic)	0.661150			

Figure D.1

Histogram – Normality test (Pre-GARCH model)

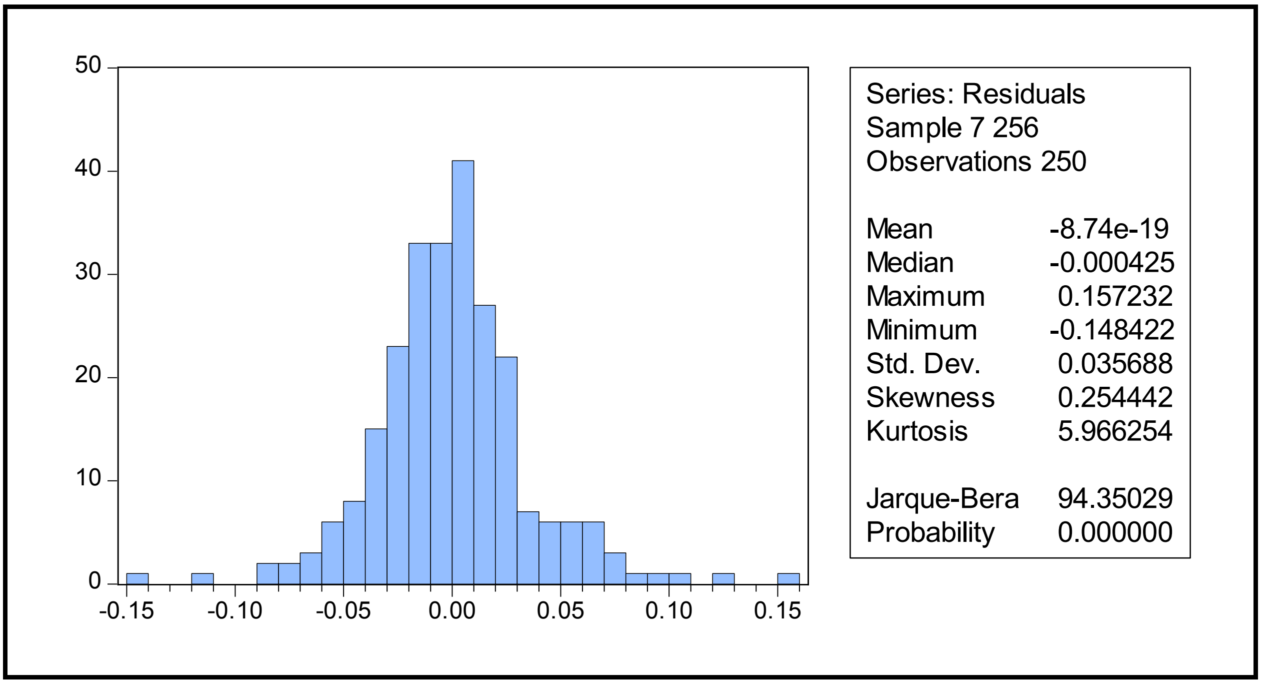
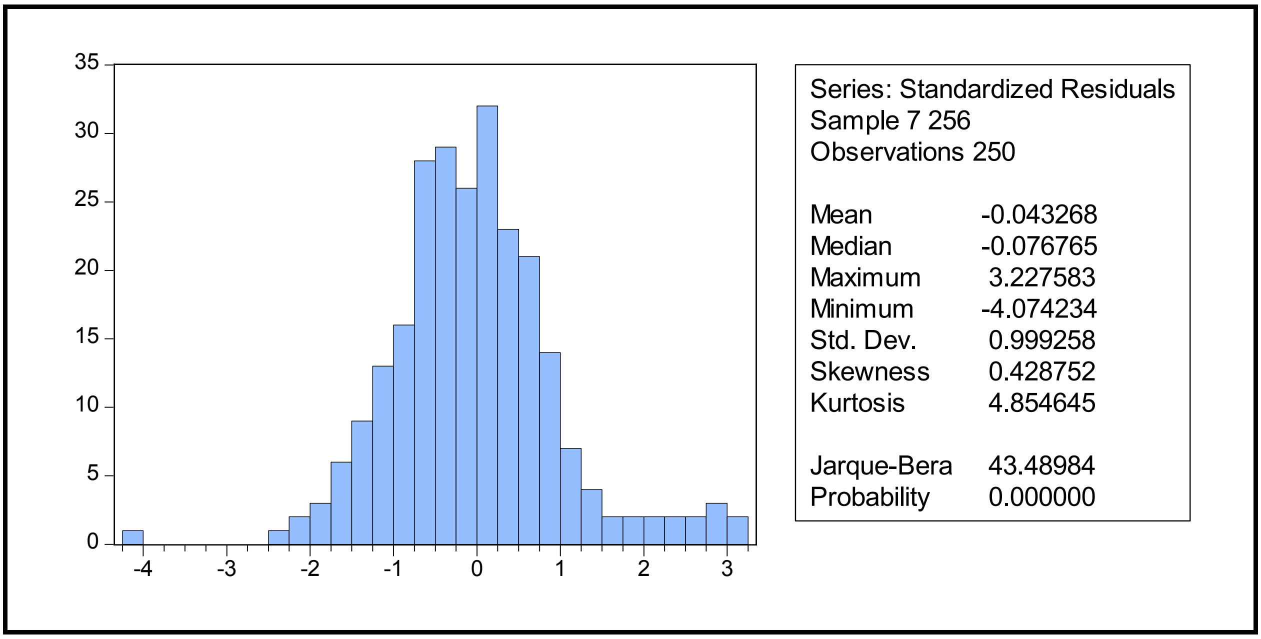


Figure D.2

Histogram – Normality test (GARCH model)



All the statistical presentations in Annexure D were generated by the EViews6 statistical software package.