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Predicting returns with the Put-Call Ratio

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

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ABSTRACT

Over 22 billion derivative contracts were traded on different stock exchanges globally during the year 2010 of which almost 50% were futures while the remaining 50% were options. An overall 25% increase in such contracts was registered as compared to those traded in the year 2009 (International Options Market Association (IOMA) Report, 2011).

Investors often use a wide array of trading tools, market indicators and market trading strategies to get the best possible returns for the money that was invested. The main objective of this paper is to focus on the use of market sentiment indicators, specifically the Put-Call Ratio (PCR) as a predictor of returns for an investor.

The Put-Call Ratio is defined as a ratio of the trading volume of put options to call options. It is called a sentiment indicator because it measures the "feelings" of option traders. Additionally, it has longed been viewed as an indicator of investors' sentiment in the market (Put-Call Ratio, 2012) and is possibly the most favoured description of market psychology (James, 2011).

KEYWORDS

Put-Call Ratio, PCR, Options, Warrants, Single Stock Futures, SSF, Futures, Put options, Call options, Black Scholes model, Binomial model, Contracts For Difference, CFD

DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

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Matthew Lee Son 07 November 2012

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1.2. Introduction to Research

Over 22 billion derivative contracts were traded on different stock exchanges globally during the year 2010 of which almost 50% were futures while the remaining 50% were options. An overall 25% increase in such contracts was registered as compared to those traded in the year 2009 (International Options Market Association (IOMA) Report, 2011).

Investors often used a wide array of trading tools, market indicators and market trading strategies to get the best possible returns for the monies that were invested. The main objective of this paper was to focus on the use of market sentiment indicators, specifically the Put-Call Ratio (PCR) as a predictor of returns for an investor.

Technical indicators have secured the interest of many scholars and practitioners during the past several years. While a few of these technical indicators do allude to the presence and power of price trends, market sentiment indicators help in the identification of these trends. Some of the most widely used sentiment indicators include the Put-Call Ratio (PCR), the Volatility Index (VIX) and the Bullish versus Bearish Investment Advisor ratio.

The Put-Call Ratio is defined as a ratio of the trading volume of put options to call options. It is referred to as a sentiment indicator because it measures the “feelings” of option traders. Additionally, it has longed been viewed as an indicator of investors’ sentiment in the market (Put-Call Ratio, 2012) and is possibly the most favoured description of market psychology (James, 2011).

It is also considered a contrarian indicator, meaning that they permit traders to know when a market has hit an abnormal condition leading to an impending market reversal. The

philosophy for such a strategy is outlined best by the classic Wall Street adage that the crowd is correct during the trend but wrong at the turns (The Put-Call Ratio, 2012).

Call options provide the holder with the right but not with the responsibility to purchase an underlying asset, shares or index on a particular date and time. The put option on the other hand provides the holder the responsibility to sell the underlying asset, share or index at a particular date and time, and at a given price. This price is called the strike price or the excise price and the date is regarded as the expiration, exercise or maturity date. No option can be obtained without paying a monthly fee, known as a premium.

The Put-Call Ratio is a sentiment indicator that shows the number of puts to calls being traded in the market. Puts are options generally used to hedge against market weakness, where traders expect the prices to drop. Conversely, call options are used to capitalise on price increases in the market. When the Put-Call Ratio is 1.0, it means that the same number of puts and calls are traded in the market. A Put-Call Ratio higher than 1.0 indicates that there are more put than call orders in the market, bearish market sentiment, whilst a ratio of less than 1.0 indicates a bullish market sentiment where more call than put orders are in the market. Although 1.0 does indicate an even number of put and call orders in the market, it is not considered to be even or non-directional by investors. Traders by nature are optimistic, therefore a ratio of 0.85 to 0.90 is considered to be more balanced (Dunyon, 2012). This of course means a ratio higher than 0.9 indicates a bearish statement, the higher the value, the stronger the sentiment. Conversely, the lower the ratio is to 0.85, the more bullish the market sentiment. However, in the extreme cases, the market generally tends to correct itself in the opposite direction (Edward, 2011).

The easiest and quickest way to view put-call data is by charting the data. An investor (chartist) using charts for technical analysis, can apply moving averages and other indicators to smooth the data and define trends (Put/Call Ratio, 2012).

Although a great emphasis is placed on the PCR, the market sentiment indicator is not without flaws:

- In a highly volatile market, the Put-Call Ratio tends to be misleading as traders tend to sell puts instead of buying calls.

- Additionally, the ratio is a simple calculation of put volumes over call volumes. It does not take into account that most investors make their decision on the value invested and not on the quantity of contracts.
- Not all shares issued have options associated with it.
- The PCR also does not describe subtle changes.

The information-centred models of Easley and O'Hara (1987) and Easley, O'Hara and Srinivas (1998) have revealed that prices modify instantly with the public information in the trading arena but may change less rapidly with private information held by informed traders. These studies had helped in establishing the manner in which price adjustment differs with the publicly and non-publicly apparent Put-Call Ratios.

As per Easley et al. (1998) "transactions in derivative markets may be an important predictor of future security price movements." They first introduced a multimarket sequential trade model which comprised of option as well as stock markets, and offered an official way of handling option trading volumes during price detection of stock market.

Later studies conducted by various experts also proposed that equity or index option trades are information centred elements that have analytical influence over stock price alterations (Jayaraman, Frye, & Sabherwal, 2011; Cao, Chen, & Griffin, 2005; Pan, The Jump-Risk Premia Implicit in Options: Evidence from an Integrated Time-Series Study, 2002; Chang, Hsieh, & Lai, 2009). Simon and Wiggins III (2001) examined the analytical influence of the publicly observed Put-Call Ratio on S&P 100 index options concerning S&P 500 futures returns. The end outcomes showed that Put-Call Ratio is a dependable contrarian pointer.

However, in case of incomplete markets, option prices are likely to disclose important information regarding future stock returns, provided, informed traders prefer the option market as a trading spot. As per Black (1975), the option market offers greater power to the traders to use their private knowledge. Option markets increase the chances of captivating short standings in reply to some shocking news by restricting probable losses. On the other hand, investors holding private knowledge about the irregularity of the underlying stock prices can easily exploit the market by trading options.

As with all other technical analysis devices, the PCR performs well in combination with various other market pointers. A great benefit is that it offers a simple way to discover where investors are placing their funds (Swaminathan & Lee, 2000).

1.1.1. South African Stock Markets

During the past few years, South Africa has registered excellent growth in its exchange traded option market. The greatest liquidity has been found in the All Share Index (ALSI) futures which are the listed future contracts on the FTSE/JSE Top 40 index. The underlying ALSI contains the leading 164 securities listed on the JSE, measured by market capitalisation and that qualify under the rules of eligibility.

The definition of futures contracts can be defined as follows:

- A standardised contract
- Listed on the JSE
- A standard quantity of a specific underlying asset
- Expires on a predetermined future date
- At an agreed price in the future

(Single Stock Futures, 2012)

In addition to future contracts, there is a great interest in Single Stock Future contracts (SSF). A SSF contract is a futures contract where the underlying security is an equity exchange listed share which in the case of South Africa is an exchange listed share.

The price for a SSF contract is negotiated through the South African Futures Exchange (SAFEX), an order matching platform called the Automated Trading System. In fulfilment of its mission statement, SAFEX provides a secure and efficient market for trading financial derivatives. Furthermore, it aims to find new avenues of growth and opportunities. It is with this in mind, that individual equity futures contracts and options on these contracts were introduced in 1999. Initially, the SAFEX had only derivatives on the four leading listed companies on the JSE. However, this has been gradually expanded to currently include derivatives on 52 JSE listed companies.

Warrants, essentially an option, were first introduced in 1997. The market growth for these instruments has significantly grown since then. Like options, call warrants allow traders to capitalise from share price increases, while put warrants allow investors to gain when the share price falls.

Warrants are typically issued by financial institutions, such as banks and not the company itself. It is traded on the JSE as if it is an ordinary share. The issuers act as market makers and keep the market running efficiently by quoting bid (buying) and offer (selling) prices all the time. The Financial Service Board (FSB) regulates warrants under the Stock Exchange Control Act. It is possible to have more than one warrant on a particular underlying share, particularly the US ones that have a number of different warrants for different issuers. Warrants are classified according to the way they are exercised.

The Put-Call Ratio can be calculated in different ways which are suitable for different settings. In its fundamental form, the Put-Call Ratio would be calculated as the amount of put contracts divided by the amount of call contracts undertaken in a particular trading day. This ratio can be measured with the help of a simple moving average (SMA), exponential moving average (EMA) or dollar volume of the contracts.

1.3. Research Questions

This study intends to reveal the answers to the following questions:

1. Does the Put-Call Ratio help in the prediction of company growth, where growth is defined by an increase in share price?
2. By shifting the even or balance ratio (0.90 to 0.85) of the PCR, does this affect the returns received by an investor?

1.4. Research Objectives

This study investigates the analytical influence of well-known market-centred sentiment indicators, the Put-Call Ratio (PCR), for the companies individually and then compared against the returns received for that share, using a trading rule approach.

The objective of the research is to study and predict the returns on the investment made by the investors with the help of the PCR. It intends to study the extent to which the investors can rely upon the information about Put-Call Ratio when making an investment decision. If an investor invests in a company after reviewing the PCR, he or she intends to earn profit from the investment.

1.5. Advantages of the Research

The main motivation for this research is to identify the ability of the Put-Call Ratio in predicting returns received for an investment. From an investor/business perspective, they will have a better understanding of PCR and the effect it has in the market, thus enabling them to make better investment decisions. From an academic point of view, it will further the knowledge and understanding of PCR. Furthermore, it aims to highlight other areas or factors for consideration.

1.6. Limitations of the Research

All companies listed on the JSE will be considered as target companies provided that there is historical trade data for the company. Since put and call options are only available through the use of single stock futures and warrants, companies that do not trade in these instruments will be excluded as it is not possible to calculate the PCR.

2. CHAPTER 2 – LITERATURE REVIEW

Initially, only technical and fundamental evaluation techniques were used for making trading decisions, but gradually a third approach appeared in the trading arena which was concerned with the emotional aspect of the human mind, sentiment. The Put-Call Ratio (PCR) has longed been viewed as an indicator of investors' sentiment in the market (Put-Call Ratio, 2012) and is possibly the most favoured description of market psychology (James, 2011).

Dr. Martin Zweig, in 1971 first developed and introduced the Put-Call Ratio (Summa, 2004). The ratio was introduced through Barron's article which was greatly liked and quickly became a regular sentiment indicator that was employed by investors and market analysts (Zweig, 1973). It is calculated and computed on a daily basis, by simply dividing the total number of put options by the total number of call options.

2.1. What is an option?

The options market has been known to be the origin of many such indicators and in 1973 the first listed call options commence trading on the Chicago Board Options Exchange (CBOE). Shortly thereafter, in 1977, put options were listed and introduced to the market (Chakravarty, Gulen, & Mayhew, 2004).

The main reason for any investor entering the market is to earn a return on their money invested. Although there are many opportunities that investors can turn to, some have made use of share trading. Share trading in its simplest form is the act of purchasing shares at a given date and time at a specific share price. The investor then can either earn a return in one of two ways:

- Selling off the share at a higher price, taking into account the transactions costs incurred or
- Through the dividends declared per a share

However, the main disadvantage of this method is the upfront capital requirement needed to make it worthwhile.

Another way to invest and benefit from shares is called options. An option is a binding contract with strictly defined terms and properties that gives the buyer the right, but not the obligation, to buy or sell the underlying asset at a specific price on or before a certain date (Options Basics: What Are Options?, 2012). It is a leveraged instrument, meaning that with one option contract, you are effectively controlling 100 shares of the underlying asset. Furthermore, the capital requirements are only about one tenth of the normal method.

Since options deal with the underlying asset and derives its value as such, it is called a derivative. The underlying asset tends to be a share or index. An option can either be used in a hedging or speculative manner. Speculation allows an investor to quickly earn a substantial return on their investment with relatively low capital requirements (Why trade options?, 2012). However, the converse is also true, in that investors can generate massive losses with this trading instrument. Hedging can be thought of as insurance, it allows you to cost effectively take advantage of shares upside, while completely restricting the downside. Most multi-national corporations make use of options in one form or another, be that to give ownership to employees through stock options or to hedge their risk against foreign exchange contracts. It is noted though that employee stock option(s) are between employee and company, while a normal option contract is between two parties unrelated to the company.

There are two types of options, namely a put option and secondly, a call option. A put option gives the investor the right to sell an asset at a specific price within a given time period. It is very similar to taking a short position on a share, whereby the investor expects the share price to drop. As the share price falls, the greater the return will be for an investor. Put options in essence are an insurance against falling share prices. Investors holding this option type, hope that the share price will drop before the expiration date. At this point the option is said to be in-the-money.

A call option gives the investor the right to by an asset at a specific price within a given time period. It is similar to taking a long position on a share, whereby the investor expects the price of share to rise. The higher the share price climbs the greater the return for the investor. A call option would be considered as an insurance against rising share prices. Investors holding call options hope that the share price will rise before the expiration date. At this point, the option is said to be in-the-money.

There are four types of participants in options markets depending on the position they take (Options Basics: What Are Options?, 2012):

- Buyers of calls
- Sellers of calls
- Buyers of puts
- Sellers of puts

People who buy options are called holders and those who sell options are called writers. Call holders and put holders (buyers) are not obligated to buy or sell and have a choice to let the contract lapse or not. In the latter case, investors only lose the cost of the option contract. On the other hand call writers and put writers (sellers), are obligated to buy or sell. This means that the seller is required to make good on the contract if the investor exercises his/her right.

Option contracts have the following characteristics:

- Strike price or Exercise price
- Expiration date
- Standard quantity of the underlying asset

The strike or exercise price is the price at which the underlying asset can be bought or sold. (Strike Price, 2012). Investors, who hold put options, need the share price to be lower than this. The lower the share price is in relation to the strike price, the greater the return to be received. Investors who hold call options need the share price to be higher than the strike price. The higher the share price in relation to the strike price the greater the return is to the investor.

Expiration date is the date at which the put or call option expires (Options Expiration, 2012). Investors can therefore exercise their position within the specified time period. If the strike price is unfavourable, irrespective of whether the contract is a put or call option, the investor can simply let the contract lapse, thus limiting the potential loss to the value paid for the option contract.

Since an option contract is a leveraged position, standard quantity implies for every contract there is a set amount of underlying assets that he or she can sell or buy. On the Chicago Board

Options Exchange (CBOE) each options contract represents a 100 shares of the underlying asset (Options Basics: What Are Options?, 2012). Options that are listed on the CBOE are also known as listed options.

There are two main types of options, American or European options (Option Styles, 2012). The major difference between these two types of options is the date when the option can be exercised. An American option can be exercised at any time between the date of purchase and the expiration date, while the European option can only be exercised at the expiration date.

Thus, this paper has only discussed short-term options. Long-Term Equity Anticipation Securities (LEAPS) were designed and introduced by CBOE in 1990 for conservative investors (Long-term Equity AnticiPation Securities (LEAPS), 2012). LEAPS are similar to short-term options with exception that they possess longer holding periods and therefore, did not form part of this research.

Exotic options are another form of option that does not follow the American or European options. This form of option is more complex in nature in that the underlying asset, calculation of how and when the investor receives pay off, or a combination of the two completely deviates from norm (American or European). These options are mostly developed for the foreign exchange market (Sooran, 2011).

2.2. Options pricing

As stated before, the value of equity options is derived from the underlying asset and the market price of the option will rise or decline in conjunction with the performance of the underlying asset (Pricing Options, 2012). The premium is the total cost that a buyer will pay a seller for an option and is calculated on a "per-share" basis. It is an upfront cost that is non-refundable even in the event of not exercising the option. The formula comprises the following elements:

- Intrinsic value
- Time value
- Volatility value

Below is the formula for calculating the premium for a share:

Premium = Intrinsic value + Time value + Volatility value

The top three factors that affect options pricing, cited by NASDAQ (National Association of Securities Dealers Automated Quotations), an America stock exchange:

- the underlying equity price in relation to the strike price (intrinsic value)
- the length of time until the option expires (time value)
- and how much the price fluctuates (volatility value)

Other factors also cited by NASDAQ, that influence option prices (premiums) include:

- the quality of the underlying equity
- the dividend rate of the underlying equity
- prevailing market conditions
- supply and demand for options involving the underlying equity
- prevailing interest rates

2.3. South Africa and Options

During the past few years, South Africa has seen tremendous growth in its exchange traded option market. The greatest liquidity has been found in the All Share Index (ALSI) futures which are the listed future contracts on the FTSE/JSE Top 40 index. The underlying ALSI contains the leading 164 securities listed on the Johannesburg Stock Exchange (JSE), measured by market capitalisation and that qualify under the rules of eligibility.

Currently on the JSE, there are three financial instruments that are very similar to options, Single Stock Futures (SSF), Contracts For Differences (CFD) and Warrants.

2.3.1. Single Stock Futures

A futures contract is a legally binding agreement that gives an investor the right to buy or sell an underlying asset at a fixed price on a future date (Single Stock Futures, 2012)

The definition of futures contracts can be defined as follows:

- A standardised contract
- Listed on the JSE
- A standard quantity of a specific underlying asset
- Expires on a predetermined future date
- At an agreed price in the future

(Single Stock Futures, 2012)

Single Stock Futures (SSF) is a futures contract between parties on individually listed JSE shares (Single Stock Futures, 2011). It derives its value from the underlying share price movement. Similar to American options, the investor can exercise the contract at any given time before the expiry date. Such actions are generally known as closing out your position.

However, in the event of the contract expiring, the investor has three options (Single Stock Futures, 2011):

- Physical settlement, where the actual underlying shares will be traded between counterparties
- Cash settlement, where cash will exchange hands at expiry, no physical delivery of shares
- Contract rolled over to the next month

Single Stock Futures are also leveraged instruments, meaning that one contract essentially represents a hundred underlying shares. All transactions resulting in SSF contracts are regulated by the JSE under the Stock Exchange Control Act, 2001.

Single Stock Futures offer the investor two positions in the market, long (buy) or short (sell). A long position allows an investor to take advantage of price increases, which is very similar to a call option. While a short position allows the investor to benefit from price decreases, which is similar to put options. In essence a long position indicates investor optimism, while a short position indicates investor pessimism.

SSF have two main uses, hedging and speculative (Jones & Brooks, 2005). Hedging is the act of protecting a portfolio by buying in an opposite position in a related security, thus limiting the

risk of the investor. Speculation on the other hand refers to benefits derived from the underlying share price movement.

There are a number of benefits associated to the use of Single Stock Futures:

- Cost of trading is significantly lower
- Easily tradable
- Characteristically liquid

The low capital requirements provide the investor with a highly capital efficient way to participate in equities (Single Stock Futures, 2012).

2.3.2. Single Stock Futures Pricing

The price of a SSF contract is determined by three factors

1. The spot (cash) price if the underlying share
2. The financing cost of borrowing funds from a financier to buy the underlying share for a specified period. This rate is primarily dependant on the credit worthiness of the borrower
3. The dividends that can be generated by the share

These elements can be incorporated into the following formula:

$$FVF = C + F - D$$

Where:

$FVF = fair\ value\ of\ futures\ contract$

$C = current\ (spot)\ price\ of\ the\ underlying\ share$

$F = financing\ cost = C * (\frac{r}{100} * \frac{t}{365})$

Where:

$r = annual\ borrowing\ rate$

$t = period\ between\ start\ and\ expiry\ date\ of\ future\ contract$

$D = dividends\ likely\ to\ be\ received\ during\ the\ lifetime\ of\ the\ contract$

Dividends need to be calculated to represent the present value of the dividend with the following formula:

$$D = \frac{dividends}{(1 + \frac{r}{100})^{(v-p)/365}}$$

Where:

$r = annual\ borrowing\ rate$

$v = divident\ payment\ date$

$p = futures\ contract\ settlement\ date$

As described above, the price of SSF contract is based on a theoretical model, where one of the key elements is the expected present value of dividends to be paid out. Although the investor is not entitled to dividends, the benefit of it is priced into the SSF contract which effectively makes the contract cheaper.

2.3.3. Contracts For Differences

Contracts For Differences or CFD is similar to SSF, it also a contract between "buyers" and "sellers" with the exception that they are not regulated by the JSE (Contracts for Difference Trading in South Africa, 2012). Furthermore there are no standard terms for the contract but they do tend to have a number of similar properties. These instruments are typically traded over-the-counter with a broker or market maker which commonly known as a CFD provider.

Investors can take advantage of price increases by taking a long position in the market, while a short position allows an investor to take advantage of falling prices (Contracts For Difference, 2012). Additionally, investors who take a long position are entitled to the cash equivalent of the dividends declared, be that ordinary or special dividends.

The major differences between an SSF and CFD contract are:

- No expiry date
- Trading is done over-the-counter and is not regulated by the JSE
- CFD contracts sizes tend to be smaller, thus minimising the capital requirement
- Creation of new instruments are easier as they are not subjected to the Stock Exchange Control Act

2.3.4. Contracts For Differences Pricing

There are two main models in the market, Market Maker (MM) or Direct Market Access (DMA). In the MM model, pricing is calculated by taking the underlying and all investor orders onto its own portfolio. Typically CFD provides using this model will hedge their portfolio through their own risk model. The main impact of this model is that the price is different from the underlying physical market.

Direct Market Access or DMA guarantees that an order will be passed directly to the underlying physical market. It allows CFD traders to view and interact with the live order books of global equity exchanges (What is Level 2?, 2012). This method ensures that the price is exactly the same on the underlying physical market.

2.3.5. Warrants

Warrants have seen tremendous growth since its launch in South Africa in 1997. These financial instruments are very similar to options, where they allow the investor to buy or sell the underlying asset at an agreed price, on or before an agreed date.

Put warrants allow investors to benefit from falling share prices, while call warrants allow investors to benefit from increasing share prices. Warrants are in profit (in-the-money), at a loss (out-of-the-money) or breaking even (at-the-money) depending on where the current share price is relative to the exercise price (How warrants are valued, 2012).

There are two main types of warrants, namely America or European. An American type of warrant allows an investor to exercise their contract at any given time on or before the expiry date, while the European type of warrant can only be exercised on the expiry date. The premium paid for a warrant decreases at an accelerated rate as the warrant approaches the expiry date (What are Warrants?, 2006). This is known as “theta” or “time decay”.

2.3.6. Warrants Pricing

The two main models used in the pricing of warrants are, the Black Scholes model and the Binomial model.

The Black-Scholes model is used to calculate a theoretical price using five key factors, ignoring the dividend paid during the lifetime of the warrant. However, in South Africa a modified version of the Black-Scholes is used, where dividend is taken into consideration.

Below are six factors that influence the pricing of warrants:

- Price of the underlying asset
- Time to expiry of the warrant
- The strike/exercise price of the warrant
- The dividends that are expected over the lifetime of the warrant
- The expected interest rate during the lifetime of the warrant
- Implied volatility

(A User's Guide To Warrants, 2011)

As stated by Standard Bank, all six of these variables are entered into the modified Black-Scholes pricing model, which in turn determines the price of the warrant (What are Warrants?, 2006). Similar to SSF, warrant holders are not entitled to the physical dividend, but the benefit is included in the formula with the net effect of cheaper call warrants or more expensive put warrants.

VARIABLES THAT AFFECT THE PRICE OF WARRANTS

MARKET VARIABLE	CHANGE IN VARIABLE	CHANGE IN CALL WARRANT PRICE	CHANGE IN PUT WARRANT PRICE
Underlying price	⇧	⇧	⇩
Time to expiry	⇩	⇩	⇩
Volatility	⇧	⇧	⇧
Interest rates	⇧	⇧	⇩
Dividend expectations	⇧	⇩	⇧

Source: Online Share Trading from the Standard

The Binomial model was first introduced Cox, Ross and Rubinstein (1979), whereby the time to expiration is broken down into time intervals. At each interval the share will either move up or down by an amount calculated using volatility and time to expiration, thus producing a binomial distribution of share prices (Option Pricing Models and the "Greeks", 2012).

2.4. Put-Call Ratio

Put-Call Ratio (PCR) is a well-accepted pointer that computes mass market psychology amid market participants. The ratio comprises the trading volume of put option contracts, which is divided by the trading volume of call option contracts. As defined earlier, a put option contract is market insurance against falling prices while a call option contract is market insurance against increasing prices. Therefore in the case that the ratio is comparatively high, it indicates that most of the investors are anticipating a downfall in the market (bearish). In the case that the ratio is comparatively low, it indicates that most of the investors are positive about the increase in the market (bullish).

The PCR can be calculated in different ways which are suitable for different settings. In its fundamental form, the PCR is calculated as the volume of put option contracts divided by the volume of call option contracts traded on a daily basis.

When the Put-Call Ratio is 1.0, it means that the same number of puts and calls are traded in the market. A Put-Call Ratio higher than 1.0 indicates that there are more put than call orders in the market, bearish market sentiment. While a ratio of less than 1.0 indicates a bullish market sentiment where more call than put orders are in the market. Although 1.0 does indicate an even number of put and call orders in the market, it is not considered to be even or non-directional by investors. Traders by nature are optimistic, therefore a ratio of 0.85 to 0.90 is considered to be more balanced (Dunyon, 2012). This of course means a ratio higher than 0.9 indicates a bearish statement, the higher the value the stronger the sentiment. Conversely, the lower the ratio is to 0.85, the more bullish the market sentiment.

Past indications have revealed an irresistible tendency for the PCR to shift together with the markets' directional advancement. This is because investors wish for security against market setbacks, even while they are certain about the future market drift.

However, the market largely disproves the majority. When the value of the PCR is exceptionally high or low, extreme cases, the market generally tends to correct itself in the opposite direction (Edward, 2011). Hence the PCR is a contrarian pointer (Cao, Chen, & Griffin, 2005). The PCR can be calculated for an index, equity or currency.

The ratio can be enhanced in the following ways:

- Calculating the ratio with a simple moving average (SMA)
- Calculating the ratio with an exponential moving average (EMA)
- Calculating the dollar volume of the contracts and not just the volume

As with all other technical analysis devices, the PCR performs well in combination with various other market pointers. A great benefit is that it offers a simple way to discover where investors are placing their funds (Swaminathan & Lee, 2000).

The pricing of put or call option contracts plays an important factor in options volume traded. If contract prices are unreasonable, investors will find alternative methods of investment. Black and Scholes (1972) published an article on option pricing. Thereafter, a number of academic and empirical articles have been published on option pricing. However, after the crash of the stock market in 1987, the Black-Scholes (BS) formula has been generating regular prejudice in money related matter and maturity of index options. Specifically, the BS formula has been considerably under-pricing short maturity, deep out-of-the-money (OTM) puts. This is known as “volatility smile” (Jackwerth & Rubinstein, 1996; Bates, 1995). This model has been tested by various experts and found that the Black-Scholes denotes that out-of-the-money (OTM) put index options are costly as compared to the to the at-the-money (ATM) index put options. Usually, put options that bring payoffs under adverse conditions, would in fact yield less returns as compared to call options that brings their payoffs in normal states.

Coval and Shumway (2001) stated in their study that option returns can comprise of pricing of two types of risks. One of them is the leverage effect.

As an option contract permits an investor to presume most of the risk of the underlying asset and a comparatively little investment, option contracts have traits like levered positions in the underlying asset. Hence, call option contracts inscribed on securities with estimated returns

higher than the risk-free rate should yield estimated returns that surpass those of the underlying security. However, put option contracts should yield estimated returns under the underlying security. The study further revealed that the Black-Scholes model has priced this absolute leverage. Also, another risk of option contracts arises from the option payoffs, that is, the outcome of skewness of option returns' distribution (which indicates that long call returns can reach infinity, but would not go below 100%) and the understanding of option returns to the greater incidents of the underlying asset's returns. Black-Scholes model operates on the assumption that the market is quite absolute and options yield no risk premium, as they are surplus assets.

There are various investigations that reveal that huge deviations from put-call parity in options on personal stock may arise during the period of the short sales on the underlying stocks (Lamont & Thaler, 2003; Ofek, Richardson, & Whitelaw, 2004). This is due to the fact that in case the value of the put option turns out considerably high as compared to the value of the subsequent call and the underlying asset, then in such case standard arbitrage approach includes selling the underlying asset short.

The study conducted by Richardson, Ofek and Whitelaw (2004) revealed that deviations from put-call association are asymmetric with regards to the direction of short sales restrictions and are likely to be viewed in options mentioned on stocks that are complicated or costly to brief. Their study also revealed that stocks with comparatively costly puts consequently yields positive normal.

Battalio and Schultz (Battalio & Schultz, 2006) however argued that short sales constraints only have slight effect and that cautious use of intraday options information instead of closing quotes, determine majority of the evident breach of the put-call parity.

The information level of option volume concerned with future stock price movements has been investigated earlier in several researches which has yielded quite mixed results. It has been found that option volume comprises of information prior to the declaration of crucial firm related news. For instance, a study conducted by (Amin & Lee, 1997) established that a higher ratio of long (or short) positions is found in the option market just prior to good or bad revenue reports on the underlying stock.

The study conducted by Cao, Chen, and Griffin (2005) also revealed similar results. Their study found that in a group of firms that have experienced takeover declarations, greater pre-declaration volume on call options indicates greater takeover premiums. On the contrary, there is limited or no information presented that can prove at "normal times" that option volume can forecast primary stock prices. At an everyday frequency, Cao et al. (2005) established that at "normal times", stock volume and not the option volume helps in the understanding of future stock returns. With the increase in frequencies at five minute intervals, it was found that signed option volume consisted of information about simultaneous stock prices. On the contrary little decisive confirmation was present on whether it consisted of information regarding future stock options (Easley, O'Hara, & Srinivas, Option Volume and Stock Prices: Evidence on Where Informed Traders Trade, 1998). Thus, the study conducted by Chan, Chung, and Fong (2002) showed explicitly that option volume does not guide stock prices on Chicago Board Options Exchange (CBOE).

A study conducted by Ofek et al. (2004) employed individual stock options along with the rebate rate to scrutinise deviation from put-call ratio. These are also useful for checking the presence of arbitrage prospects amid stock and options markets. The study also revealed that the deviations from put-call parity and rebate rate divisions are important forecasters of forthcoming stock returns.

2.4.1. Roles of Information Asymmetry and Stock Liquidity

In a study conducted by Cao et al. (2005) exposed that before the takeover proclamation, call volume imbalances intensely correlated with the following-day stock returns. Pan and Poteshman (2006) also illustrated that Put-Call Ratios of newly commenced traders have considerable consistency for equity returns, pointing towards informed trading within the options market.

In case there is greater information irregularity connected with a specific stock or a specific stock is less liquid, then there are greater chances that informed traders will select the option market (Easley, O'Hara, & Srinivas, Option Volume and Stock Prices: Evidence on Where Informed Traders Trade, 1998). Thus, investors may look at the extent of returns

announcement forecast to be quite higher during the period of higher possibility of informed trading on a stock or lower liquidity of a stock.

2.4.2. Open-Buy Subset

Open-buy trading volume is a crucial element to consider as informed traders probably reveal new thinking where they have private information about the underlying asset. Therefore, open-buy subset comprises of all options trading volume set off by buyers to untie new positions. The total open-buy volume is calculated by aggregating the entire put and calls at all existing registered prices and times to termination.

2.4.3. Advantages of the Put-Call Ratio

The PCR has several benefits of not involving price openly in its calculations. In an investigation conducted by Chande and Kroll (1994), it was revealed that there was approximately 70% to 90% correlation amid accepted technical analysis indicators like Momentum, Stochastics and Relative Strength Index (RSI). A brief examination similarly showed the existence of a slight functional variation amid moving averages of similar lengths, like the generally utilized 200-day simple moving average against a 15O-day moving average. Both these indicators offer fundamentally identical information with small yet eventually insignificant variances (Chande & Kroll, 1994).

Some traders believe that a dollar weighted PCR is more effective than just utilising a contract volume. This ratio is used to establish the total value of the trade by multiplying the volume of option contract traded and its price. These traders believe that the total amount of money spent on option contracts, put or call option, is of far greater value than only the option contract volume traded.

The following advantages can be derived from the options:

- Capability to Leverage

  Options offer a person as well as a firm with the capability to leverage. Options can help in acquiring payoffs that are generally achieved at a very higher cost. They can make the markets more competitive by creating an atmosphere where investors

possess the capacity to hedge a variety of risks which would have been otherwise quite huge to consider.

- Establishing Market Competence

  Options have the capacity to create more competence in the underlying market though proper flow of information. Options help the investors to retrieve and trade on information which is generally quite difficult or expensive to obtain.

- Cost Effectiveness

  Derivatives are very cost effective. Investors can generate an option environment to replicate the position of the underlying share or index at a very economical cost.

- Round-The-Clock Security

  Options offer relative protection to probable catastrophic influences of slits in the underlying share or index. For instance, a stop-loss order can be placed to avoid losses under a pre-set price fixed by the investor. However, this kind of security operates at day time. If on the subsequent day, the market goes down the stop-loss order of the investor may get activated at a price much less than the one stated by him and consequently he may suffer heavy losses. With the help of a put option for downward security, the investor would be able to acquire protection from gap risk.

- Flexibility

  An investor has a variety of investment choices under options and therefore he can hedge countless risks under particular conditions.

- Trading Extra Elements

  Execution of options signals towards probability of extra asset classes for the investors who are involved in options. They permit the investor to trade in underlying activities. However they are concerned with the passage of time and the controlling of volatility.

2.4.4. Weaknesses of the Put-Call Ratio

The put-call ratio has been designed to detain limits in worry and greed. The ratio performs excellently well on data which calculates complete speculative activity with the chief objective of decreasing risk. Purchasing options to hedge a range of accessible securities is quite a distinct plan than purchasing out-of-the-money options, essentially gambling on stock market trends.

It is unfeasible to establish the segment of open interest which has been hedged. Additionally, it is also difficult to determine whether people are bearish as put option contracts are being purchase or bullish as they essentially possess the underlying shares, or whether they are neutral.

As the PCR can vary from almost zero to infinity, there exists a huge variation between the optimistic zone (zero to one) and the pessimistic zone (one to infinity). Thus, pessimistic readings can stretch much more relative towards the neutral zone as compared to parallel optimistic readings. Since the intensity of sentiment limits modify from time to time, there is no fixed range, and perfect buy and sell zones that presents a few extra challenges (Graham, 2011).

Another disadvantage of utilising volume while estimating the ratio is that one has no knowledge whether that volume is the outcome of new arrangements being accrued, previous arrangements being liquidated or simply the outcome of an energetic day trading. Estimation of the PCR with open interest permits one to establish whether volume has transformed into new positions or not. It can be a valuable authenticating pointer in connection with the standard Put-Call Ratio.

2.4.5. Black & Scholes Environment

It is believed that Black & Scholes realised that the financial market operates in a balanced manner. It performs in an equilibrium which implies that in the absence of any external or exogenous influences, supply is equal to the demand. The market investors always strive to maintain such balance. They are quite alert towards every twist or disturbance that is likely to

hamper this equilibrium. The system responds to the disturbance and tries to revert to equilibrium as quickly as possible so as to remain under balanced (Peters, 1991).

2.4.6. Stochastic Models

Black & Scholes models consider volatility as the standard deviation since it calculates the returns variability of the underlying asset. They helped in establishing the historical volatility and utilised it as a proxy for the anticipating or implying volatility in the future. Volatility is a way to determine the diversion that appears in the time series (price, time or output) of data.

There are two kinds of volatility:

- Implied volatility

  It is the volatility that may be pulled out of a suitable pricing formula. This kind of volatility can be openly traded when there exists an agreement on suitable pricing formula or may be included by considering the price and establishing suitable volatility with the help of an algorithm like Brent's or Newton's method. This kind of volatility is based upon forward looking and investor sentiment.

- Historic or realised volatility

  This kind of volatility can be considered as the one which is based upon backward looking. As implied volatility involves the use of market sentiments and jumpiness, it is generally greater than the historical volatility.

The stochastic character of volatility has helped the researchers to frame the volatility shell in a stochastic framework. These models help to explain the reason why options having dissimilar strikes and expirations have dissimilar Black & Scholes implied volatilities. They also presume realistic dynamics for the underlying. The popular stochastic volatility models are Heston model (Heston, 1993) and the SABR model (Hagan, Kumar, Lesniewski, & Woodward, 2002).

Volatility is shaped as a long-term mean reverting procedure in Heston model. It fits the comfortably in the long-term skews, though it is inappropriate for shorter terminations (Gatheral & Lynch, 2002). Heston models the volatility shell as a combined force in time and

strike break. A viable option to the Heston model is the SABR model, where volatility is presented as a short term procedure by presuming that the underlying is certain ordinarily distributed variable.

The SABR model is based upon the fact that both the strike and time to terminate dynamics are not associated with each other. This model performs better for shorter terminations. A study conducted by West (West, 2005) demonstrated the manner in which to use SABR model on South African index option data. Another study also illustrated a way to find the representative South African volatility surface through the execution of SABR model and ALSI option data (Bosman, Jones, & Melmed, 2008).

These stochastic volatility models however, are unable to model the dynamics of the short term volatility skews as the at-the-money volatility term arrangement can be quite complicated in the short end. Therefore, such models are simply unsuccessful at precisely modelling the short end volatility dynamics.

2.4.7. Different Trading Models

There are different models for the investors while trading in the market. One of the options is the sequential trading model. According to Easley et al. (1998) informed investors choose to utilise their personal information through trading options at the time when the option markets are fairly liquid. Hence, in case the deviations from put-call parity can forecast earnings declaration returns, this forecast would be considered sound at the time of calculation of the deviations with the help of liquid options.

2.4.8. Different Strategies for Options Trading

Different methods have been proposed by Brittain and Garner (2006) so as to enable the investors to understand and employ in their trading to minimize risk involved in such trading. Eight different strategies have been proposed for the investors:

- Short Call Option

  This option can be used by the investor at the time when the market is going down. The power of the confidence establishes the strike prices at which the investor should

sell off. If the investor feels prices are not increasing then he might sell at-the-money options (higher strike prices). However, if the investor strongly believes that prices are not going to increase then he may opt for sell out-of-the-money options. In such cases, the probable earning is restricted to the premium gathered. The reverse breakeven point at expiration may be equal to the strike price and the premium gathered. The investor can earn maximum profit at the time when the market is performing under the strike price at expiration. However, the investor in this case is exposed to infinite risk. Therefore, it is necessary to observe the situation very closely and constantly. The losses will increase when the market increases more than the time diminishes the option value.

- Short Put Option

  In the case the investor believes that the market is going up, he may opt for this model. The force of one's belief establishes the strike prices at which the investor would sell. The investor may use sell out-of-the-money options (lower strike rates) if he feels that prices are going down or may select sell at-the-money options (at current rate) in case he strongly feels that prices are not reducing. Here the profit would be restricted to the premium collected less commissions charged on it. Also, the reverse breakeven will be equal to the strike price less the premium gathered at expiration. The investor would be able to earn maximum profit if the market is more than the strike price at expiration. The risks in this case are unlimited for the investor and therefore need to observe the market closely. The losses will increase where the market goes down more quickly than the time decay destructs the option value.

- Bull Call Spread with a Naked Leg

  In this case the investor feels that the market will rise, but also finds that purchasing a near-the-money outright call option quite costly. The intention of the investor here is to obtain an economical or free, trade. The profit earned by the investor is restricted to the discrepancy amid the strike prices and premium gathered for the put. During the time of expiration, the breakeven (BE) is equivalent to the long call strike price along with the net amount expended for the spread.

In the case of a debit:

BE = Long Strike Price + Net Premium Incurred.

In the case of a credit:

BE = Short Put Strike Price - Net Premium Gathered

In this option as well, the risk on the short put side is very indefinite.

- Bear Put Spread with a Naked Leg

  When the investors feel that the market will descend but the straight put option is very costly and therefore would prefer to get long a put option along with a closer strike price. He then would be able to buy a close to the money put by investing only a minimal amount of money.

  Profit would be restricted to the variation amid the strike prices and the premium gathered collected for the call. During the expiration the breakeven is equivalent to the long put strike price and the amount paid for the spread.

  In the case of a debit:

  BE = Long Strike Price - Net Premium Incurred.

  In the case of a credit:

  BE = Short Put Strike Price + Net Premium Gathered

  One finds an indefinite degree of risk on the short call in this option.

- Put Ratio Spread

  This option can be exercised by the investor when he feels that the downside is restricted. The purpose is to place this trade on like a credit, free or inexpensive trade. This happens once a trader gathers high premium for the short options than what is put up on behalf of the long option. When exercised at a credit, the profit is the restricted premium gathered where the market is over the long put at expiration. Similarly, the profit on the down side is also restricted to the variation amid the short and long puts. Where the market expires over the long put the risk is restricted to any premium rewarded for the spread. As the number of short puts is more than the

number of long puts, the downside is limitless under short puts. Like other options, the trade in this option also needs to be carefully observed.

- Call Ratio Spread

  An investor can exercise this option, when he anticipates that the market will progress further but also feels that the upside is restricted. The purpose is to place this trade on as a credit, free or inexpensive trade. This happens during the time when a trader gathers more reward for the short options. In the case it is exercised as a credit, the profit is restricted to the premium gathered on the down side. Return on the up side is restriction to the discrepancy amid the short and the long calls. When the market expires under the long call, the risk of the investor will be restricted only to the extent of the premium paid for the spread. The up side in this option is that risk is quite limitless over the short calls, as this kind of trade requires more short calls rather than long calls. This trade also calls for close observation.

- Synthetic Long Call Option

  At the time the investor is bullish but is unwilling to undertake unrestricted risk. The purchase of out-of-the-money put by the investor would depend upon the nature of his bullishness. A genuine fake call would require an at-the-money put option. This arrangement is occasionally utilised in place of a direct long call option because of higher flexibility. Similar to the long call, it provides the investor with significant power with infinite profit possibility and restricted downside threat. In this case also the prospective of earning profit is quite limitless. The breakeven at expiration is equivalent to the aggregate of the futures price and the premium paid. For every point the market move above the break even, the profit also moves by one point. Although the risk here is limited, yet there is a probability to experience a "cash call" losses on the futures contract which may be more than the accessible cash in the account. This is just like a margin call and would demands additional money within three days. The losses are restricted to the variation amid the entry price of the long future and the option strike price along with the amount expended for the option. An investor will sustain maximum loss in the case when the market falls under strike price at expiration.

- Synthetic Long Put Option

  At this time, the investor is quite bearish but looks out for limited risk. The intensity of bearishness of the investor would determine the strike price of the purchase, though a genuine partial put includes an at-the-money call option. Similar to the long put, it provides considerable force with unrestricted earnings probability and restricted risk. Return possibility is tentatively unrestricted. The short futures less the premium paid is the breakeven at expiration. Profit increases with every minor decrease in the market below this breakeven point. In this option, the loss is quite restricted to the variation amid the futures entry prices and the call strike price along with the premium paid on the option. The maximum loss here would be incurred when the market will move above the strike price at expiration (Brittain & Garner, 2006).

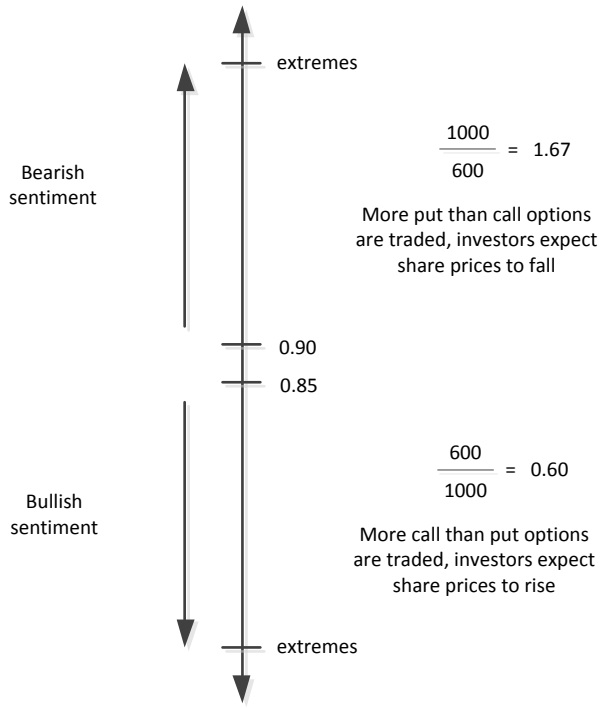
3. Chapter 3 – Research Questions and Hypotheses

The literature review has definitely identified the Put-Call Ratio as market sentiment indicator that is used by the majority of investors around the world. Furthermore, it is used as contrarian indicator to gauge excessive bullish and bearish extremes. In these cases, contrarians turn bearish (bullish) when there are too many bullish (bearish) traders in the market.

As defined by literature put and call option contracts are by definition the same across all markets, with the main differences as to when they can be exercised (American or European style) and the pricing model. Below is a summary of the pricing model per type of contact.

Type of Contract	**Pricing Model**
Options	Premium = Intrinsic value + Time value + Volatility value
Single Stock Futures (SSF)	Fair Value of Futures contract = Current spot price + Financing costs – Present value of dividends to be declared
Contract For Difference (CFD)	Market Maker (MM) model Direct Market Access (DMA) model
Warrants	Modified Black Scholes model, dividends taken into consideration Binomial Model

It is clear that when the Put-Call Ratio is exceptionally high or exceptionally low, the market tends to correct itself in the opposite direction. Therefore there exists an upper and a lower bound in the PCR, below is a diagram illustrating the indicator:



Source 1 : Matthew Lee Son

3.1. Research Questions

The study intends to reveal the answer for the following questions:

1. Does the Put-Call Ratio help in the prediction of company growth, where growth is define by an increase in share price?
2. By shifting the even or balance ratio (0.90 to 0.85) of the PCR, does this affect the returns received by an investor?

3.2. Research Hypothesis

Research question one: Does the Put-Call Ratio help in the prediction of company growth, where growth is define by an increase in share price? Therefore the null hypothesis states that there exists no relationship between the PCR and the underlying share price. The alternative hypothesis states that there exists a negative linear relationship between the PCR and the underlying share price.

As defined by the diagram the lower the PCR is the more bullish the market sentiment, therefore the demand for call options increases as investors want to take advantage of rising share prices. The higher the PCR the more bearish the market sentiment, there the demand for put options increases as investors want to take advantage of falling share prices.

Research question two: By shifting the even or balance ratio (0.90 to 0.85) of the PCR, does this affect the returns received by an investor? Therefore the null hypothesis states that there is no optimal ratio for the balanced PCR. The alternative hypothesis states that there exists an optimal ratio for the balanced PCR, where the returns received by an investor increases.

Literature defines that in extreme cases, the market shifts in the opposite direction. Therefore an optimal balanced Put-Call Ratio should exist.

4. Chapter 4 – Research Methodology

4.1. Research Design

As defined in the literature review, the Put-Call Ratio (PCR) is a contrarian indicator, meaning that in extreme cases the market tends to shift in the opposite direction. The study will be of a quantitative nature of secondary data (Blumberg, Cooper, Schindler, 2008), where the PCR has been calculated for individual shares and used as the sole basis for trading.

Trading rules surrounding the use of the Put-Call Ratio have been inputted into a trading model. This type of approach prevents abnormal trading of shares from occurring, while it ensures that the use of the PCR is consistent in the production of returns received by an investor.

The aim of this research is to gain a better understanding of the Put-Call Ratio and whether it can be used as a predictor for returns to the investor. This research paper follows two research methodologies. The first hypothesis follows an experimental design, where the hypothesis is backward tested against historical data. The second hypothesis follows a trading rule methodology.

4.2. Population and sampling

4.2.1. Unit of analysis

The unit of analysis for this study is the returns received by an investor from using the PCR limits.

4.2.2. Population

The study is limited to companies listed on the JSE where financial derivative instruments are traded on them. Currently there are about 400 listed companies, with the All Share Index representing about 96% of total market capitalisation. Historical trade data for the period 2006 to 2012 have been collected from various data vendors, with the primary source being

the Johannesburg Securities Exchange. The trade data will be specific to shares or indices where Warrants, put or call options, and SSF contracts, long and shorts, are traded on them. The monthly volume of the instrument used and underlying spot price are a pre requisite requirement of data.

Although CFD is also a financial derivative instrument and is traded in South Africa, it falls outside the scope of this dissertation as these instruments are not regulated by the JSE.

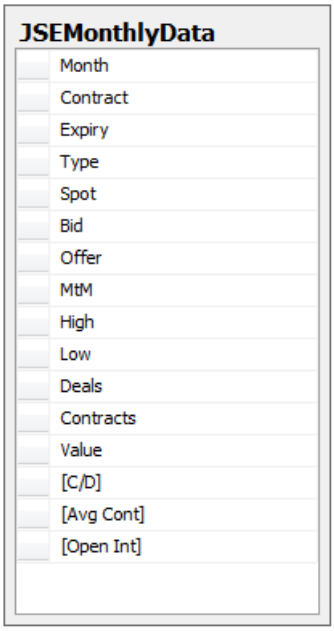
4.2.3. Sampling

The volume of put and call options traded is an important factor in the calculation of the Put-Call Ratios for individual companies. The research will be limited to any company listed on the JSE that have trade data for SSF or Warrant contracts associated to them. Specifically long or short SSF contracts and put or call options on Warrant contracts. Incomplete historical trade data for listed company will be excluded from the sample.

4.3. Data Collection Process

The first step in the data collection process was the collection of historical data from SAFEX for the period 2006 to 2012. This resulted in 81 monthly reports being collected, with average of 2000 plus transactions per a file. A brief inspection of the files revealed different file layouts. In order for data analysis to occur, the data had to be imported into a database server as the sheer quantity of the data completely eliminated manual data consolidation.

A sample of files were selected and analysed for a standardised set of fields from which a data table was created.



To simplify the data import process, a custom software application was written with various data rules to ensure data consistency amongst the data being imported into the table. Any missing data was collected and completed by the Sharenet daily file, which were also imported into another data table. Following the data import, data extraction scripts were used to query the data and extract relevant data for data analysis.

4.4. Data Analysis

Descriptive statics were run on the sampled data to identify outliers, missing values and anomalies.

4.4.1. Statistical Analysis (Hypothesis 1)

Correlational analysis was run on the sample data to determine if there were any underlying relationships in the data. The following tests were used to analyse the data:

- Correlation Coefficient (r) measures the strength and the direction of a linear relationship between two variables. The value of r can range between -1 and 1. A negative value indicates a negative relationship between x and y meaning that as x increases, y decreases. A positive value indicates a positive relationship between x and

y meaning that as x increases, y increases. The closer the value is to 0 the weaker the linear correlation is or non-existent.

- Coefficient of Determination (r^2 or R^2) measures the strength of the linear association between x and y. The value of r^2 can range between 0 and 1. The closer the value is to 1, the better the explanation of the total variation in y can be explained by the linear relationship between x and y.

4.4.2. Trading Rule Methodology (Hypothesis 2)

On a monthly basis a given share will be purchased on the basis of the previous months calculated Put-Call Ratio. If the previous month's calculated PCR is higher than the set balanced PCR, the model will result in put option contracts being bought. When the previous month's calculated PCR is lower than the set balanced PCR, the model will result in call option contracts being purchased. At the end of the month the given share will be traded out. The process is then repeated over the study period to optimise the set balanced PCR. Transaction costs have been ignored in the calculation of returns received by an investor.

4.5. Trading Model

A trading model was built in Microsoft Excel, where it accepted historical data defined by the following columns:

- Month
- Total monthly volume of put option contracts
- Total monthly volume of call option contracts
- Closing spot price for the month

The model calculated the following:

- Opening spot price
- The monthly PCR
- The type of trade for the month, whether long or short position. A long position is taken when the previous month's PCR is lower than the set balanced PCR resulting in call option contracts being purchased for the current month. A short position is taken

when the previous month's PCR is higher than the set balanced PCR resulting in put option contracts being purchased for the current month.

- The share index return is calculated by dividing the closing monthly share price by the original open monthly share price.
- The PCR trading index return is calculated by the model by taking the type of trade into account and multiplying the cash closing amount of the previous month.
- A win is calculated when the PCR trading index > previous month PCR trading index
- A loss is calculated when the PCR trading index < previous month PCR trading index
- Total wins were calculated by adding up the column
- Total losses were calculated by adding up the column

4.6. Data Integrity

During the data collection process the following problems existed:

- Inconsistent file layout
- Inconsistent and missing data
- Conversion of date fields proved to problematic as different files exhibited different formats
- The format and the layout of the SAFEX report changed four times during the data import process

4.7. Limitations

The following limitations have been identified:

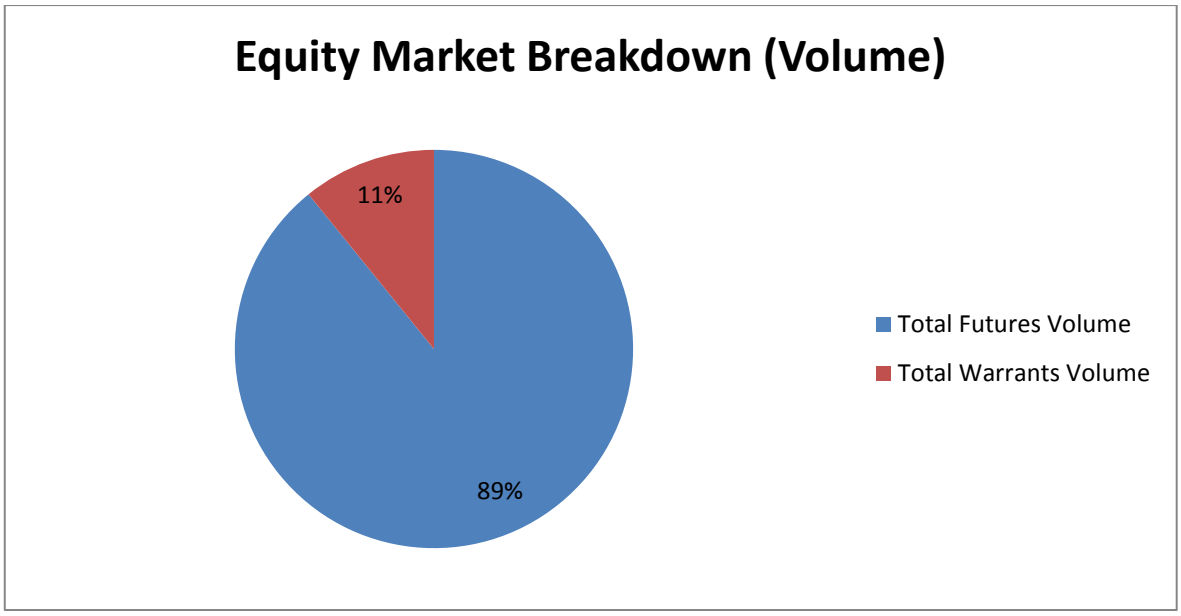
- The study was limited to the period of 2006 and 2012
- The research was limited to JSE, which limits the findings to the South African market
- Companies outside the JSE Top 40, were excluded from the sample data
- Historical trade data for Single Stock Futures with regards to the volume of long (call) and short (put) positions taken, were not available
- Data integrity problems
- Limited use of put and call options on the JSE
- The PCR is only concerned with the volumes of put and call volumes, it does not take it account the value of the contracts traded

- The data was limited to equity options, where currency and index options could have been included

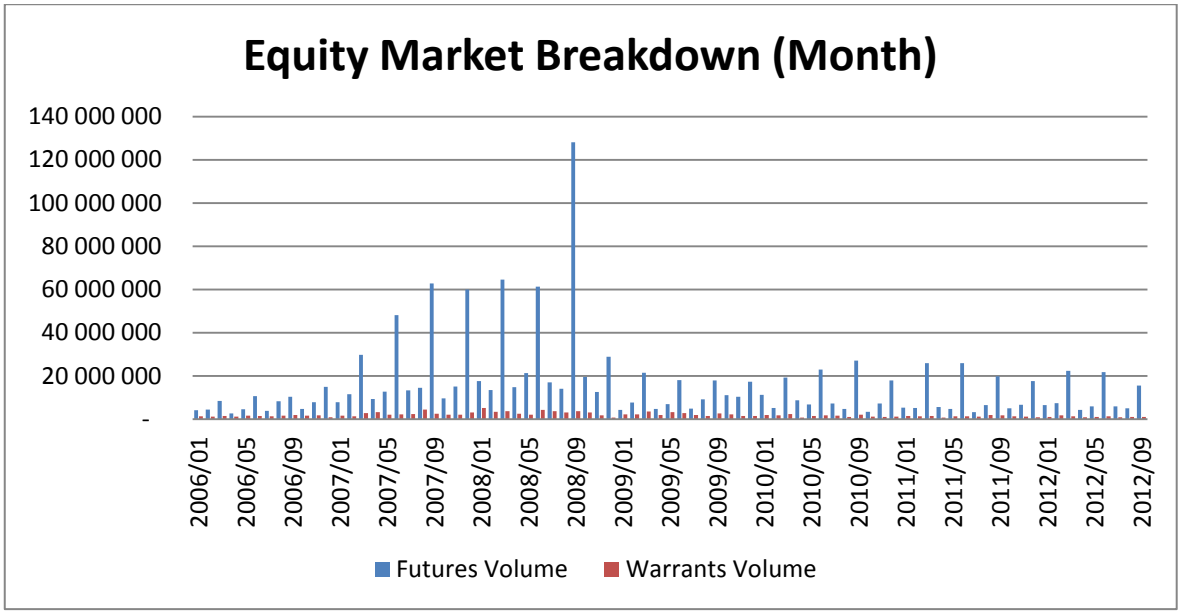
5. CHAPTER 5 – RESULTS

5.1. Description of Sample

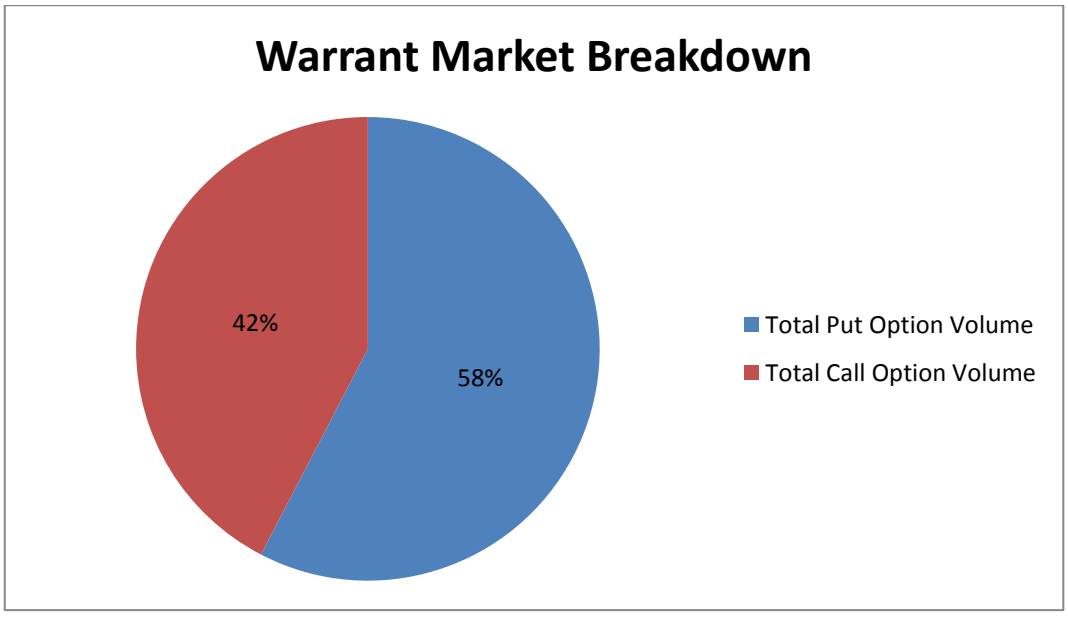
Equity derivative share trading data was collected from the Johannesburg Stock Exchange for the period 2006 to 2012. The data was then separated into the various financial derivative instruments available in South Africa, namely SSF and Warrants. As described in Chapter 4, CFD contracts are not regulated by the JSE and therefore they were excluded from the sample. Below is the breakdown of the equity derivative market by total traded volume.



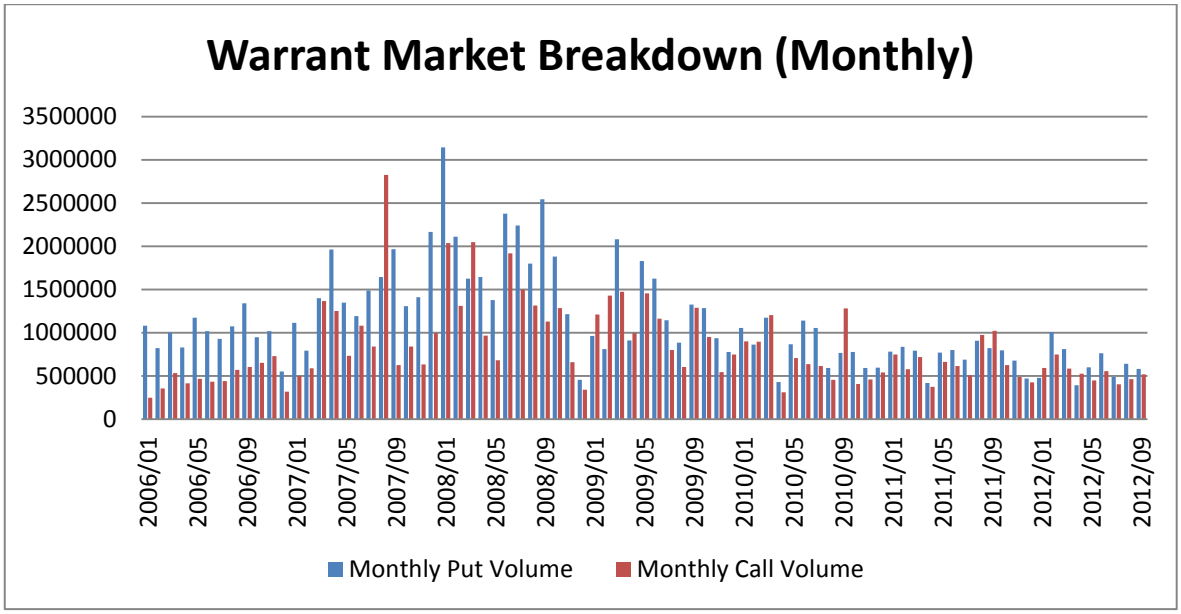
Below is a graph showing the monthly traded volumes of Futures and Warrants.



Although Single Stock Futures allow the investor to take a long or short position, where a long position would be considered as a call option and short position would be considered as a put option, it was noted that the data did differentiate between the two. Hence SSF contracts could not be used in the study as it is not possible to calculate the PCR without such data. Warrants were easily recognisable from the data as trades were clearly marked as a put or call option. Below is the breakdown of put options versus call options for the period.



Below is the monthly breakdown of the traded put and call options on the market.



5.2. Data Analysis

Descriptive statistics were completed on the data to identify missing values, high and low values and any anomalies. Below is the descriptive statistics for the data

Put Volume			*Call Volume*	
Mean	1 123 579		Mean	826 185
Standard Error	61 106		Standard Error	51 061
Median	962 245		Median	658 243
Mode	#N/A		Mode	#N/A
Standard Deviation	549 953		Standard Deviation	459 548
Sample Variance	302 448 367 050		Sample Variance	211 184 257 854
Kurtosis	2		Kurtosis	4
Skewness	1		Skewness	2
Range	2 751 284		Range	2 576 501
Minimum	392 720		Minimum	249 379
Maximum	3 144 004		Maximum	2 825 880
Sum	91 009 865		Sum	66 921 016
Count	81		Count	81

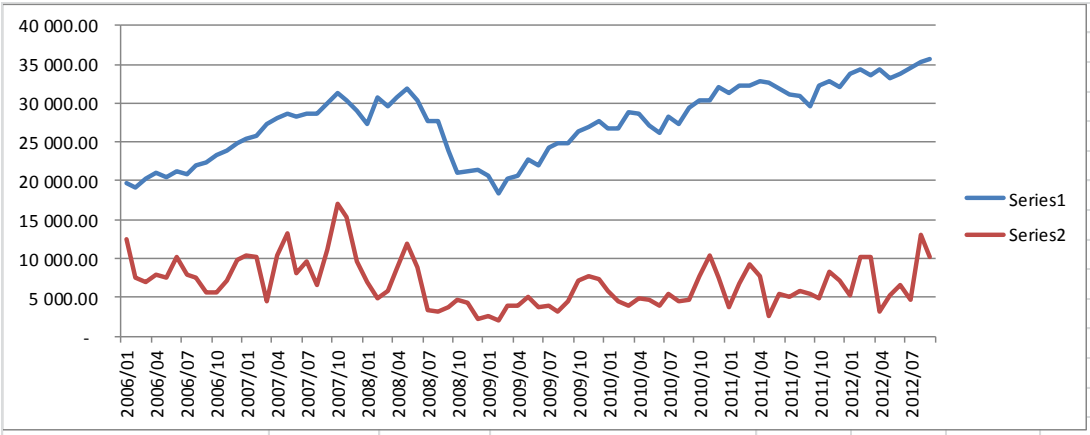
5.3. Hypothesis 1

Although the volume of put and call options are fundamental in the calculation of the PCR, incomplete datasets posed a greater problem. Therefore the shares were selected based on their completeness of trade data. Additionally, shares that were only missing one month of data were also considered. Below is the list of shares that fell into the criteria.

Ticker	Name	Months	Missing Month(s)
ALSI	JSE All Share Index	81	0
AGL	ANGLO AMERICAN PLC	81	0
BIL	BHP BILLITON PLC	81	0
FSR	FIRSTRAND LTD	81	0
IMP	IMPALA PLATINUM HLGS LTD	81	0
MTN	MTN GROUP LTD	81	0
SAB	SABMILLER PLC	81	0
SOL	SASOL LIMITED	81	0
ASA	ABSA GROUP LTD	80	1
IPL	IMPERIAL HOLDINGS LTD	80	1
NPN	NASPERS LTD -N-	80	1
OML	OLD MUTUAL PLC	80	1
SBK	STANDARD BANK GROUP LTD	80	1

5.3.1. JSE ALL SHARE INDEX – ALSI

The JSE All Share index is the main index of the local share market and comprises of 62 stocks in total (Basic Investment Course, 2012). It is made of the top 40 shares by market capitalisation and another 22 shares across all industries and sectors.



Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 3000	0.24	0.06	scaling factor of 3000
Spot Price / Put Volume	-0.32	0.10	
Spot Price / Call Volume	-0.46	0.22	
Outliers			
Quartile 1	1.52		
Quartile 3	2.93		
Interquartile Range	1.41		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	5.05	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	2.00		

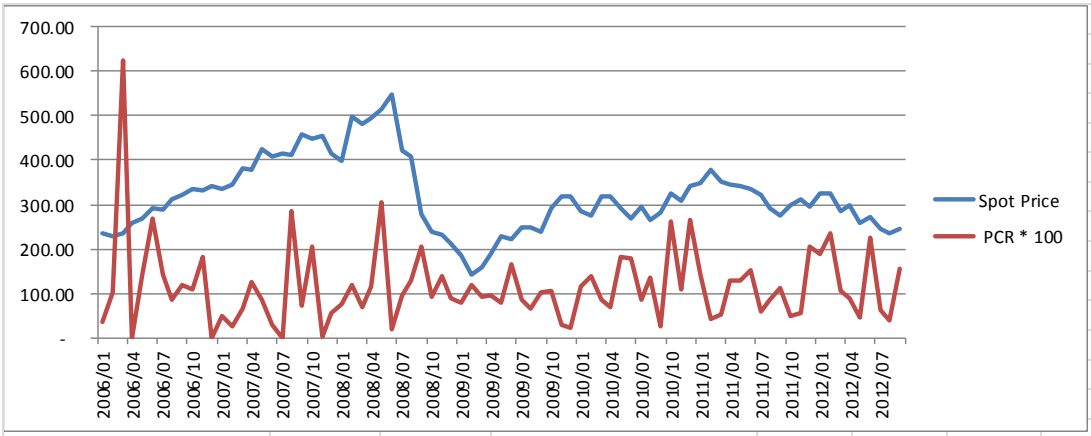
Below is the data for the two months that were highlighted as outliers

Month	Ticker	Spot Price	Put Volume	Call Volume	Total Volume
2007/10	ALSI	31 334.99	576077	101290	677367
2007/11	ALSI	30 307.80	913440	178465	1091905

Closer analysis of the two months of data revealed that more put than call option contracts were being purchased. These months directly correspond to the start of the global financial crisis, subprime mortgage crisis. Hence, the increase in put option volumes as investors was expecting a downturn in the market.

5.3.2. ANGLO AMERICAN PLC – AGL

Anglo American Plc is one of the world's largest mining companies with a market capitalisation of 376.66 billion (Anglo American Plc, 2012). It is headquartered in the UK and listed on the London and Johannesburg stock exchanges. It has a portfolio of mining businesses that span across various precious metals and minerals where currently it is a global leader in platinum and diamonds.

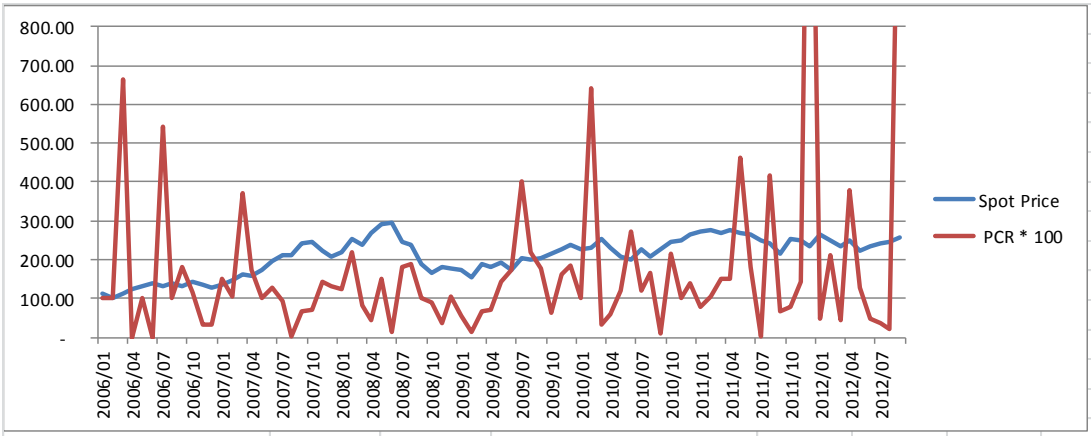


Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 100	-0.06	0.00	scaling factor of 100
Spot Price / Put Volume	-0.38	0.14	
Spot Price / Call Volume	-0.39	0.15	
Outliers			
Quartile 1	0.60		
Quartile 3	1.41		
Interquartile Range	0.81		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	2.64	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	8.00		

A scaling factor of one hundred was used on the PCR, to better represent if on the graph. As you can see from the chart, the red line that represents the PCR touches the horizontal axis at four places. Closer inspection of the data revealed that the PCR could not be calculated for those days as there was not trade registered for either the put or call option contract. Looking at the graph, the point 2007/11 seems to touch the horizontal axis, when in fact it actually does not. The reason why it seems that way is that the calculated PCR is 0.02.

5.3.3. BHP BILLITON PLC – BIL

BHP Billiton is the world's largest diversified natural resources company. It is listed on the Australian, London and New York stock exchanges. The main objective of this company is to create long term shareholder value through the discovery, development and conversion of natural resources. It is focused on creating innovative, market focused solutions for its customer base. BHP Billiton has approximately 41 000 employees, and 58 000 contractors, working in more than 100 operations in over 25 countries.

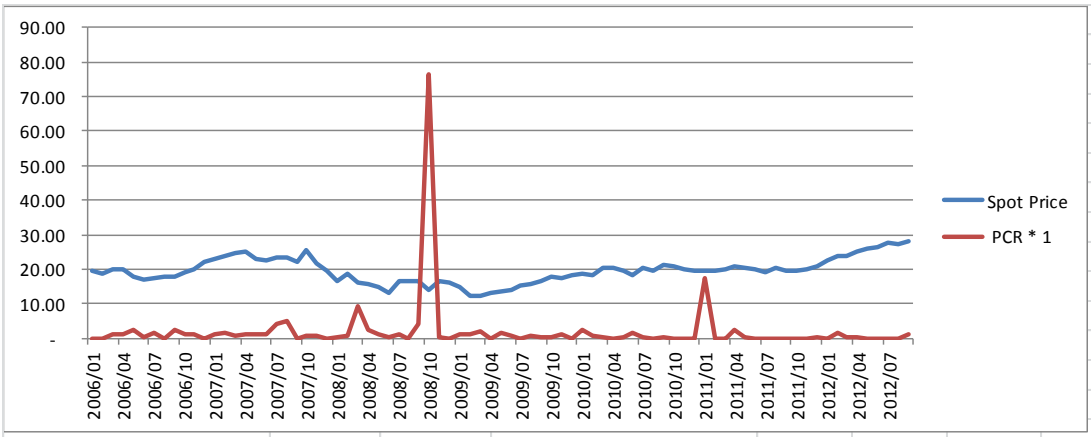


Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 100	0.07	0.01	scaling factor of 100
Spot Price / Put Volume	0.08	0.01	
Spot Price / Call Volume	0.02	0.00	
Outliers			
Quartile 1	0.65		
Quartile 3	1.79		
Interquartile Range	1.14		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	3.51	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	12.00		

From the above graph, the PCR seems to touch the horizontal axis in quite a few places. However, closer inspection of the data reveals that only two points do indeed touch the axis as the PCR could not be calculated. The other points do not touch, but have very low calculated PCR.

5.3.4. FIRSTRAND LTD – FSR

First Rand Limited is a registered financial services provider in South Africa. It is headquartered in Johannesburg and has subsidiaries in five neighbouring South African countries. Additionally it also has subsidiaries in India and Australia.

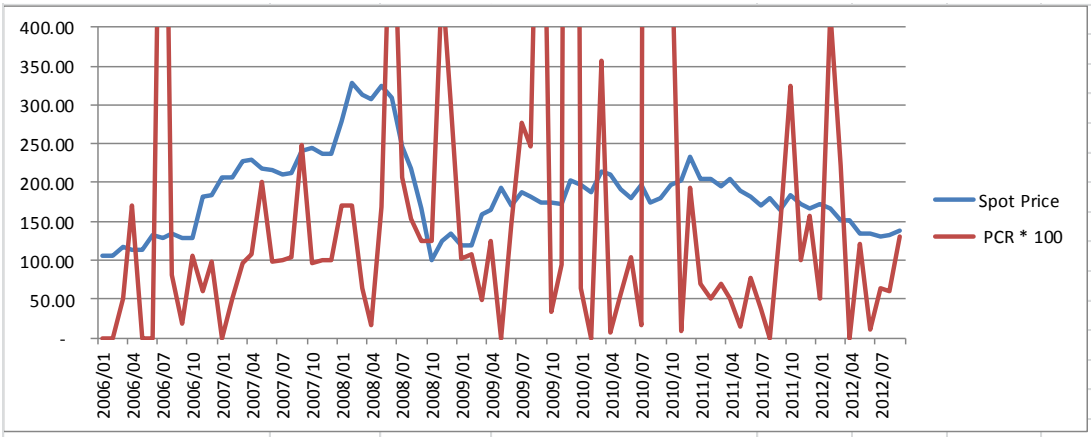


Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 1	-0.18	0.03	scaling factor of 1
Spot Price / Put Volume	-0.24	0.06	
Spot Price / Call Volume	-0.16	0.03	
Outliers			
Quartile 1	-		
Quartile 3	1.12		
Interquartile Range	1.12		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	2.80	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	32.00		

From the graph it can be seen that the share is hardly traded as the line of the PCR follows the horizontal axis closely. Closer inspection of the data reveals that there are months where option contracts are not traded at all.

5.3.5. IMPALA PLATINUM HLGS LTD – IMP

Impala Platinum Holdings Ltd. is principally in the business of producing and supplying platinum group metals (PGMs) to industrial economies. The group employs approximately 63,000 people (including contractors) across its operations and is one of the most efficient and lowest cost primary platinum producers in the world.

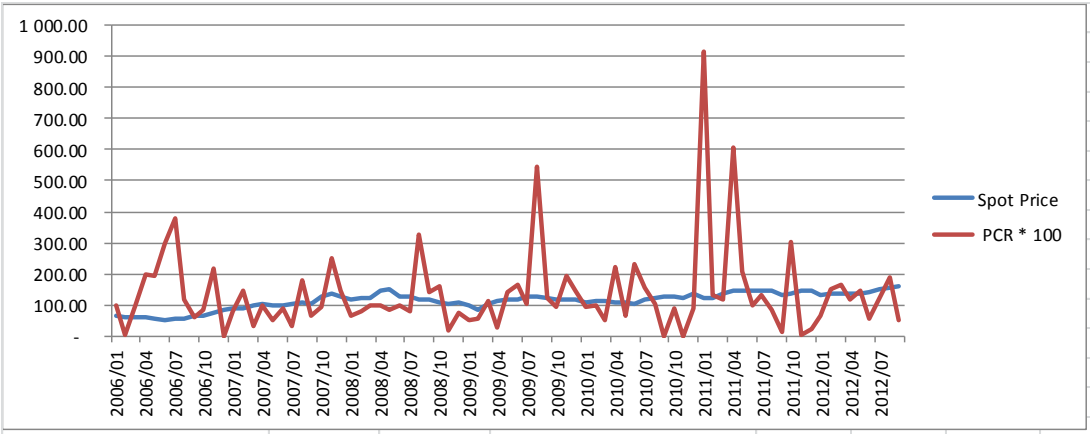


Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 100	0.01	0.00	scaling factor of 100
Spot Price / Put Volume	0.20	0.04	
Spot Price / Call Volume	0.14	0.02	
Outliers			
Quartile 1	0.50		
Quartile 3	1.71		
Interquartile Range	1.21		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	3.52	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	19.00		

It can be seen from the results that there is a fair amount of outliers with this data, 19. Closer inspection of the data reveals that the PCR could not be calculated for nine data points, hence the erratic PCR line.

5.3.6. MTN GROUP LTD – MTN

MTN Group Ltd. is a leading provider of communication services, offering cellular network access and business solutions. Their head office is located in Johannesburg, but it also operates in three other regions in Africa (MTN Company Profile, 2012)

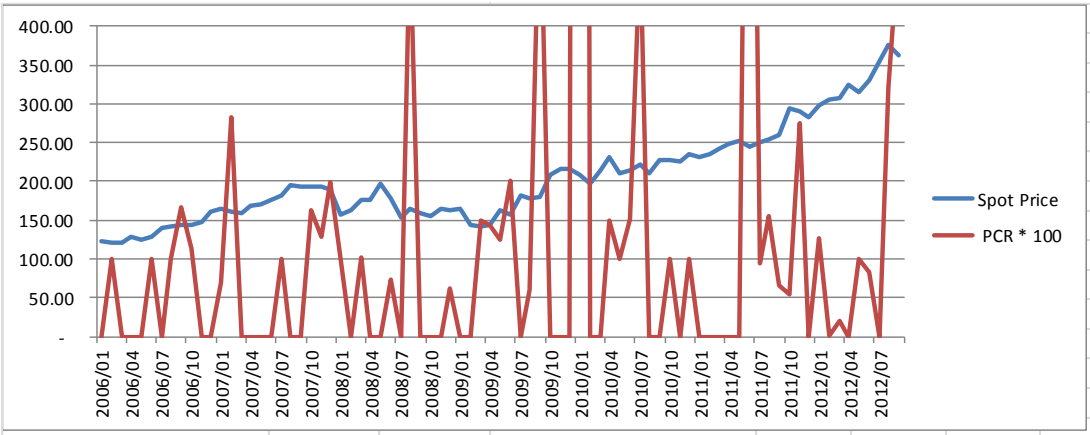


Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 100	0.03	0.00	scaling factor of 100
Spot Price / Put Volume	0.19	0.03	
Spot Price / Call Volume	0.17	0.03	
Outliers			
Quartile 1	0.65		
Quartile 3	1.56		
Interquartile Range	0.91		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	2.93	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	9.00		

Closer inspection of the data reveals that the PCR line only touches the axis at two points, as the PCR could not be calculated for those months. The graph is very erratic, but it does correctly mimic the underlying option volume data.

5.3.7. SABMILLER PLC – SAB

SABMiller is a global operation covering 75 countries on six continents and employing over 70 000 people. Its business portfolio is divided into six regions and is well balanced between developed and emerging markets. The businesses produce over 200 different brands and sell 213 million hectolitres of lager a year. It currently has a market capitalisation of 619.27bn.

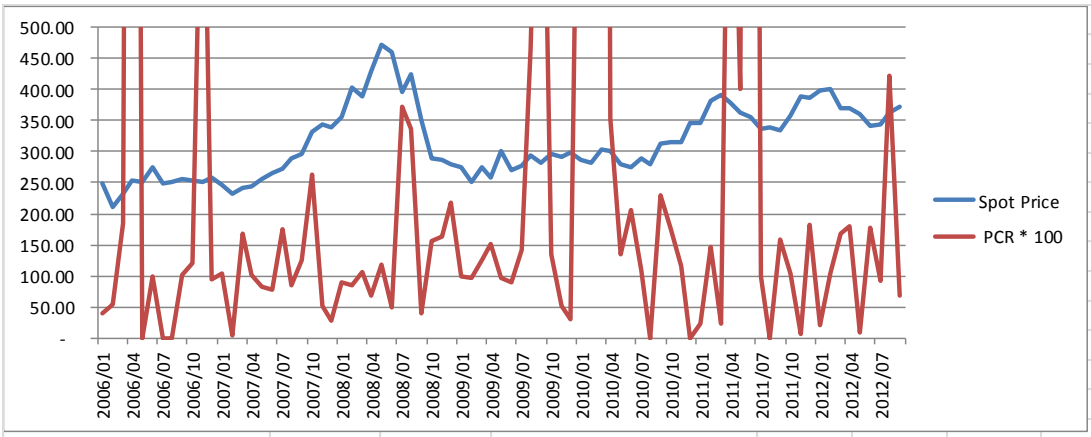


Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 100	0.06	0.00	scaling factor of 100
Spot Price / Put Volume	-0.01	0.00	
Spot Price / Call Volume	0.14	0.02	
Outliers			
Quartile 1	-		
Quartile 3	1.26		
Interquartile Range	1.26		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	3.14	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	46.00		

The graph definitely demonstrates limited trading of Warrant data. From the graph it can be seen that the PCR could not be calculated for consecutive months.

5.3.8. SASOL LIMITED – SOL

The Sasol Group of companies are diversified across fuel, chemical and related manufacturing and marketing operations. Core operations are complemented by coal mining operations and oil and gas exploration and production.

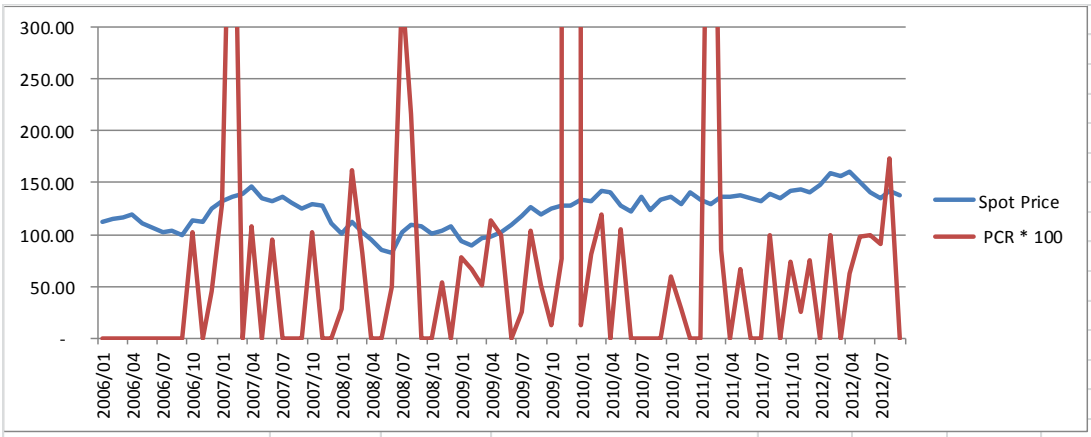


Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 100	-0.07	0.01	scaling factor of 100
Spot Price / Put Volume	-0.01	0.00	
Spot Price / Call Volume	0.14	0.02	
Outliers			
Quartile 1	0.61		
Quartile 3	1.81		
Interquartile Range	1.20		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	3.61	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	18.00		

From the graph we can see that there are a couple of months where the PCR could not be calculated. There graph is extremely erratic, therefore I expect no correlations between the variables. A quick look at the correlation coefficients confirms this.

5.3.9. ABSA GROUP LTD – ASA

ABSA is a subsidiary of Barclays Bank PLC (Barclays), which owns 55,5%. It offers a complete range of retail, business, corporate and investment banking, insurance and wealth management products and services.

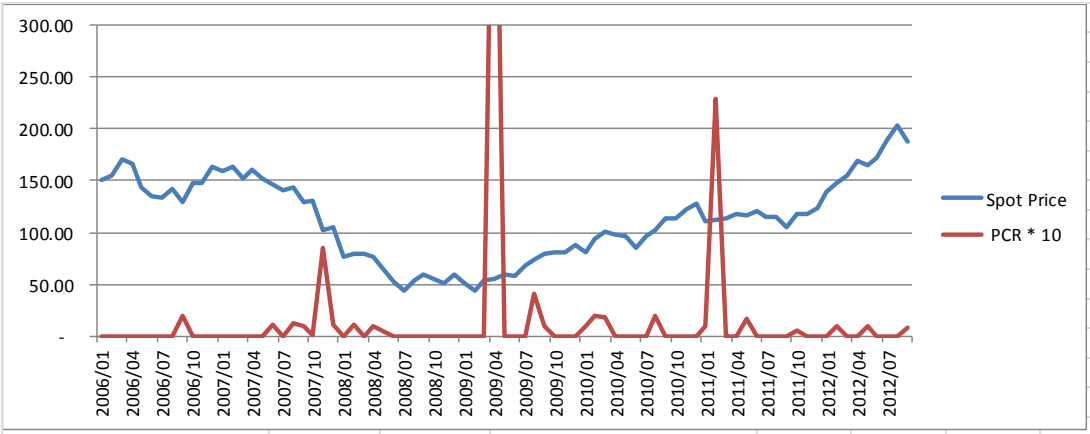


Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 100	0.03	0.00	scaling factor of 100
Spot Price / Put Volume	-0.26	0.07	
Spot Price / Call Volume	-0.12	0.02	
Outliers			
Quartile 1	-		
Quartile 3	0.97		
Interquartile Range	0.97		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	2.43	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	40.00		
Missing data, 2006/06			

From the graph we can see that the PCR could not be calculated for the first couple of months. There is a significant amount of outliers in data, hence the very erratic PCR line. Furthermore the table of results also highlight a month of missing data.

5.3.10. IMPERIAL HOLDINGS LTD – IPL

Imperial is a diversified industrial services and retail group with activities spanning logistics, car rental and tourism, vehicle distribution and retail including allied financial services, as well as parts and industrial products distribution.

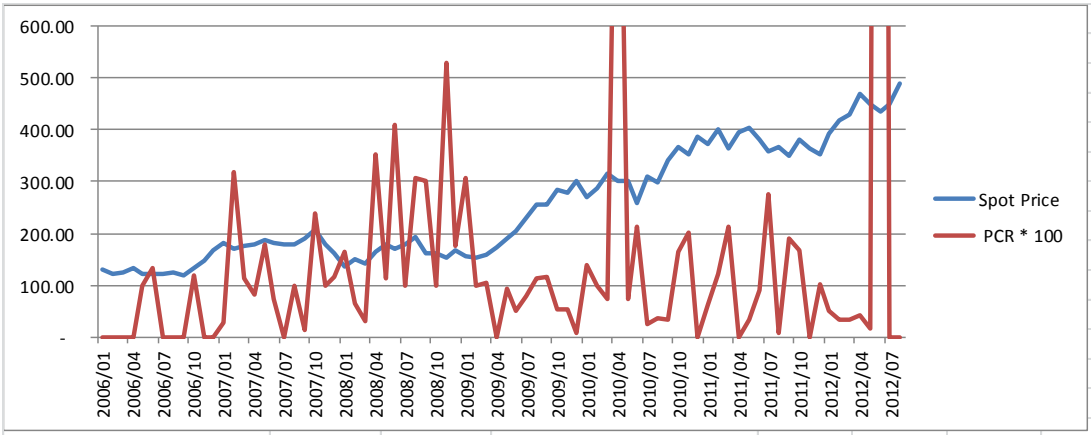


Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 10	-0.17	0.03	scaling factor of 10
Spot Price / Put Volume	-0.28	0.08	
Spot Price / Call Volume	0.06	0.00	
Outliers			
Quartile 1	-		
Quartile 3	0.90		
Interquartile Range	0.90		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	2.24	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	61.00		
Missing data, 2008/05			

From the graph, it can be seen that the monthly PCR could not be calculated for majority of the period. Therefore this leads to the conclusion that investor do not really trade warrants on this share. A quick look at the underlying data table confirms this.

5.3.11. NASPERS LTD – NPN

Naspers is a leading multinational media group, incorporated in 1915 as a public limited liability company and listed on the Johannesburg Stock Exchange (JSE) in September 1994. The company also has an ADR listing on the London Stock Exchange (LSE). The group's principal operations are in internet platforms (focussing on commerce, communities, content, communication and games), pay-television and the provision of related technologies and print media (including publishing, distribution and printing of magazines, newspapers and books). Most of Naspers's businesses hold leading market positions.

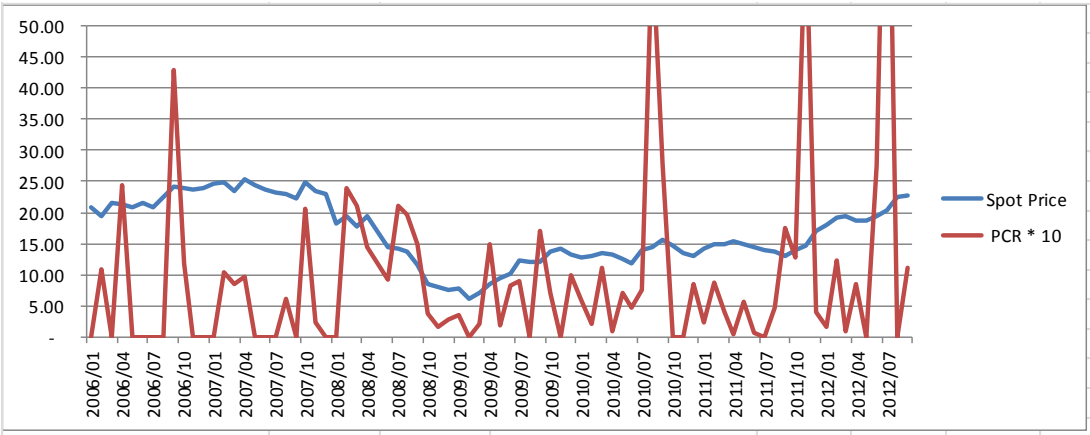


Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 100	0.16	0.03	scaling factor of 100
Spot Price / Put Volume	-0.05	0.00	
Spot Price / Call Volume	0.14	0.02	
Outliers			
Quartile 1	0.18		
Quartile 3	1.58		
Interquartile Range	1.40		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	3.68	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	20.00		
Missing data, 2012/09			

From the graph it is conclude that company has grown over the last few years. The PCR is very erratic pointing to missing monthly Put-Call Ratios. A quick look at the underlying data confirms this.

5.3.12. OLD MUTUAL PLC – OML

Old Mutual Group is an international long-term savings, protection and investment Group. They provide life assurance, asset management, banking and general insurance in Africa, Europe, the Americas and Asia. Currently the company has 12 million customers and approximately 55 000 employees.

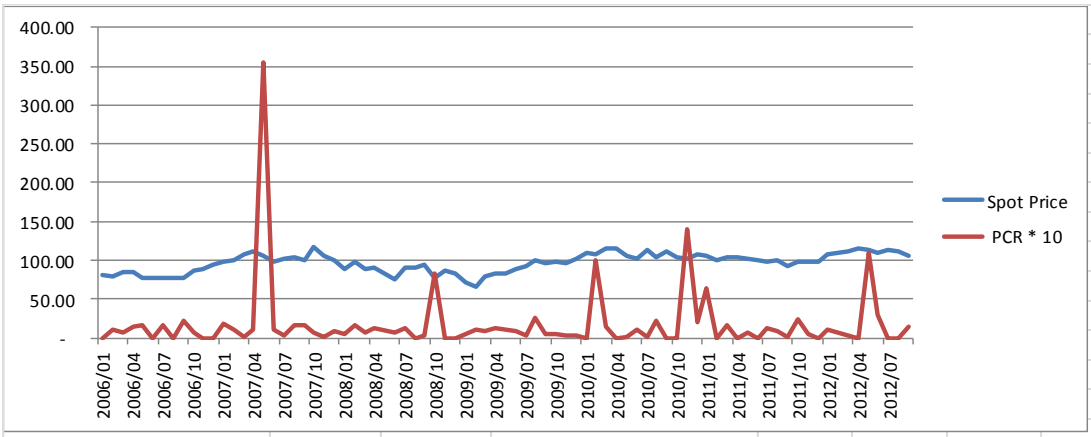


Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 10	0.04	0.00	scaling factor of 10
Spot Price / Put Volume	-0.32	0.10	
Spot Price / Call Volume	-0.48	0.23	
Outliers			
Quartile 1	-		
Quartile 3	1.17		
Interquartile Range	1.17		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	2.91	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	27.00		
Missing data, 2008/05			

From the data, a weak negative correlation exists between the spot price and the call volume. In terms of the spot price and the calculated monthly PCR, no correlation exists, which is further supported by the coefficient of determination being zero.

5.3.13. STANDARD BANK GROUP LTD – SBK

Standard Bank has a 150-year history in South Africa and started building a franchise in the rest of Africa in the early 1990s. They currently operate in 18 countries on the African continent, including South Africa, as well as in other selected emerging markets.



Correlation coefficients	**r**	**r2**	
Spot Price / PCR * 10	0.12	0.01	scaling factor of 10
Spot Price / Put Volume	0.01	0.00	
Spot Price / Call Volume	-0.06	0.00	
Outliers			
Quartile 1	0.17		
Quartile 3	1.55		
Interquartile Range	1.38		
Lower Limit for Outlier	-	Q1 - 1.5*(Q3-Q1) or 0	
Upper Limit for Outlier	3.61	Q3 + 1.5*(Q3-Q1)	
Number of Outliers	22.00		
Missing data, 2008/05			

From the graph we can see a massive spike in the PCR for the period 2007/05. A look at the underlying data reveals an extremely large portion of put option contracts being purchased. Looking at the correlation coefficients, a relationship does not exist between any of the tested variables.

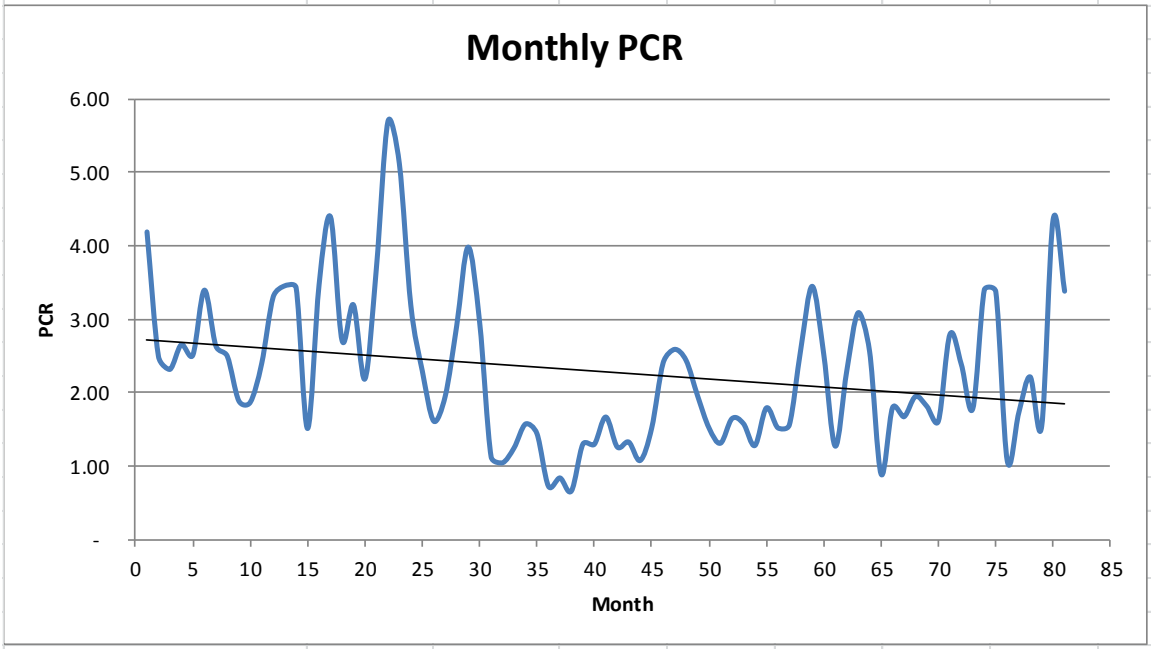
5.4. Hypothesis 2

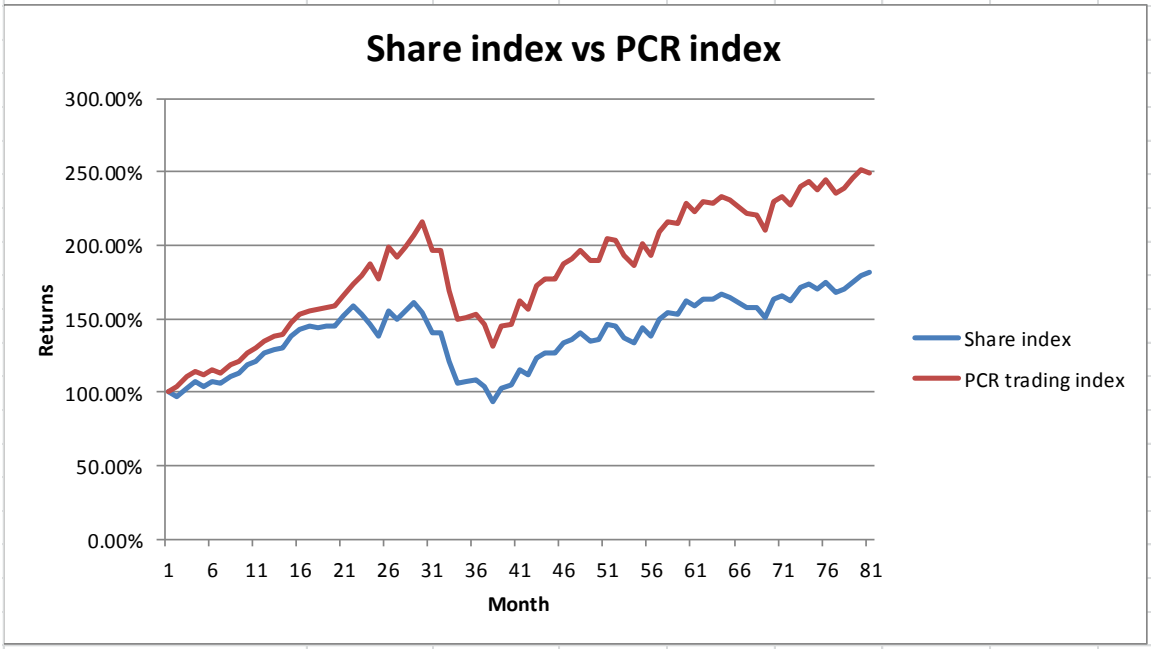
The trading model is reliant on complete datasets; therefore the following shares were selected from the sample:

Ticker	Name	Months	Missing Month(s)
ALSI	JSE All Share Index	81	0
AGL	ANGLO AMERICAN PLC	81	0
BIL	BHP BILLITON PLC	81	0
FSR	FIRSTRAND LTD	81	0
IMP	IMPALA PLATINUM HLGS LTD	81	0
MTN	MTN GROUP LTD	81	0
SAB	SABMILLER PLC	81	0
SOL	SASOL LIMITED	81	0

5.4.1. JSE ALL SHARE INDEX – ALSI

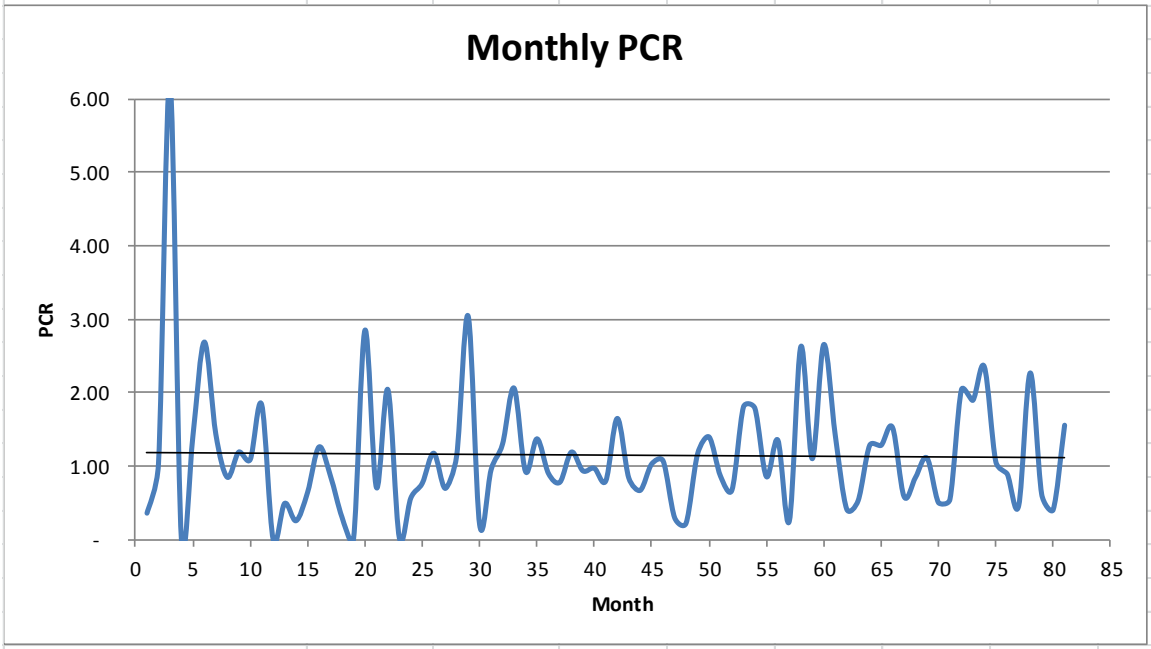
Trading Rules		
Long @ PCR Level	3.95	
Short @ PCR Level	3.95	
Results		
PCR wins	51	63.75%
PCR losses	29	36.25%
PCR final trading index	248.70%	
Share final index	181.10%	

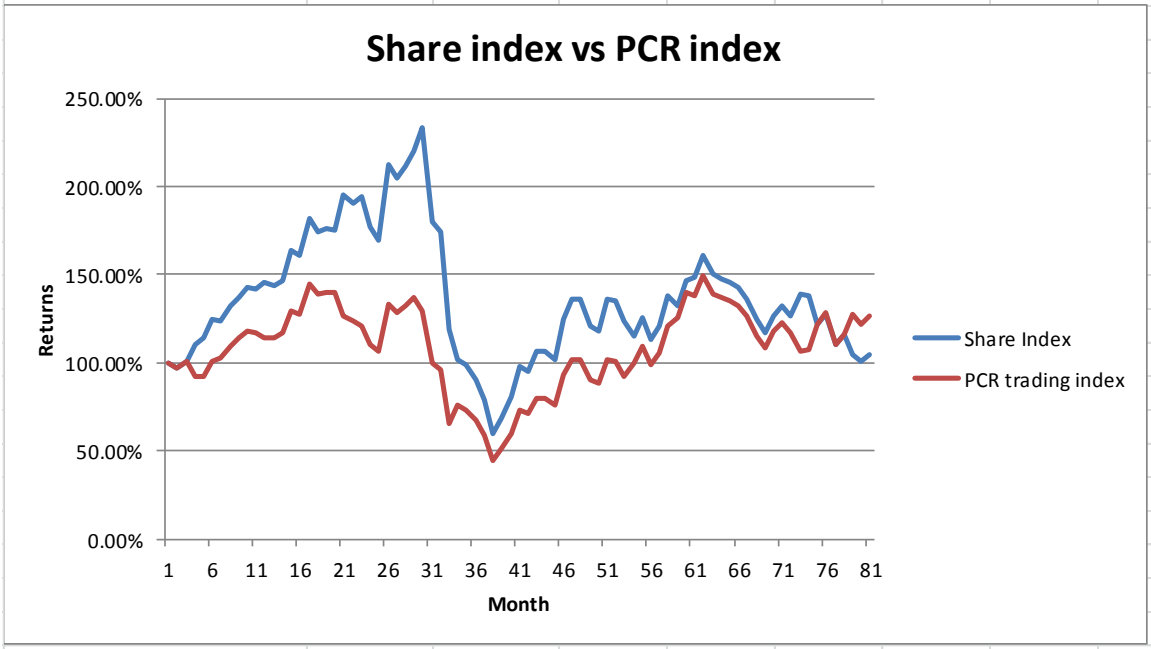




5.4.2. ANGLO AMERICAN PLC – AGL

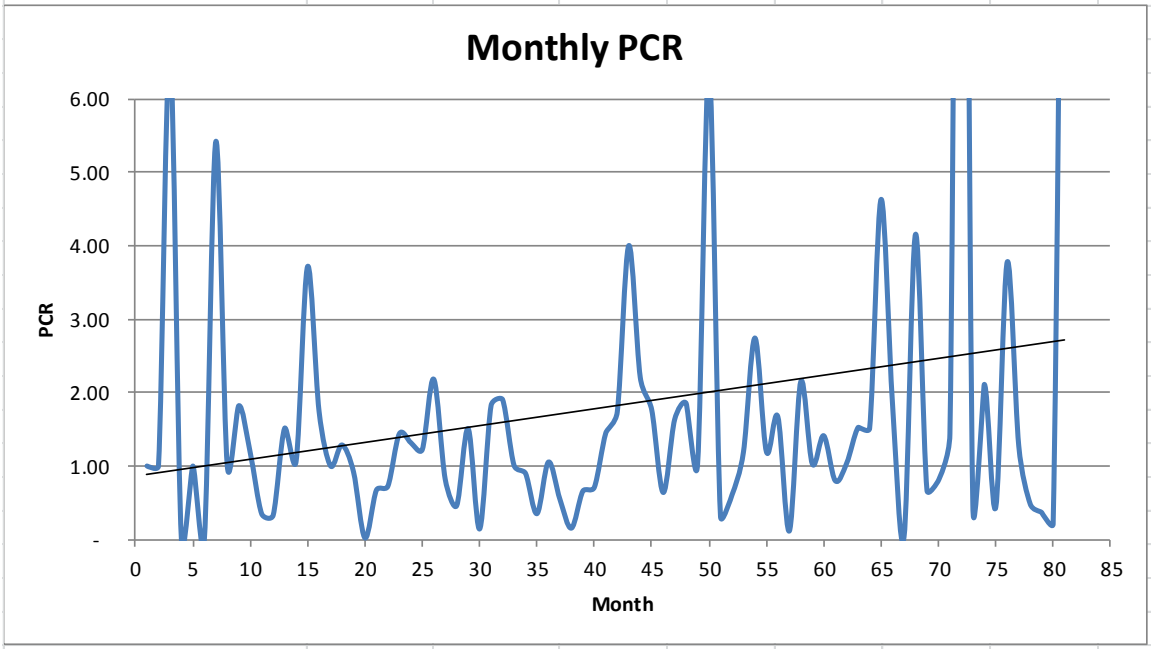
Trading Rules		
Long @ PCR Level	1.8	
Short @ PCR Level	1.8	
Results		
PCR wins	38	49.35%
PCR losses	39	50.65%
PCR final trading index	126.74%	
Share final index	104.33%	

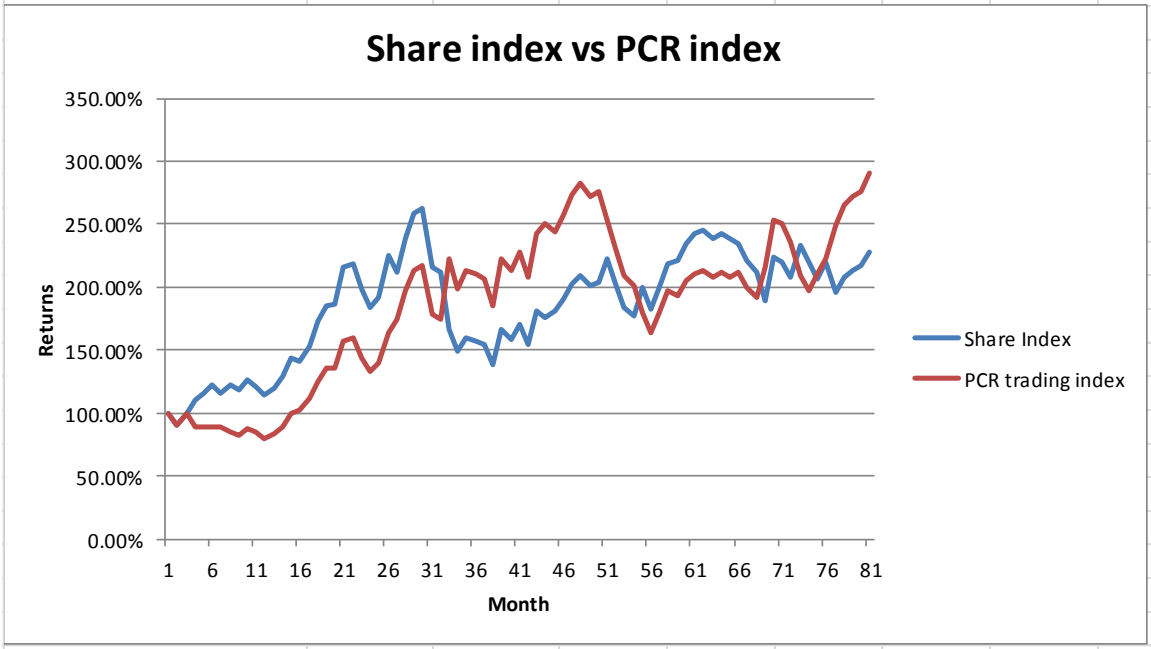




5.4.3. BHP BILLITON PLC – BIL

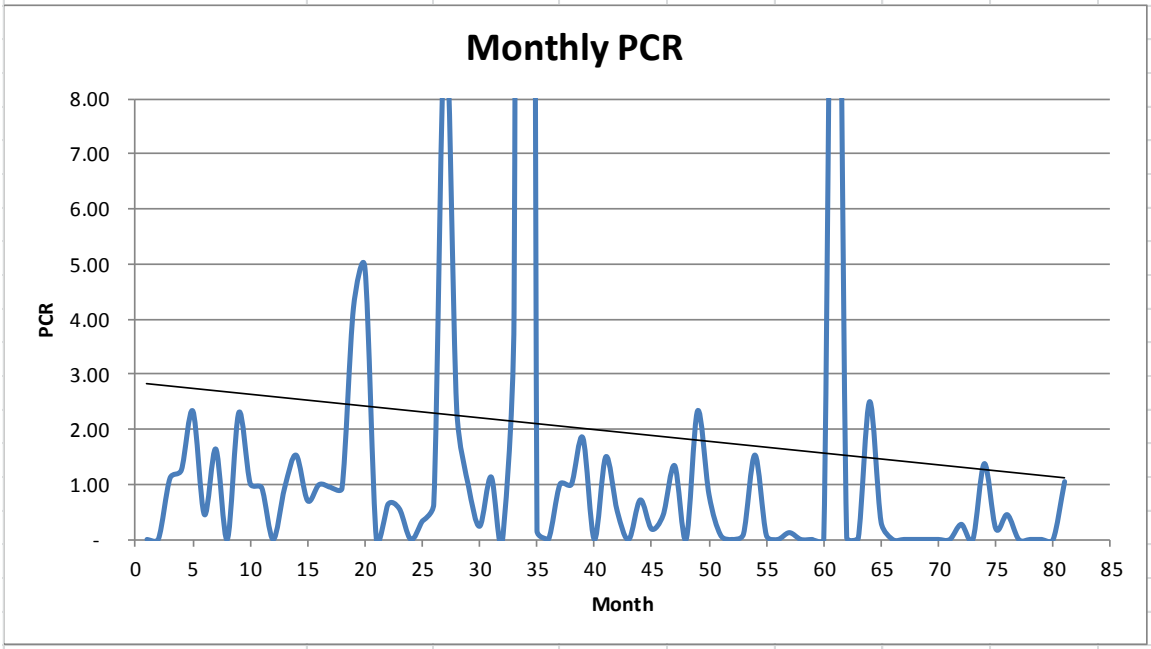
Trading Rules		
Long @ PCR Level	1.9	
Short @ PCR Level	1.9	
Results		
PCR wins	44	57.14%
PCR losses	33	42.86%
PCR final trading index	290.76%	
Share final index	228.17%	

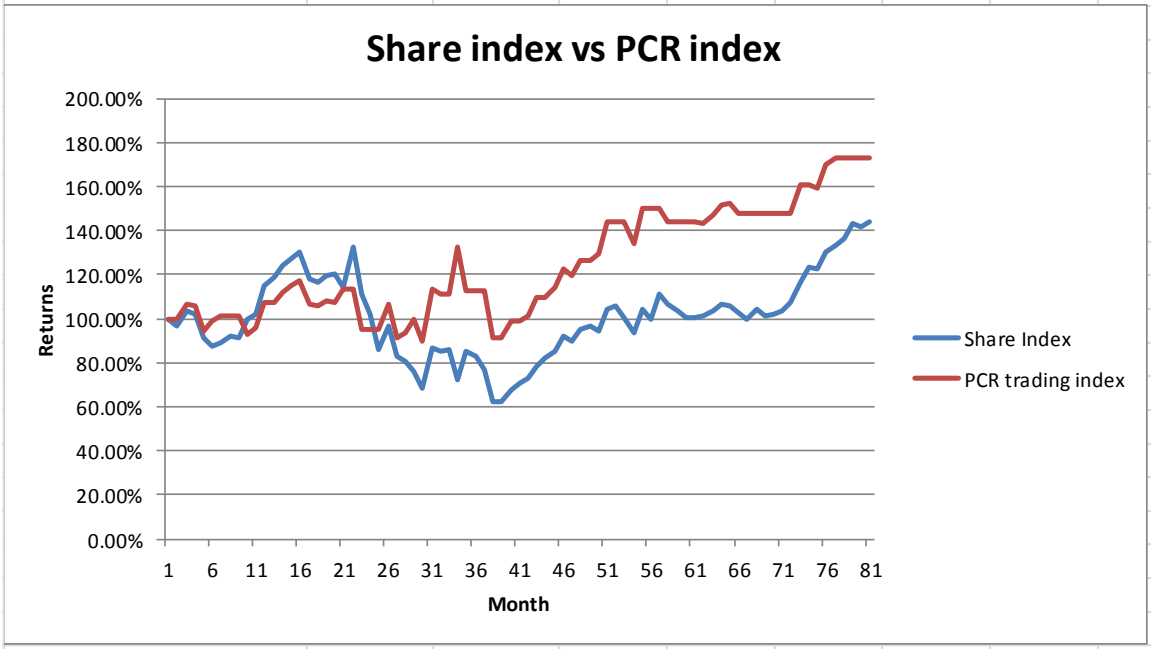




5.4.4. FIRSTRAND LTD – FSR

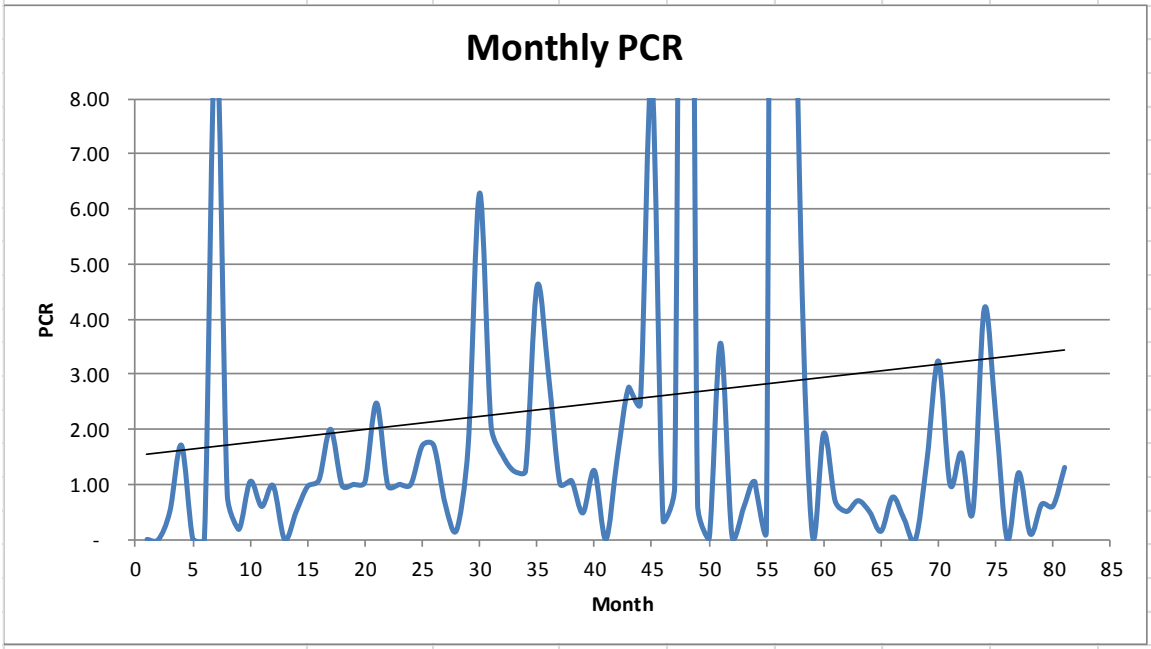
Trading Rules		
Long @ PCR Level	2	
Short @ PCR Level	2	
Results		
PCR wins	31	63.27%
PCR losses	18	36.73%
PCR final trading index	172.98%	
Share final index	144.13%	

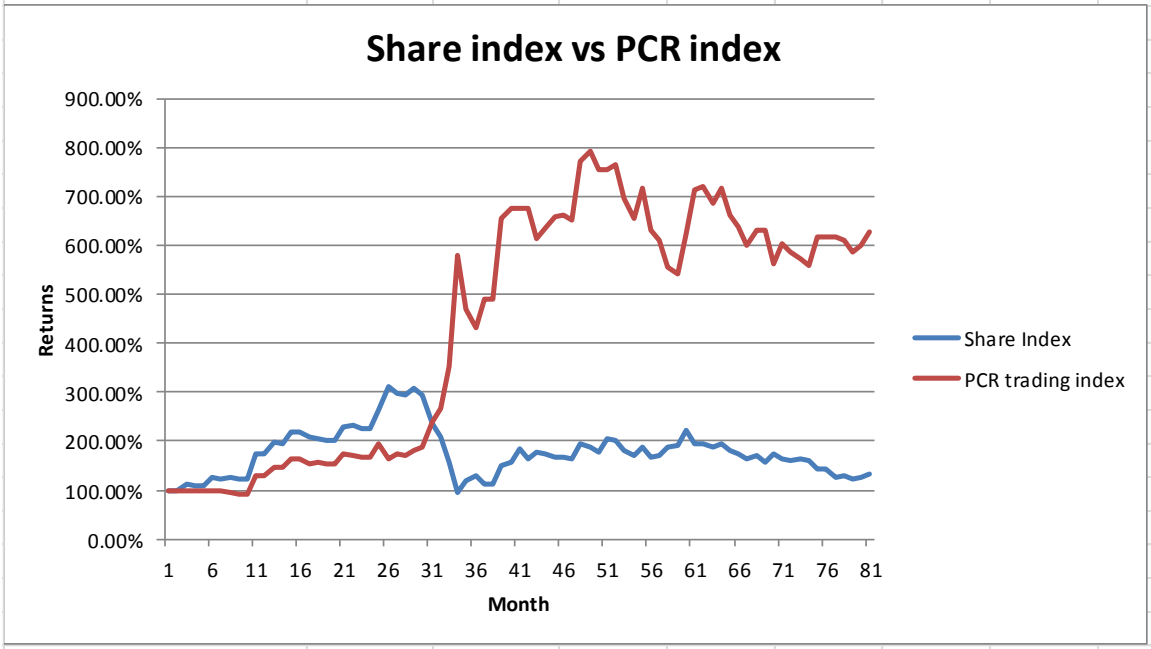




5.4.5. IMPALA PLATINUM HLGS LTD – IMP

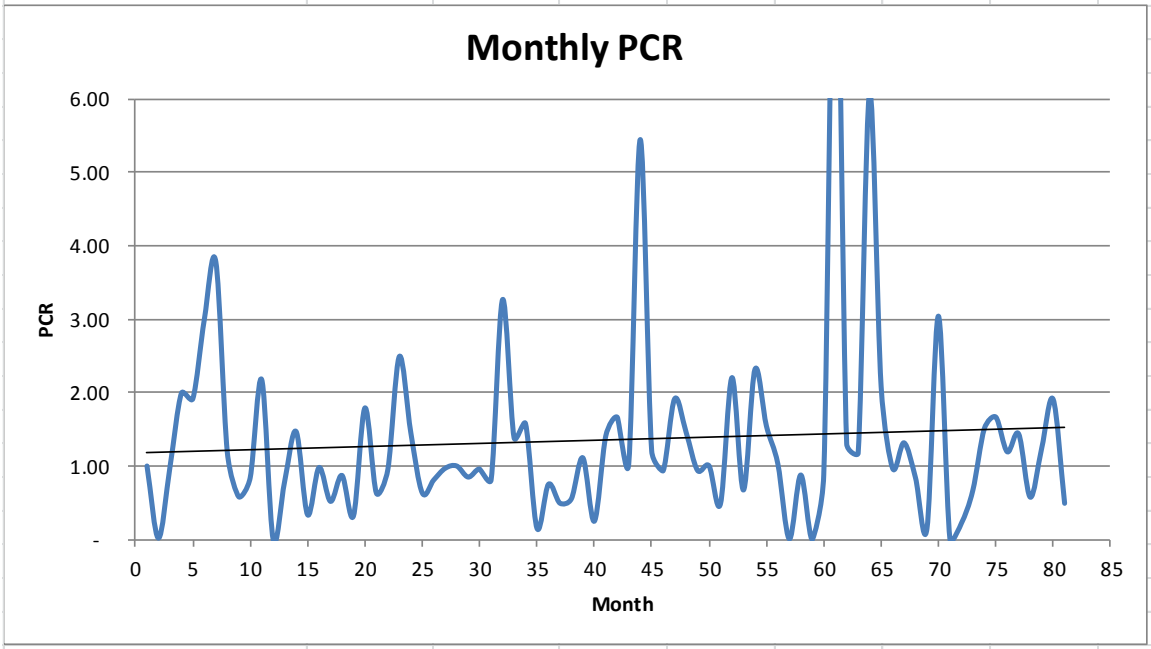
Trading Rules		
Long @ PCR Level	1.2	
Short @ PCR Level	1.2	
Results		
PCR wins	38	54.29%
PCR losses	32	45.71%
PCR final trading index	626.54%	
Share final index	132.38%	

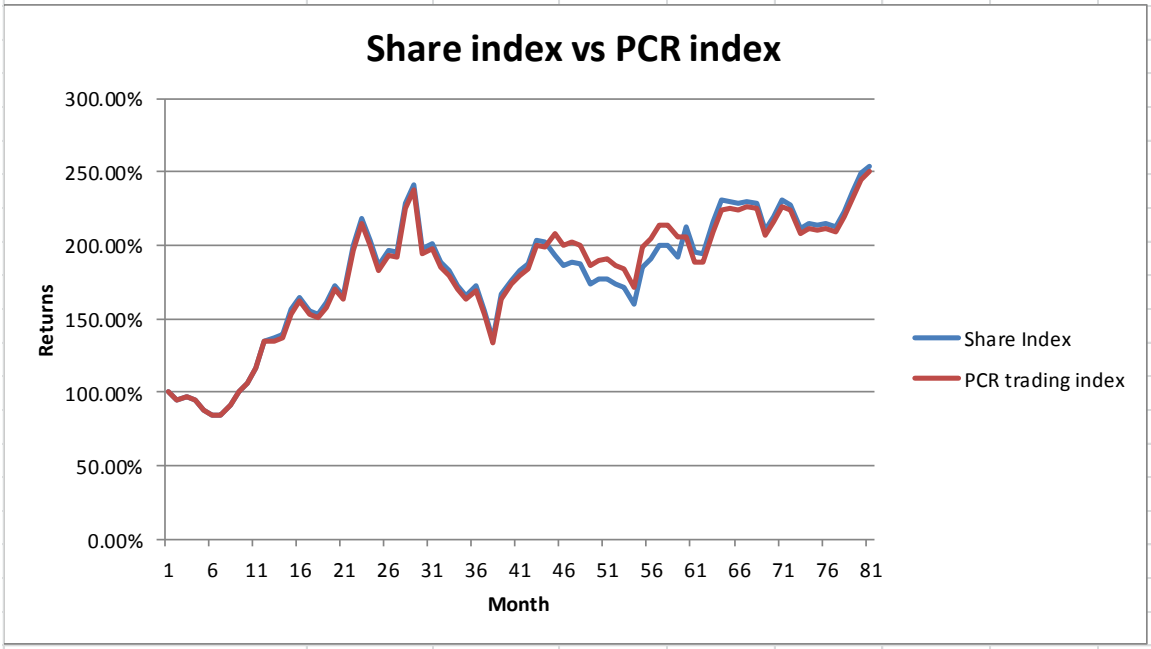




5.4.6. MTN GROUP LTD – MTN

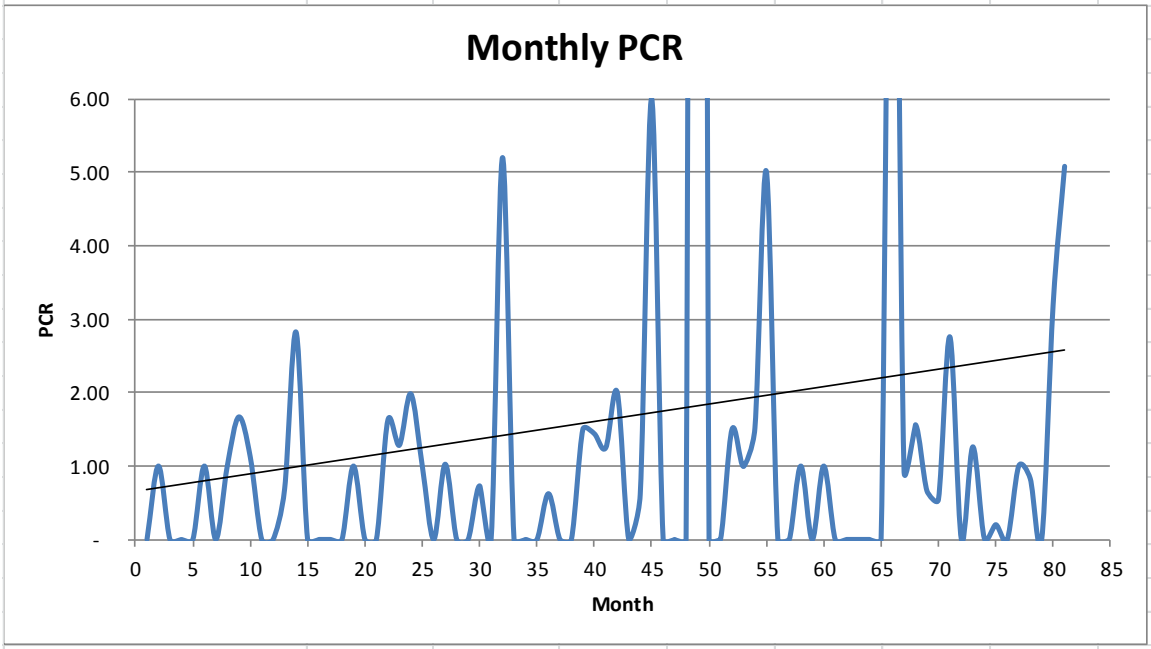
Trading Rules		
Long @ PCR Level	3.8	
Short @ PCR Level	3.8	
Results		
PCR wins	44	57.14%
PCR losses	33	42.86%
PCR final trading index	249.82%	
Share final index	253.90%	

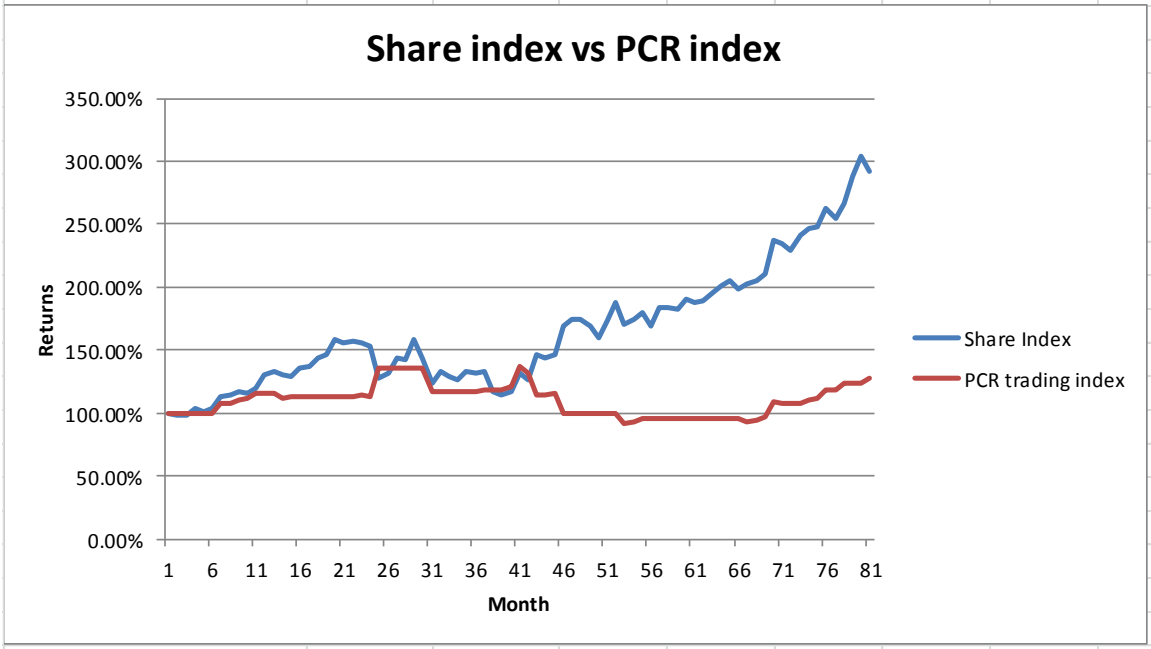




5.4.7. SABMILLER PLC – SAB

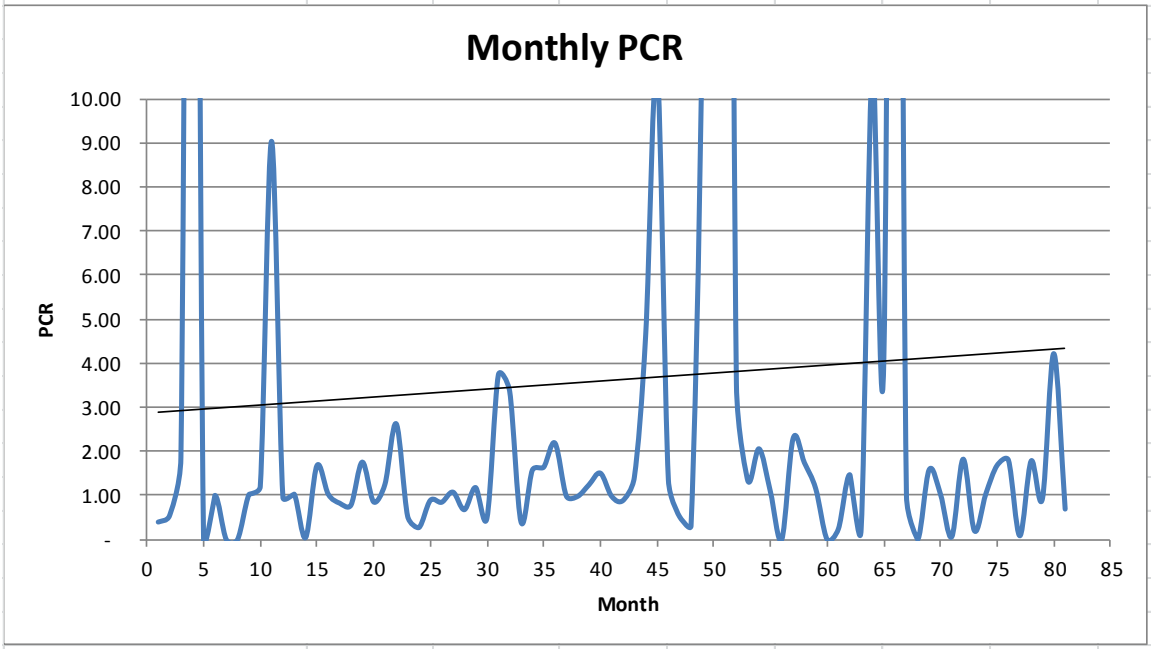
Trading Rules		
Long @ PCR Level	1.6	
Short @ PCR Level	1.6	
Results		
PCR wins	21	67.74%
PCR losses	10	32.26%
PCR final trading index	128.39%	
Share final index	292.69%	

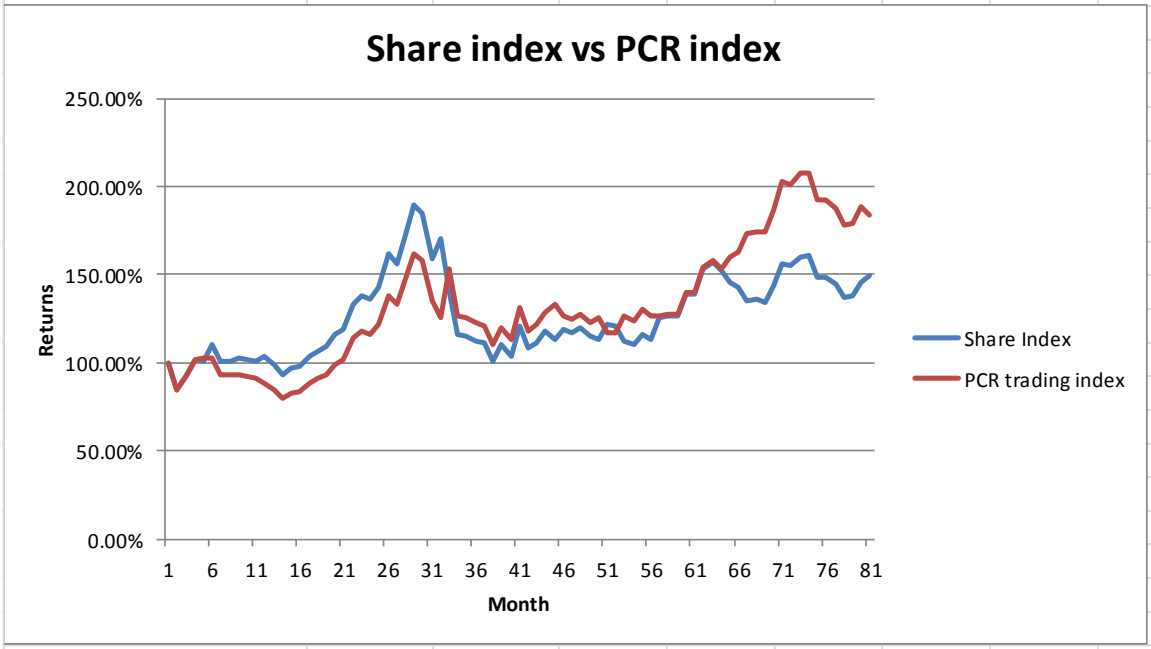




5.4.8. SASOL LIMITED – SOL

Trading Rules		
Long @ PCR Level	3	
Short @ PCR Level	3	
Results		
PCR wins	41	55.41%
PCR losses	33	44.59%
PCR final trading index	183.86%	
Share final index	149.51%	





6. CHAPTER 6 – DISCUSSION OF RESULTS

6.1. Hypothesis 1

The first hypothesis states that there exists no relationship between the PCR and the underlying share price. The alternative hypothesis states that there exists a negative linear relationship between the PCR and the underlying share price.

A statistical analysis between the PCR and the spot price was performed to investigate the strength of their correlation. Due to the lack of data points within the historical trade data, only as selected few shares was analysed. Although trading volume of put and call options is important in the calculation of the PCR, shares that exhibit complete trading history will be used. The reason for this is that in any data there exist outliers, incomplete or missing traded will further compound the effect of outliers in the data.

The trade data was scanned from completeness and the following shares that had completed trading history were used. In order to expand on the selection, shares that were only missing one month's trade data were also included in the limited sample. The following shares and index were considered:

- JSE All Share Index
- ANGLO AMERICAN PLC
- BHP BILLITON PLC
- FIRSTRAND LTD
- IMPALA PLATINUM HLGS LTD
- MTN GROUP LTD
- SABMILLER PLC
- SASOL LIMITED
- ABSA GROUP LTD
- IMPERIAL HOLDINGS LTD
- NASPERS LTD
- OLD MUTUAL PLC
- STANDARD BANK GROUP LTD

A scaling factor was used in the analysis as it does affect the correlation of the data (Klemens, 2008).

From the results, it can be seen from the sample that some shares have a small negative correlation while other shares have a small positive correlation. However, the strength of the relationship is weak to non-existent for the shares and index that were tested. Furthermore outliers were identified using quartiles and were removed from the correlation testing. However this had no material effect on the data. It was noted though, that some correlations changed from positive to negative and vice versa.

The result from the correlation testing therefore supports the hypothesis that there is no relationship between the spot price and the PCR.

6.2. Hypothesis 2

The null hypothesis states that there is no optimal ratio for the balanced PCR. The alternative hypothesis states that there exists an optimal ratio for the balanced PCR, where the returns received by an investor increases.

A trading rule was used to test this hypothesis. However trading rules are reliant on complete trade data. Therefore the following shares and index were selected:

- JSE All Share Index
- ANGLO AMERICAN PLC
- BHP BILLITON PLC
- FIRSTRAND LTD
- IMPALA PLATINUM HLGS LTD
- MTN GROUP LTD
- SABMILLER PLC
- SASOL LIMITED

A “what-if-analysis” or otherwise known as sensitivity analysis was performed on all the shares and index. This essentially varied the inputs of the model, thus changing the output of the model which is the return on the PCR final trading index.

Below is the summary of the trading rule approach:

Ticker	Name	PCR final trading index	Share index	PCR could not be calculated (months)
ALSI	JSE All Share Index	248.71%	181.10%	0
AGL	ANGLO AMERICAN PLC	126.74%	104.33%	3
BIL	BHP BILLITON PLC	290.76%	228.17%	2
FSR	FIRSTRAND LTD	172.98%	144.13%	25
IMP	IMPALA PLATINUM HLGS LTD	626.54%	132.38%	9
MTN	MTN GROUP LTD	249.82%	253.90%	2
SAB	SABMILLER PLC	128.39%	292.69%	39
SOL	SASOL LIMITED	183.86%	149.51%	6

From the summary results we can see that the simple trading rule outperforms its own share index six out of eight times and in some cases by quite a margin. This goes to support the hypothesis that there is an optimal ratio for the balanced PCR.

However, there are two shares that do not support this, MTN and SAB Miller. A closer look at the data reveals that the PCR for SAB Miller could not be calculated 39 times out of the 81 data points. This is primarily attributed to months where there is no data for either the put or call option traded. In some cases both put and call options did not have data. The corresponding months were checked against the original imported data, where no fault was found. Because 39 times represents a large portion of the total data points, it is logically concluded that this could have affected the results of the model. Therefore SAB Miller will be marked inconclusive and excluded from the discussion.

MTN on the other hand only has two times where the PCR could not be calculated, therefore it cannot be excluded. A close look at the PCR final trading index and its share index reveals a difference of only 4.08 %, which is rather small when compared to the returns received by the investor in some cases. This could have been attributed to the two missing months were the PCR could not be calculated. However, it is noted though the investor still increased his return from a base of 100% to 249.82% thus supporting the hypothesis that there is an optimal ratio for the balanced PCR.

CHAPTER 7 – CONCLUSION

This research report set out to identify the relationship between the well-known sentiment indicator and the returns received by an investor, where all trades were based on the Put-Call Ratio. Through literature it was identified that PCR is considered as a contrarian indicator by most investors, where in extreme cases the market tended to correct itself in the opposite direction.

Hypotheses were then formulated out of the literature review and tested for the period 2006 to 2012 on the historical trade data of the JSE. Although, CFD contracts were also identified to part of the financial derivative market, they were excluded from the study on the basis that historical traded data is not easily obtainable.

A statistical analysis was conducted on the first hypothesis to see if a relationship existed between the underlying spot price and the monthly calculated PCR. Coefficient of determination was then conducted to determine the strength of the relationship. The sample was severely limited to shares or indices that had complete trade data as missing data with compound the effect of existing outliers. Outliers were removed from the data and the tests for correlation were repeated. Results showed that outliers had no material effect on the data. It was concluded that no relationship exists between the PCR and the underlying stock price, which supports the findings of a previously conducted study (Chan, Chung, & Fong, 2002).

The second hypothesis was tested using a trading rule approach where a simple trading model was structure around the monthly PCR. The model was then tested on the historical traded data for Warrants for the period 2006 to 2012. Although SSF contracts can be used in the calculation of the monthly PCR, there was no way to distinguish between the long and short trades conducted in the market. The sample size was also limited for the following reasons:

- A breakdown of the derivative market showed that the use of Warrants only represented 11% of the total market. Further investigation revealed that Warrant contracts carried a hefty premium, hence the limited use
- Missing data which was mainly attributed to the limited use of warrants

The results from the trading model showed that in no uncertain terms, for every single share for which there is an efficient options market (the parameters and definitions of an "efficient options market" which have not been established, but are suspected to be one in which the total options traded per million share traders (TOTPMST) exceed a minimum level), there will exist an optimal PCR (being the point which should a prior month's PCR be below, the current position be long, and should the prior month's PCR be above, the current position be short), which if applied resulted in the a return that exceed the value of a total long position taken in the underlying share. Therefore the results of the trading model support the hypothesis that there exists an optimal / balanced PCR where returns received by an investor can be predicted.

The following recommendations are suggested for future study:

1. A longer time period than 2006 and 2012.
2. A market where the studied derivative instrument represents a sizable portion of the trade market, American or European Options market.
3. Currency Indexes can also be included in future studies, but were excluded due to limit use of Warrants in the South Africa.
4. Historical data for SSF contracts where trades can be distinguished between long and short positions should be collected and analysed through the proposed trading model.

REFERENCES

(2006, September 7). *What are Warrants?* Standard Bank. Retrieved from Standard Bank.

A User's Guide To Warrants. (2011, November 24). Retrieved from Investopedia: http://www.investopedia.com/articles/trading/10/warrants.asp#axzz29HgKcuxx

(2011). *International Options Market Association (IOMA) Report.* World Federation of Exchanges.

Single Stock Futures. (2011, November 10). Retrieved from JSE: http://www.jse.co.za/HowToInvest/Online-Courses/Online-Course-Single-Stock-Futures.aspx

Single Stock Futures. (2011, December 16). Retrieved from Standard Bank: https://securities.standardbank.co.za/pv_obj_cache/pv_obj_id_8699961765EBAE44425379E5A378312838C50300/filename/ssf_brochure.pdf

Anglo American Plc. (2012, November 06). Retrieved from Fin 24: http://dashboard.fin24.com/Company/Anglo-American-Plc/Profile

Basic Investment Course. (2012, November 06). Retrieved from Standard Bank: https://securities.standardbank.co.za/ost/

Contracts For Difference. (2012, November 05). Retrieved from Investec: http://www.investec.co.za/content/dam/investec/investec.co.za/documents/IWIN-sa/Fact-Sheets/wi_cfd.pdf

Contracts for Difference Trading in South Africa. (2012, October 03). Retrieved from Contracts For Difference and CFDs Trading: http://www.contracts-for-difference.com/South-Africa-CFDs.html

How warrants are valued. (2012, October 22). Retrieved from Australian Securities Exchange: http://www.asx.com.au/products/how-warrants-are-valued.htm

Long-term Equity AnticiPation Securities (LEAPS). (2012, June 12). Retrieved from CBOE: http://www.cboe.com/products/leaps.aspx

MTN Company Profile. (2012, January 06). Retrieved from MTN: http://www.mtn.com/MTNGROUP/Pages/CompanyProfile.aspx

Option Pricing Models and the "Greeks". (2012, October 15). Retrieved from Hoadley Trading and Investment Tools: http://www.hoadley.net/options/bs.htm#Binomial

Option Styles. (2012, July 7). Retrieved from Nasdaq: http://www.nasdaq.com/investing/options-guide/option-styles.aspx

Options Basics: What Are Options? (2012, October 16). Retrieved from Investopedia: http://www.investopedia.com/university/options/option.asp#axzz29HgKcuxx

Options Expiration. (2012, July 20). Retrieved from The Options Guide: http://www.theoptionsguide.com/expiration-date.aspx

Pricing Options. (2012, July 8). Retrieved from NASDAQ: http://www.nasdaq.com/investing/options-guide/pricing-options.aspx

Put/Call Ratio. (2012, April 02). Retrieved from StockCharts: http://stockcharts.com/school/doku.php?id=chart_school:technical_indicators:put_call_ratio

Put-Call Ratio. (2012, October 24). Retrieved from Investopedia: http://www.investopedia.com/terms/p/putcallratio.asp#axzz2BAd55kkE

Single Stock Futures. (2012, October 18). Retrieved from JSE: http://www.jse.co.za/Products/All-Products/Product-Details/Single_Stock_Futures.aspx

Strike Price. (2012, August 12). Retrieved from The Options Guide: http://www.theoptionsguide.com/strike-price.aspx

The Put-Call Ratio. (2012, September 26). Retrieved from American Association of Individual Investors: http://www.aaii.com/computerizedinvesting/article/the-put-call-ratio

What is Level 2? (2012, October 12). Retrieved from Contracts For Difference and CFDs Trading: http://www.contracts-for-difference.com/DMA-CFD.html

Why trade options? (2012, November 02). Retrieved from Schaeffer's Investment Research: http://www.schaeffersresearch.com/schaeffersu/why_trade_options/speculating.aspx

Amin, K. I., & Lee, C. M. (1997). Option trading, price discovery, and earnings news. *Contemporary Accounting Research Vol. 14*, 153-192.

Bates, D. S. (1995). Testing Option Pricing Models. 14-95.

Battalio, R., & Schultz, P. (2006). Options and the Bubble. *The Journal of Finance Vol. 61*, 2071-2102.

Black, F., & Scholes, M. S. (1972). The Valuation of Option Contracts and a Test of Market Efficiency. *Journal of Finance Vol. 27*, 399-417.

Bosman, P., Jones, S., & Melmed, S. (2008). The Construction of an Alsi Implied Volatility Surface: Smiling at the skew. *Cadiz Quantitative Research*.

Brittain, P., & Garner, C. (2006). Eight Simple but Proven Option Strategies. *Futures Vol. 35 No 12.*

Cao, C., Chen, Z., & Griffin, J. (2005). Informational content of option volume prior to takeovers. *Journal of Business Vol. 78*, 1073-1109.

Chakravarty, S., Gulen, H., & Mayhew, S. (2004). Informed Trading in Stock and Option Markets. *Journal of Finance Vol. 59*, 1235–1257.

Chan, K., Chung, Y. P., & Fong, W.-M. (2002). The Information Role of Stock and Option Volume. *The Review of Financial Studies Fall 2002 Vol. 15*, 1049-1075.

Chande, T., & Kroll, S. (1994). *The New Technical Trader: Boost your Profits by Plugging into the Latest Indicators.* John Wiley and Sons.

Chang, C. C., Hsieh, P. H., & Lai, H. M. (2009). Do Informed Investors Predict Stock Returns?: Evidence from TAIFAX. *Journal of Banking and Finance Vol. 33*, 757-764.

Coval, J., & Shumway, T. (2001). Expected Option Returns. *Journal of Finance Vol. 56*, 983-1009.

Cox, J., Ross, S., & Rubinstein, M. (1979). Option Pricing: A Simplified Approach. *Journal of Financial Economics Vol. 7*. Retrieved from Global Derivatives: http://www.global-derivatives.com/index.php?option=com_content&task=view&id=15

Dunyon, J. (2012, May 28). *Market Sentiment Analysis*. Retrieved from EzineArticle: http://ezinearticles.com/?Market-Sentiment-Analysis&id=4366392

Easley, D., & O'Hara, M. (1987). Prices, trade size and information in security markets. *Journal of Financial Economics Vol. 19*, 69-90.

Easley, D., O'Hara, M., & Srinivas, P. S. (1998). Option Volume and Stock Prices: Evidence on Where Informed Traders Trade. *Journal of Finance Vol. 53*, 431-465.

Edward, S. (2011, March 30). *Put / Call Ratio*. Retrieved from EzineArticles: http://ezinearticles.com/?Put-/-Call-Ratio&id=399463#action-do-cite

Fischer, B. (1975). Fact and Fantasy in the Use of Options. *Financial Analysts Journal Vol. 31*, 36-41, 61-72.

Gatheral, J., & Lynch, M. (2002). Stochastic Volatility and Local Volatility.

Graham, J. (2011, October 23). *The Put-Call Ratio: A Useful Indicator of Sentiment*. Retrieved from DiscoverOptions: http://www.discoveroptions.com/mixed/content/education/articles/putcallratio.html

Hagan, P. S., Kumar, D., Lesniewski, A. S., & Woodward, D. E. (2002). Managing Smile Risk.

Heston, S. (1993). A closed-form solution for options with stochastic volatility, with application to bond and currency options. *Review of Financial Studies Vol. 6*, 327-343.

Jackwerth, J. C., & Rubinstein, M. (1996). Recovering Probability Distributions from Option Prices. *The Journal of Finance Vol. 51*, 1611-1631.

James, D. P. (2011, February 23). *3 Most Popular Indicators for Measuring Market Psychology*. Retrieved from EzineArticles: http://ezinearticles.com/?3-Most-Popular-Indicators-for-Measuring-Market-Psychology&id=5931669#action-do-cite

Jayaraman, N., Frye, M. B., & Sabherwal, S. (2011). Informed Trading Around Merger Announcements: An Empirical Test Using Transaction Volume and Open Interest in Options Market. *The Financial Review Vol. 37*, 45-74.

Jones, T., & Brooks, R. (2005). An analysis of single-stock futures trading in the U.S. *Financial Services Review Vol. 14*, 85-95.

Klemens, B. (2008). *Modeling with Data: Tools and Techniques for Scientific Computing.* Princeton University Press.

Lamont, O. A., & Thaler, R. H. (2003). Can the Stock Market Add and Subtract? Mispricing in Tech Stock Carve-Outs. *Journal of Political Economy Vol. 111 No. 2*, 227-268.

Ofek, E., Richardson, M., & Whitelaw, R. F. (2004). Limited arbitrage and short sales restrictions: evidence from the options markets. *Journal of Financial Economics Vol. 74*, 305-342.

Pan, J. (2002). The Jump-Risk Premia Implicit in Options: Evidence from an Integrated Time-Series Study. *Journal of Financial Economics Vol. 63*, 3-50.

Pan, J., & Poteshman, A. M. (2006). The Information in Option Volume for Future Stock Prices. *Review of Financial Studies Vol. 19*, 871-908.

Peters, E. E. (1991). *Chaos and Order in the Capital Markets - a new view of cycles, prices, and market volatility.* John Wiley and Sons.

Simon, D. P., & Wiggings III, R. A. (2001). S&P futures and contrary sentiment indicators. *Journal of Futures Markets Vol. 21*, 447-462.

Sooran, C. (2011, December 6). *An Introduction to Exotic Options*. Retrieved from The Financial Pipeline: http://www.finpipe.com/exoptions.htm

Summa, J. (2004). *Trading Against the Crowd.* John Wiley and Sons Inc.

Swaminathan, B., & Lee, C. M. (2000). Price Momentum and Trading Volume. *Journal of Finance Vol. 55*, 2017–2069.

West, G. (2005). Calibration of the SABR Model in Illiquid Markets. *Applied Mathematical Finance Vol. 12*, 371-385.

Zweig, M. E. (1973). An investor expectations stock price predictive model using closed-end fund premiums. *Journal of Finance Vol. 28*, 67-87.

APPENDICES

JSE Top 40 shares

Ticker	Name	Months	Missing Months
AGLQ	ANGLO AMERICAN PLC	81	0
BILQ	BHP BILLITON PLC	81	0
FSRQ	FIRSTRAND LTD	81	0
IMPQ	IMPALA PLATINUM HLGS LTD	81	0
MTNQ	MTN GROUP LTD	81	0
SABQ	SABMILLER PLC	81	0
SOLQ	SASOL LIMITED	81	0
ASAQ	ABSA GROUP LTD	80	1
IPLQ	IMPERIAL HOLDINGS LTD	80	1
NPNQ	NASPERS LTD -N-	80	1
OMLQ	OLD MUTUAL PLC	80	1
SBKQ	STANDARD BANK GROUP LTD	80	1
AMSQ	ANGLO AMERICAN PLAT LTD	78	3
SLMQ	SANLAM LIMITED	78	3
BVTQ	BIDVEST LTD	77	4
INPQ	INVESTEC PLC	76	5
ANGQ	ANGLOGOLD ASHANTI LTD	75	6
GFIQ	GOLD FIELDS LTD	75	6
HARQ	HARMONY GM CO LTD	73	8
SHFQ	STEINHOFF INT HLDGS LTD	70	11
EXXQ	EXXARO RESOURCES LTD	66	15
KIOQ	KUMBA IRON ORE LTD	64	17
REMQ	REMGRO LTD	62	19
TRUQ	TRUWORTHS INT LTD	62	19
MSMQ	MASSMART HOLDINGS LTD	61	20
SHPQ	SHOPRITE HOLDINGS LTD	59	22
APNQ	ASPEN PHARMACARE HLDGS LTD	58	23

ABLQ	AFRICAN BANK INV LTD	56	25
WHLQ	WOOLWORTHS HOLDINGS LTD	56	25
RMHQ	RMB HOLDINGS LTD	51	30
NEDQ	NEDBANK GROUP LTD	50	31
TBSQ	TIGER BRANDS LTD	50	31
CFRQ	COMPAGNIE FIN RICHEMONT	46	35
BTIQ	BRITISH AMERICAN TOB PLC	43	38
ARIQ	AFRICAN RAINBOW MIN LTD	36	45
GRTQ	GROWTHPOINT PROP LTD	33	48
VODQ	VODACOM GROUP LTD	27	54
CSOQ	CAPITAL SHOP CENT GRP PLC	14	67
MNPQ	MONDI PLC	5	76
ASRQ	ASSORE LTD	2	79