

**Gold in the South African market: A safe haven or hedge?**

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## **DECLARATION**

I, Lauren Bodington, declare that this research report is my own work. Where someone else's work was used (whether from a printed source, the Internet or any other source) due acknowledgement was given and reference was made according to departmental requirements. It is submitted in partial fulfilment (50%) of the requirements for the degree of Master of Commerce in Finance at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

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## Definitions of Terms and Abbreviations

**Asset Bubble:** The market price of an asset increases beyond sustainable levels that cannot be supported by the economic fundamental value of the asset.

**Correlation:** The movement of two or more assets or asset classes in relation to one another.

**Diversifier:** A security or asset class that is positively but not perfectly correlated with another security or portfolio on average.

**ETF:** Exchange Traded Fund.

**Flight to Liquidity:** Propensity of investors to move from less liquid assets to assets with higher levels of liquidity during periods of market uncertainty.

**Flight to Safety:** Propensity of investors to move from asset classes associated with high risk to asset classes associated with lower levels of risk during turbulent market conditions.

**Hedge:** A security or asset class the exhibits negative correlation or no correlation with another security or portfolio on average (considering all market conditions).

**Knightian Uncertainty:** The uncertainty that arises from randomness with unknown probabilities as oppose to risk that arises from randomness with knowable probabilities.

**Safe Haven:** A security or asset class that exhibits negative correlation or no correlation with another security or portfolio during times of extreme market stress.

**Portfolio Selection:** Markowitz (1952) and Tobin (1952) devised normative rules for the inclusion of assets in a portfolio relating to the correlation of assets in the portfolio and risk reduction characteristics.

**Prospect Theory:** A behavioural economic theory developed by Kahneman and Tversky (1979) which shows that individuals value gains and losses differently.

**Maturing commercial paper:** Debt instruments issued by corporate entities that is at a stage where the principle amount is due to be paid.

## **Abstract**

The evolution of gold from a precious metal to a means of exchange and a financial asset has allowed gold to exhibit unique characteristics from a portfolio management perspective. This research report seeks to analyse the characteristics of gold in order to determine its feasibility as a safe haven asset, a diversifier or a hedge in the South African capital markets during different economic climates. This study replicates the methodology of Baur and Lucey (2010) and uses two principle regression models to analyse the properties of gold as a safe haven, a hedge or a diversifier for the South African Investor. Despite the general consensus of gold as a safe haven asset, academic research on this topic to date is relatively sparse, especially within a South African context. This study therefore provides empirical evidence to support the hypothesis of gold as a safe haven and a hedge in a South African context.

The findings of this research show that, for South African investors investing in South African equities, gold acts as a hedge on average. In relation to the finding for gold as a safe haven or a hedge for the South African bond market, it was found that gold does act as a hedge on average. The findings further demonstrate that for a South African investor, gold does not act as a hedge for international stocks. The portfolio analysis section of this paper demonstrates that the return for gold is positive on the day that an extreme negative shock occurs in the stock market. Furthermore, the safe haven effect of gold is eliminated after two trading days.

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## **1. Introduction**

Global markets have arguably never experienced such high levels of uncertainty as those brought about by the 2007 credit crisis and the ensuing global economic recession of 2008. In times of such economic and financial turmoil, investors are prone to exhibit behaviour indicative of fear and panic. As a result, investors have a propensity to “flee-to-safety” during these periods. As the name suggests, investors faced with uncertainty seek a safe haven for their wealth where it is protected from loss. This phenomenon is most commonly characterised by the movement of investors’ money from equity markets into bond markets or cash (Goyenko & Ukhov, 2009). This allows holders of safe-haven assets to experience greater returns than equity holders, as these returns are less volatile and less affected by economic downturns. These periods of uncertainty within capital markets also results in high investor demand for safe haven assets, which causes the prices of those safe haven assets to increase (Coudert & Raymond-Feingold, 2011). This increase in investor demand for these assets, which subsequently causes the price of these assets to increase, also acts to increase the returns generated from these assets.

Due to international integration and the instability of global bond markets over recent periods, the global flight-to-safety from equity holdings to bond holdings has not been as effective in recent times in protecting investments and diversifying away from equity holdings, as they were in the past (Baele, Bekaert, & Inghelbecht, 2010). This practice is especially questionable in the South African marketplace where the bond market is underdeveloped and characterised by low liquidity and a high currency risk premium (Grandes & Pinaud, 2004). Furthermore, high levels of globalisation and capital market integration have limited the scope for international diversification or international flight to safety episodes. This is evident from the global nature of the crisis that ensued following the U.S. based subprime mortgage crisis in 2007. During this period, all international markets were affected, causing a recession on a global scale. Whilst international diversification still demonstrates benefits, these are severely diminished from those evident in former regimes. Furthermore, the European credit crisis demonstrated the high levels of integration between the equity and bond market internationally, calling into question the safe-haven value of the bond market.

Given these concerns, it is highly pertinent to determine whether there is an alternative safe haven asset in the South African marketplace that can more effectively protect investors from losses in the marketplace during periods of uncertainty, than the bond market. The evolution

of gold as a financial asset has led to a general consensus in the financial press that it does indeed act as a safe haven asset. Unlike other safe haven assets, such as bonds or cash, the price of gold is prone to exhibit high levels of volatility in the short-run (Jaffe, 1989). These levels of volatility expose the high levels of riskiness of gold as an individual asset and portray an uncommon characteristic of safe haven assets (Jaffe, 1989). Despite the volatility of the gold price, this financial asset has exhibited remarkable returns giving the recessionary nature of the economy. The U.S. dollar price of gold has increase 161.56% from the beginning of 2007 to the end of 2012, whilst the rand price of gold has increased 217.47% over the same period (data sourced from McGregor BFA). This difference would be due to fluctuations in the value of the rand relative to the U.S. dollar.

Despite the general consensus of gold as a safe haven asset, academic research on this topic to date is relatively sparse, especially within a South African context. Baur and Lucey (2010) were the first to directly test gold as a safe haven for stocks and bonds and their findings show that gold did act as a safe haven asset during bear markets and a hedge against stocks on average within the U.S., U.K. and German capital markets. These results were corroborated by Baur and McDermott (2010) who extended the research of Baur and Lucey (2010) to include emerging markets and found that gold was a safe haven for major European and U.S. markets, but not for large emerging markets. The South African market was not examined in this research and whilst it can be classified as an emerging market, it is probable that gold may act as a safe haven given the substantial increase of the rand gold price over the recessionary period.

The finding outlined above, along with increasing gold prices during the economic recession of 2007, propagates questioning as to whether gold is a safe haven or a hedge in the South African context. This question becomes especially pertinent when taken in the context of recent research into the explosive nature of the gold price as being indicative of an asset bubble (Baur & Glover, 2012). This notion is supported by some of the greatest names in the investment realm, including George Soros and John Paulson, who have both publicly declared their view of gold as an asset bubble. This opinion was rejected by Bialkowski, Bohl, Stephan and Wisniewski (2012), who found that the fundamental value of gold, given its value as a safe haven, dollar and inflation hedge and diversifier, explained the explosive nature of the gold price over the recent recessionary period. Any asset bubble in the market can be dangerous as demonstrated by the U.S. housing bubble preceding, and largely responsible for, the credit crisis. If gold does exhibit safe haven properties, there is a higher

probability that fundamental principles account for the increase in the gold price. A further finding by Baur and Lucey (2010), that the safe haven property of gold is eliminated 15 days after an extreme shock has occurred, provides contention for the notion that the explosive price of gold is explained by fundamental factors alone. It is therefore important to understand the varying characteristics of gold in order to understand its value as an investment in the South African context.

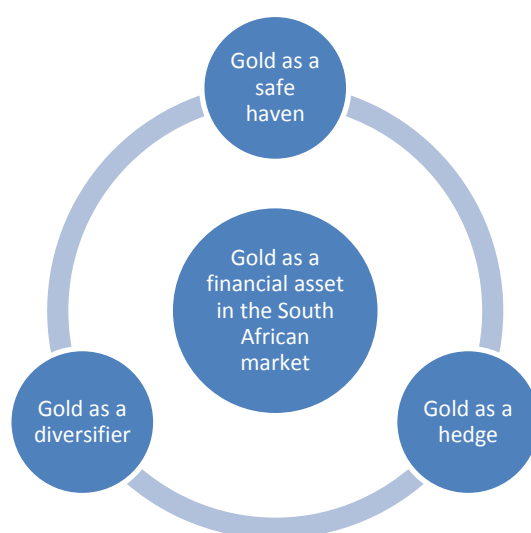
### **1.1. Research problem and objectives**

The evolution of gold from a precious metal to a means of exchange and a financial asset has allowed gold to exhibit unique characteristics from a portfolio management perspective. These characteristics appear to be influenced by market conditions and the state of the economy. Whilst there is a general consensus that gold acts as a safe haven during extreme bear markets for developed markets, there is a lack of evidence to support this hypothesis for emerging markets (Baur & McDermott, 2010). Gold also appears to act independently of other assets on average, and there is strong evidence that it may act as an effective diversifier or hedge for equity portfolios (Jaffe, 1989). Due to the fact that gold is priced in U.S. dollars, there is a large possibility that international findings with regards to gold's ability to act as a safe haven, hedge and diversifier do not hold in the South African context, due to exchange rate considerations between the South African rand and the U.S. dollar

Gold therefore appears to have many different features that evolve as the economic climate changes. This research aims to analyse the characteristics of gold in order to determine its feasibility as a safe haven asset, a diversifier or a hedge in the South African capital markets during different economic climates. This is done by examining the correlation between gold returns and South African share returns, international share returns and South African bond returns. In doing so, this research will fill a vital void in the empirical literature with regards to gold as a safe haven or a hedge for the South African investor. The analysis of portfolio returns and the minimum variance portfolio serve as a robustness test for the findings of the regression analysis. These results will provide evidence to support the notion that increasing the weighting of gold in a South African investor's portfolio during extreme market condition can serve to minimise the effects of falling equity prices. A prudent investor would therefore increase their holdings in gold over the recessionary period if it does in fact act as a safe haven asset. The scope of this research does not extend to include gold's feasibility as a hedge for other macro-economic variables such as inflation or exchange rates, but rather

focuses on assessing its feasibility as safe haven, a diversifier and a hedge for South African shares, international shares and South African bonds.

The results of these international studies suggest that gold is a rewarding investment during extreme bear markets and that investors seeking to not only protect their wealth, but also grow their wealth, should invest in gold during recessionary periods. This research will allow South African investors to gain a level of insight into the feasibility of gold as an investment during different market conditions. Figure 1 below describes the characteristics of gold that will be examined within the South African context.



**Figure 1: Characteristics of gold as a financial asset**

## **1.2.Summary of Findings**

The findings of this research show that, for South African investors investing in South African equities, gold acts as a hedge on average. Furthermore, gold will display safe haven qualities for the South African equity investor when shares fall to the lowest one percentile of returns. These conditions were prevalent during the 2008 economic recession and during this period gold did in fact experience significantly higher returns than South African equities. The result for gold as a hedge and for gold as a safe haven for all levels using one lag is insignificant. From a practical perspective, this implies that investors holding gold at the time of severe bear markets would profit from the safe haven properties of gold. Investors that only invest in gold once extreme bear market conditions are prevalent would not experience the same level of protection from losses.

In relation to the finding for gold as a safe haven or a hedge for the South African bond market, it was found that gold does act as a hedge on average. Furthermore, it was found that gold only acts as a contemporaneous safe haven for falling bond markets within a certain range (within the lowest two and a half percentile). The results also indicate a significant lagged effect of gold as a hedge for South African bonds.

The findings further demonstrate that for a South African investor, gold does not act as a hedge for international stocks. Rather, it was found that gold is positively but not perfectly correlated with international share returns, allowing gold to act as a diversifier in portfolios of South African investors investing in international shares. The findings also demonstrate that gold is not a contemporaneous safe haven for South African investors investing in international equities however, it was found that the lagged effect is stronger than the contemporaneous effect of gold as a safe haven for international stocks at the lowest five percentile. These results suggest that gold is only a safe haven for international share returns after international equities have experienced moderately negative returns (in the lowest fifth percentile). Gold also acts as a hedge for lagged international equity returns

When the cumulative returns for a portfolio comprising of gold and the JSE All Share Index for the period spanning 50 and 100 trading days after an extreme negative shock has occurred is examined, it is evident that the return for gold is positive on the day that an extreme negative shock occurs in the stock market. Furthermore, the safe haven effect of gold is eliminated after 2 trading days. This is consistent with the findings of Baur & Lucey (2010) who found that the safe haven effects of gold are short lived. As it was found that gold is a hedge for South African shares on average this phenomenon can be explained as being due to the dual function of gold as a hedge for shares.

When the cumulative returns for a portfolio comprising of gold and the MSCI Global Stock Index for the period spanning 50 and 100 trading days after an extreme negative shock has occurred is examined, it is evident gold acts as a safe haven for global equities and that this effect is eliminated after two days. Furthermore it is clear that whilst gold does act as a hedge for global equities on average, this effect is weaker than that found for South African equities. This is consistent with the regression results that show that gold acts as a hedge for global equities at a 5% level whilst it acts as a hedge for South African equities at a 2.5% level.

During 2008 and 2009 a total of thirty seven severe market shocks within the fifth percentile of South African equity returns occurred. Many of these shocks occurred within seven days of one another. The findings in this research report suggest that, even over this turbulent period, gold continues to act as a safe haven for both South African and global equities. The combined qualities of gold as a safe haven and a hedge for South African and global equities allows gold returns to offset negative losses incurred by South African equity investors.

The results of the minimum variance portfolios showed that the results for gold as a safe haven for international and South African equity markets are robust. It is evident from these results that during extreme market condition (such as those experienced in the 2008 financial crisis) a higher proportion of gold is included in the minimum variance portfolio. It is also evident from these results that global diversification is beneficial over all periods as a portfolio constructed with three asset classes (gold, the ALSI and the MSCI) has a lower standard deviation than a portfolio constructed using only gold and the ALSI. These results provide evidence to support the notion that increasing the weighting of gold in a South African investor's portfolio during extreme market condition can serve to minimise the effects of falling equity prices. A prudent investor would therefore increase their holdings in gold over the recessionary period. This is consistent with the findings of The World Gold Council (2010) who found that investor demand for gold increased substantially over the recessionary period. Given that supply remained relatively stable and that demand increased (mainly due to investor demand), a future area of research could address whether the safe haven value of gold causes an increase in the price of gold to levels consistent with an asset bubble, as postulated by Baur and Glover (2012).

This research report will progress as follows. Chapter 2 will examine an overview of the literature pertaining to this area of study. Following this, chapter 3 will outline the methodology used to determine whether gold is a safe haven, a hedge or a diversifier in the South African markets, as well as the methodology used to thoroughly examine gold's safe haven property. Chapter 4 includes the presentation and discussion of the results of this study and finally, chapter 5 will conclude and provide areas for future research.



## **2. Literature review**

In order to understand the characteristics of gold as a financial asset, it is important to delve into the mechanisms affecting its pricing. Gold is unlike any other asset or commodity. It has evolved beyond its simple use as a precious metal into a financial asset and yet, it does not generate any predictable cash flows from which its intrinsic value can be calculated. This chapter will cover aspects of the financial literature concerning the ability of gold to act as a financial asset. This includes the characteristics of gold as a financial asset, outlining the literature pertaining to the qualities of gold that allow it to act as a meaningful financial asset and the implications of this for portfolio managers. Furthermore, the pricing of gold and the many ways of gaining exposure to gold will be examined, addressing the practical features of gold as a financial asset. Flight to safety literature will finally be examined and gold will be assessed as a safe haven asset. This section will conclude with a discussion on gold as a safe haven and a summary highlighting pertinent literature relating to this research topic.

### **2.1 Gold as a financial asset**

Given the high returns experienced in the gold market over recent years, it seems incredulous that almost a decade ago, gold's value as an investment was challenged due to its relatively poor performance (Apak, Akman, & Cankaya, 2012). In order to understand the shift in investors focus towards gold, one must first understand the characteristics of gold as a financial asset and the pricing determinants of gold.

#### **2.1.1 Characteristics of gold as a financial asset**

Gold derives its value as an investment vehicle from its perceived store of value, which is inextricably linked to its history as a means of exchange and as a means of valuing currencies during the reign of the gold standard (Baur & McDermott, 2010). Gold was used as a medium of exchange as far back as 1500 BC, where it was accepted as a medium of exchange for international trade. During periods characterised by economic turmoil leading to a loss in confidence in the value of paper money, gold is used as a medium of exchange. It is a liquid, physically tangible asset that possesses value that cannot be destroyed by a rising inflation rate or a government's seemingly insatiable lust for printing money.

##### **2.1.1.1 Characteristics of a hedge**

An asset can be classified as a hedge if it is uncorrelated or negatively correlated with another asset, portfolio or variable on average (Baur & Lucey, 2010). Hedges are useful tools for portfolio management and gold has been found to act as hedges against many economic variables, adding to its value as a financial asset. The "store-of-value" quality of gold allows

it to exhibit a unique quality. Gosh, Levin, Macmillan and Wright (2004) examined gold as an inflationary hedge and found that it was highly correlated with levels of U.S. inflation. This enabled gold to successfully act as an inflationary hedge within the U.S. market. These findings were corroborated by Levin and Wright (2006), who similarly found that the U.S. inflation rate and gold price moved together in a statistically significant long-run relationship.

In the long-run, the fundamental value of gold should be closely tied to long run U.S. inflation due to its store-of-value quality and the fact that gold is priced in US dollars. In the short run, however, gold cannot be classified as an inflationary hedge as it does not exhibit high levels of comovement with inflation over shorter time periods (Aggarwal, 1992). This important characteristic of gold is highlighted by the findings of Lui, Hatzell and Hoesli (1997) who found that real estate securities provide a worse hedge against inflation than equities in some countries, whilst being comparable to stocks in other countries. The majority of research on the ability of a country's shares acting as an inflationary hedge has shown that equities only act as a significant hedge against inflation in Argentina, Chile, Mexico and Venezuela, which all exhibit high inflation rates (Choudhry, 2001). Gold, on the contrary, is able to act as a non-contingent inflationary hedge and provides protection for portfolios against all levels of inflation. A non-contingent inflationary hedge will act as an inflationary hedge regardless of changes in other macro-economic factors.

Whilst the characteristic of gold as an inflationary hedge is well publicised, there are other characteristics of gold as a financial asset that allow it to act as a useful tool in portfolio management. Given that gold is priced in U.S. dollars, the precious metal is able to act as an exchange rate hedge for investors holding dollar denominated investments (Capie, Mills, & Wood, 2005). The fact that it is easily traded in an open market that is continuously traded makes it a homogeneous asset and allows it to serve as an exchange rate hedge. Capie et al. (2005) did however find that the degree to which gold served as a dollar hedge varied over time due to public attitude and expectations of currency fluctuations and the gold market.

For investment purposes, gold has also been considered as a portfolio diversifier and a portfolio hedge (Coudert & Raymond-Feingold, 2011). This implies that as a hedge, gold is uncorrelated or negatively correlated with another asset or portfolio on average and as a diversifier, gold is positively but not perfectly correlated with another asset or portfolio on average (Baur & Lucey, 2010). Gold was not found to be a successful tool in hedging

portfolios as it was not found to be negatively correlated with other assets on average (Baur & Lucey, 2010).

### **2.1.1.2 Portfolio diversification**

Markowitz (1952) and Tobin (1952) devised the theoretical models of portfolio selection and provided normative rules for the diversification of risky assets. According to these rules the inclusion of assets in a portfolio can only reduce risk if the returns of the asset are not correlated to those of assets within the portfolio. Diversification will therefore only reduce the risk of a portfolio for a level of returns if the assets in the portfolio are not perfectly correlated.

Given the increase in globalisation, which has led to increased integration of most asset types, the importance of gold as a portfolio diversifier has increased (Baur & Lucey, 2010). Gold has also been found to exhibit a minor negative correlation with stocks, which allowed it to act as a portfolio diversifier (Jaffe, 1989). This was supported by Hillier, Draper & Faff (2006) who found that gold was insignificantly negatively correlated with stocks and other commodity indexes in the U.S. and international markets, allowing it to act as a portfolio diversifier. Furthermore, Hillier et al. (2006) found that portfolios containing a 5% to 10% proportion in gold exhibited higher performance than portfolios without gold. These characteristics of gold as a financial asset allow it to be used as an investment tool in order to successfully hedge inflation and dollar denominated investments in the long run, whilst also acting as a portfolio diversifier due to its minor negative correlation with other assets. This demonstrated how gold's "store-of-value" quality allows it to act as a completely unique financial asset that is uncorrelated with other assets.

### **2.1.2 Pricing of gold**

Whilst this store of value quality of gold allows it to act as a financial asset and hedge inflation and dollar denominated investments in the long run, short term fluctuations in the price are driven by factors affecting the supply and demand for the asset. (Gosh, Levin, Macmillan, & Wright, 2004) There are two sources of supply for gold, namely gold extraction from mines and the lease of gold from central banks (Gosh et al., 2004). Levin & Wright (2006) found that the supply of gold will fluctuate in response to several factors, discussed below.

#### ***2.1.2.1. Extraction from gold mines***

The gold price in earlier periods will affect the supply of gold through extraction from gold mines (Levin & Wright, 2006). The amount of gold supplied is positively related to the price of gold in previous periods. Mines are not able to react to price changes for gold immediately due to the scale of their operations. If, for example, the price of gold were to drop as it did over 2012, it would take a significant amount of time for mines to decrease their operational capacity to adjust to the lower pricing of gold. The companies would have to shut down mine shafts, retrench workers and mothball certain operations and assets. This results in a considerable lag in their adjustment in supply due to gold price fluctuations. The supply of gold through extraction from gold mines is also affected by the amount of leased gold in earlier periods. The amount of gold supplied is negatively related to the amount of extracted gold that is used to repay the central banks for gold leased in previous periods, adjusted for a physical interest rate where interest is repaid in gold. The amount of gold supplied from extraction is therefore also negatively related to the gold lease rate in the previous period.

#### ***2.1.2.2. The lease of gold from central banks***

The amount of gold supplied through being leased from central banks is determined by three main factors, namely the convenience yield, the gold lease rate and default risk (Levin & Wright, 2006). The convenience yield is the associated benefit of physically holding gold for one period. When central banks lease gold out, they forgo this yield. The amount of gold leased by central banks is therefore negatively related to the convenience yield. The gold lease rate is the amount that central banks receive from leasing gold. The amount of gold a central bank will lease is positively related to the gold lease rate. Default risk refers to the probability that the central banks will be able to recover the amount leased and the gold lease rate from the parties involved. Default risk is therefore negatively related to the amount of gold leased by central banks.

The Central banks will determine the optimal amount of gold to be leased based on an equilibrium between the convenience yield, gold lease rate and default risk. The banks will adjust their gold reserves to a point where the physical rate of interest they receive is equal to the convenience yield and the risk of default. It is therefore this equilibrium that will determine the supply of gold from central banks. In summation, the total supply of gold from both extraction from gold mines and the lease of gold from central banks are determined by the current price of gold, the current and lagged values of the gold lease rate, the convenience yield and the default risk premium. Despite the significantly large increase in the price of

gold, the supply factors affecting its price remained relatively constant over the last decade (World Gold Council, 2010).

Intuitively, one can readily deduce that it is therefore an increase in the demand for this asset that has caused the price to increase. Whilst this is not a ground breaking revelation in itself, closer inspection of the exact demand factors responsible for the price increase reveal an interesting observation. The demand for gold is comprised of three main categories: jewellery, dental and industrial, and investor demand (World Gold Council, 2010). The two former categories are governed by consumer spending power and are largely cyclical, whilst the latter category is countercyclical in nature. Levin and Wright (2006) therefore identify two sources of demand, namely “use” demand and “asset” demand.

#### ***2.1.2.3. “Use” demand***

The “Use” demand for gold is largely determined by the current price of gold (Levin & Wright, 2006). The demand for jewellery, medals, electronic components and dentistry goods made from gold will be determined by the current price of gold, a relationship is derived from classical economic theory and this demand is largely cyclical. Cultural and religious traditions also play a role in determining the “Use” demand for gold. Specogna (2011) highlighted the fact that in countries similar to India (which accounted for 27% of the total demand for gold in 2009), gold is associated with social status and used as a cultural emblem. The demand for gold in these areas is not linked to economic trends but rather driven by sociocultural aspects.

#### ***2.1.2.4. “Asset” demand***

“Asset” demand is driven by five main factors, namely dollar exchange rate expectations, inflation expectations, fear, the return on macroeconomic variables and its lack of correlation with other assets (Levin & Wright, 2006). Given that gold is priced in U.S. dollars, investors expecting the value of the dollar to increase in relation to their home currency would invest in gold. The demand for gold is also influenced by its use as an exchange rate hedge. Furthermore, given that the price of gold has tracked inflation in an almost perfect relationship in the past, investors expecting inflation to increase would invest in gold (Gosh et al., 2004). As inflation rises, eroding the real value of cash, the value of gold would also increase, offsetting the change in an investors total asset value due to the eroding value of money.

During times of financial turmoil, fear generally governs the market (Levin & Wright, 2006). As the return in others assets decrease, investors seek a stable, safe asset to invest their funds into. As gold exhibits a lack of correlation with other assets, it is not generally affected by the negative contagion between risky assets during extremely negative market conditions (Baur & Lucey, 2010). These factors act to increase the demand for gold during extreme market conditions. This is consistent with the safe haven quality of gold. During the global recession, it was in fact an increase in investor demand that caused an increase in the gold price as investors sought to invest in an asset that would preserve their wealth (Baur & McDermott, 2010). Another interesting observation over this time period is that the price of gold increased whilst the price of other assets, including commodities, decreased. This lends support to the notion that the price of gold increased due to the safe haven quality that gold possesses.

### **2.1.3 Investing in gold**

Gold is unique in many of its attributes as a financial asset. The many different methods of acquiring and holding gold as a financial asset are consequential to gold's unique nature as an investment asset. Unlike other investment assets, such as bonds and equity, access to gold is not limited to exchange traded products.

#### ***2.1.3.1 Direct access to gold bullion***

Investors can gain direct access to gold bullion through investing in gold bullion coins and gold bars (The World Gold Council, 2010). Gold bullion coins are issued by governments across the world and come in many different weights and sizes. These coins can either be used as legal tender in the issuing country or as an investment asset. When these coins are used as legal tender, their value is determined by their face value rather than the gold content of the coin, much like a other coin used as legal tender. For example, a one rand coin can purchase goods and services for one rand rather than being used to purchase goods and services to the value of the metal used in producing the coin. For investment purposes, the value of the coin is determined by the value of its gold content and a variable premium for different coins and dealers. When dealing in bullion coins, there are two defining characteristics used as descriptive variables between coins, namely weight and karatage, where karatage is a measure of gold content (pure gold being 24 karats). In South Africa, Kruger Rands are the most traded gold bullion coins and are used by both individual investors and institutional investors as a means of accessing the gold market.

Gold bars can be purchased in a variety of weights and sizes, with differing pure gold contents which determine their value (The World Gold Council, 2010). Gold bars are generally marked with the name of the manufacturer, a serial number, the purity of the bar and the weight of the bar. Investing in gold coins and gold bars allow investors to gain access to the gold market by physically holding the asset (The World Gold Council, 2010). This market is very liquid and actively used by many different investors as a means of accessing the gold market. Bullion banks offer both allocated and unallocated gold accounts to the holders of gold. These accounts provide a domicile for the gold of both institutional investors and large private investors and make investments in the physical holdings of gold as an asset safe and accessible.

### ***2.1.3.2. Exposure to the gold price***

Investors can gain access to exposure to the gold price through various instruments. These instruments differ from gold bullion as the investor never actually holds the physical asset. Gold exchange traded funds (ETF's) allow investors access to the gold market by buying an exchange traded instrument that is 100% backed by physical gold bullion (The World Gold Council, 2010). The gold bullion is not physically held by the investor, but instead they hold a gold ETF which is traded just like any other share on the exchange and each ETF entitles the holder to a certain percentage of the gold bullion holding. These shares track the price of gold, less administration fees. For this reason the returns on gold ETF's will always be less than the returns of gold bullion, despite being 100% backed by the asset.

Gold futures and options specify the quantity and quality of gold that an investor either commits to (futures) or has the option to (options) make or take delivery of at a certain future date (The World Gold Council, 2010). These contracts are traded on options and future exchanges globally and represent a liquid market. Whilst the holder of an options or future contract can opt to take physical delivery of the asset, the majority of contracts are rolled over (the near dated contract is sold and a contract for settlement at a later date is bought) or settled financially. These contracts expose investors to price fluctuations in the gold price and the derivatives are priced in accordance with, and will fluctuate with, the value of the underlying asset. Forward contracts are similar to futures contracts, however they are customised and trade over-the counter (OTC) (The World Gold Council, 2010). As a result, forward contracts are less liquid and expose the investor to higher levels of risk.

The final method of gaining exposure to the gold price is through investment in gold mining equities (The World Gold Council, 2010). As gold is the sole output of gold mining companies, investors can gain leveraged exposure to the gold price through investing in these company's shares. An increase in the price of gold should result in an increase in a gold mining company's profit, and result in the share price increasing in value. However, the shares of these companies are exposed to many more variable factors affecting their profits that the gold bullion market is not exposed to. This is particularly evident during the mining strikes in South Africa over 2012, where the share price of gold mining companies was severely depressed due to operational shutdowns of main mining shafts and a complete breakdown in labour relations brought the mining industry to a standstill and greatly affected investor confidence in this sector over this period. During the same period, however, the rand price of gold continued to rise. This demonstrates that a separate set of risk factors affect the gold mining industry, making this market more volatile than the gold bullion market.

Investing in gold through gold exchange traded funds, futures and options and gold mining equities allows investors to gain exposure to the gold price, however, it also exposes them to other risk or pricing factors. Whilst the purest form of gaining exposure to the gold price is through the gold bullion market, these other options are often used for including gold in an investor's portfolio (The World Gold Council, 2010). The form in investment in gold will depend on the risk appetite and purpose of the individual investor's exposure to the gold price.

## **2.2 Flight to safety or quality**

Turbulent market conditions propagate high levels of uncertainty within global capital markets. During these periods, investors exhibit a propensity to move out of equity markets into safe haven assets. This movement is commonly referred to as flight-to-quality or flight-to-safety episodes and is historically characterised by investor movement out of the equity markets into bond markets (Baele et al., 2012). Academics and theorists have postulated and researched numerous underlying causes of this phenomenon. Vayanos (2004) constructed a model based on the theory that high levels of volatility in the market cause risk-averse investment managers to flee to liquidity due to fear of redemptions. In the event that investors would want to redeem their investments in managed funds as a result of high levels of uncertainty and volatility in capital markets, the investment manager would want to be in liquid assets that can easily be converted to cash. The main assumption in his model is that investors are fund managers and redemption is triggered when performance falls below a



certain threshold. According to this model, high levels of market volatility cause investors to become more risk averse and to seek out highly liquid assets. Assets' liquidity premia increase during these periods as investors flee-to-liquidity. Concurrently, higher levels of risk aversion cause an increase in the required risk premium of assets and the returns on risky assets become increasingly negatively correlated with volatility in a flight-to-quality episode.

In a similar vein, Brunnermeier and Pedersen (2008) present a model whereby speculators, who are responsible for creating market liquidity, experience more volatile margin requirements. Under this model, margin requirements are responsible for drying up liquidity following shocks in the market and flight-to-quality occurs through a precipitous decrease in liquidity provisions for more volatile assets with high margins. According to these theories, the safe haven value of an asset is determined by its level of liquidity and correlation with the market as it is these qualities that will protect the investor's portfolio from loss during volatile periods.

An alternative model focusses on Knightian uncertainty as the key driver of flight-to-safety episodes. Knightian uncertainty is immeasurable and incalculable, as opposed to risk that is defined as randomness with known probabilities which can therefore be calculated (Knight, 1921). Caballero and Krishnamurthy (2008) demonstrate how Knightian uncertainty causes investors to favour claims that are not contingent on market movements and perceived as safe over risky claims during periods of low market liquidity. Equities (or shares) are usually assets whose value and claims are contingent on market factors. As a result, during volatile market conditions characterised by low aggregate liquidity, investors chose to shed these assets and flee to bonds, whose claims are considered safe and of an ascertainable value. This theory therefore postulates that the safe-haven value of an asset is driven by its ability to provide non-contingent claims during volatile market periods.

The findings of Lei and Wang (2012) highlight liquidity as a driver of investors' flight-to-safety. They find that high stock illiquidity, high stock volatility and low stock returns are associated with high yield spreads in the bond market. These findings highlight a rational explanation for investors' flight-to-safety, rather than simply attributing it to changes in investor sentiment and behavioural attributes. Their model focusses on inherent differences in the investment horizons of investors and as a result, their sensitivity to changes in transaction costs in the stock and bond market. Under the aforementioned market conditions, the

transaction costs of shares increases resulting in investors moving out of equities towards bonds, accompanied by an increase in the investment horizon of investors.

The general subtext of the literature relating to flight-to-safety episodes is a lack of certainty and liquidity in the market due to volatile market conditions. It has been found that flight-to-safety episodes are driven by investors' flight-to-liquidity as much, if not more than it is driven by investors' flight-to-quality (Baele et al., 2012). It can therefore be inferred from this literature that investors seek highly liquid assets that generate certain payoffs as safe-haven assets during periods of high market volatility. Due to the shift in investor preferences over these periods, equities tend to perform weakly as investors flee from them in favour of fixed income securities such as bonds, which tend to exhibit strong and consistent returns. This, however, is not indicative of bond performance during the recent economic recession suggesting that levels of contagion between equity and bond markets have reached high enough levels to prevent bonds from possessing the safe-haven quality they have in the past.

### **2.2.1 Safe haven assets**

Safe havens protect an investor's portfolio from falling equity prices during periods of extreme volatility and uncertainty. The origin of safe haven assets is inextricably linked to prospect theory in behavioural finance (Ciner, Gurdgiev, & Lucey, 2010). Prospect theory was first developed by Kahneman and Tversky (1979) and provided a critique of expected utility theory as a descriptive model for decisions under risk. It suggests that investors will exhibit different reactions between gains and losses, being more sensitive to losses than they are to gains. It has been found that there is a general prevalence of financial agents being more loss averse and therefore reacting more to losses than to gains in their portfolio (Duxbury & Summers, 2004). In this context individuals will switch abruptly between assets during extreme conditions due to their sensitivity to loss aversion (Ang, Bekaert, & Liu, 2005). As extreme losses do not occur on average, this behaviour will not be exhibited as typical behaviour, but only in extreme market conditions (Ang, Bekaert, & Liu, 2005). This explains why the safe haven property of assets does not exist in normal market conditions but rather only in extreme market conditions.

Whilst it is widely accepted that gold and the short term credit market do exhibit safe haven properties, currencies have also been found to provide safe havens for investors during volatile market periods. The Japanese yen and Swiss franc were both found to appreciate against the US dollar when US stock prices fell and bond prices and FX volatility increased

(Ranaldo & Soderlind, 2010). This provides evidence of the Japanese yen and Swiss franc acting as safe haven currencies for US dollar denominated investments (Ranaldo & Soderlind, 2010). For emerging economies safe haven currencies can also act to protect investors from falling prices in the local equity market. The US dollar and Swiss franc are also widely considered safe haven currencies for the currencies of Brazil, Russia, India, China and South Africa (BRICS) (Thupayagale, 2013). Investors from the BRICS countries can therefore protect their portfolios from falling local equity markets by investing in these safe haven currencies. As commodities are dollar denominated investments, its inclusion in the portfolio of an emerging market investor should act as a safe haven due to the safe haven value of the US dollar.

However, this is not true for all commodities. In the US and the UK gold was found to act as a safe haven against equities and the dollar, however oil was found to act as a safe haven against the dollar and against bonds (Ciner, Gurdgiev, & Lucey, 2010). Gold and oil are both dollar denominated commodities, however only gold acts as a safe haven for US and UK equities. The findings of Jubinski and Lipton (2013) support the fact that oil does not act as a safe haven asset for US equities. Jubinski and Lipton (2013) found that whilst silver and gold do exhibit safe haven properties during extreme market conditions in the United States, oil did not exhibit the qualities associated with a safe haven asset. These findings suggest that not all commodities are able to act as safe haven assets for equity markets, despite being denominated in a safe haven currency.

In the past, the bond market has been viewed as a suitable safe haven for investors however, given increased global integration within the stock and bond market, the safe haven characteristic of bonds is questionable (Baele et al., 2010). It is therefore pertinent to determine whether gold is a more effective safe haven asset during economic downturns than bonds in the current economic climate. During the economic crisis investors were unwilling to refinance maturing commercial paper, leading to a drying up of demand in the US bond market (Kacperczyk & Schnabl, 2009). High levels of uncertainty within the bond market over the financial crisis period diminished the safe haven properties associated with the bond market. Research by Baur and Lucey (2010) has shown that gold exhibits safe haven properties as an asset in the American stock and bond markets and that it can be used as an alternative to bonds in an investor's flight to safety over the period from 1995 to 2005. The key components that allow assets to act as safe-havens are generally present in gold. Whilst gold does not produce a stream of cash flows, one's claim on gold is not contingent on

general market conditions due to the store value property of the asset. Furthermore, there is evidence that during periods of market stress, movement in the gold price is not correlated with general market movements.

### **2.2.2 Gold as a safe haven**

The safe haven property of gold originates from its ability to act as an inflationary hedge and has origins as one of the first forms of money (Baur & Lucey, 2010). A safe haven asset is classified as one which is uncorrelated (or negatively correlated) with another asset or portfolio in times of market stress and in the past gold has displayed this quality and it is a generally accepted principle within the financial markets that gold is a safe haven asset. The propensity of risky assets to move together during these turbulent times diminishes the number of positive investment opportunities in the market, making it increasingly difficult for investors to identify and invest in financial assets that generate positive returns (Coudert & Raymond-Feingold, 2011). The increase in the price of this asset during turbulent market conditions due to increasing investor demand could provide investors with positive returns, which are in excess of those provided by risky assets. Despite this general consensus, academic research relating to this property of gold has been limited and has only evolved into a well-researched field of study in recent years, following the research conducted by Baur and Lucey (2010) (Baur & Glover, 2011). This is consistent with the finding of Baur and Glover (2011), that gold has only evolved as a safe haven asset in recent years and prior research into this field would prove futile.

Through studying the time varying relations between U.S., U.K. and German stock and bond returns and gold, Baur and Lucey (2010) were able to identify that gold is a hedge for stocks on average and a safe haven in extreme market conditions. Another finding in this study was that the safe haven property of gold was short lived and diminished approximately 15 days after an extreme shock. From this evidence, one would expect the price of gold to decrease as the uncertainty in the capital market decreases and investors move their funds out of safe haven assets back into risky assets. When the period of an investor's flight to safety ends, gold's use as a safe haven asset will be eliminated causing a decrease in the demand (*ceteris paribus*) and price of gold. Investors holding gold after its use as a safe haven asset has been eliminated should experience negative returns on their gold investment (Baur & Lucey, 2010). These findings were supported by Baur and McDermott (2010), who found that gold was a safe haven for major European and U.S. markets, but not for large emerging markets.

However, the recent surge in the gold price has propagated questioning as to the changing characteristics of the fundamental properties of gold (Baur & Glover, 2011). If the fundamental value of gold is in fact changing, its value as a safe haven asset comes into question. An increase in investor demand for gold (driven by higher demand for safe-haven assets) will increase the price of gold. This may in turn lead to the elimination of gold's safe-haven value (Baur & Glover, 2011). It is therefore important to examine the safe haven property of gold within the context of recent turbulent market conditions. These periods of turbulence are characterised by a form of negative contagion within the capital markets, causing the price of all risky assets to decrease (Coudert & Raymond-Feingold, 2011).

### **2.2.2 Gold asset bubble**

Asset bubbles are detrimental to the markets in which they occur. The bursting of the U.S. housing bubble was the pretext to the U.S. credit crisis of 2007, which subsequently led to the global recession in 2008. This chain of events highlights the corrosive and damaging nature of an asset bubble and the far reaching effects it may have. The global integration of the world economy has long diminished the isolated effects of asset bubbles to the market in which they occur. It has therefore become increasingly important to be able to detect and manage the occurrence of asset bubbles before they 'burst'. Research relating to the time-series characteristics of asset bubbles, incited by the subprime mortgage crisis of 2008, has allowed researchers to gain insight to the mechanisms through which bubbles are generated and subsequently burst (Baur & Glover, 2012).

The surge in the gold price, from 2008 to 2011, has propagated many, including the likes of George Soros and John Paulson, to infer that there is in fact a gold bubble present. This would bring into question many of the fundamental characteristics of gold as a financial asset (Baur & Glover 2012). The very nature of a store-of-value asset proposes that the asset cannot be prone to bubble behaviour. The value of a store-of-value asset must be represented by the asset at all times and cannot fluctuate with investor whims or behaviourist factors. If gold does exhibit bubble-like behaviour, the store-of-value quality of gold comes into question and cannot be assumed to exist (Baur & Glover, 2012). Furthermore, gold's ability to act as a safe haven asset is questionable under the imposition of a gold bubble in the market. Bubble-like characteristics, including an inflated price, would destroy the safe-haven property of gold. This would have detrimental effects on the stabilising effects that this asset would have in the economy as a safe-haven asset.

The existence of an asset bubble in the gold market is widely postulated and well researched following the explosive growth in the gold price in recent times. It is hypothesised that the safe-haven value of gold is insufficient in explaining this price movement and that it is rather governed by underlying behavioural and irrational factors. Baur and Glover (2012) find strong evidence of bubble-like characteristics in the gold market and detect a bubble in the gold market extending from 2002 to 2012. Furthermore, they believe that their findings are due to behaviourist factors, as chartists are very prevalent in the gold market in recent times. This belief is affirmed by the evidence that real demand has decreased in relation to investor demand for gold. According to evidence presented in their study, the store-value and safe-haven value of gold is under threat.

The existence of a speculative bubble in the gold market is supported by Homm and Breitung (2012), who find highly explosive price behaviour from 1968 to 1980 and from 1985 to 2010 and lower levels of significance in the gold market. They interpret this explosive behaviour in the price of gold to be indicative of a gold bubble. The methods used in the studies of both Baur and Glover (2012) and Homm and Breitung (2012) do not require the fundamental value of gold to be determined and require less stringent assumptions regarding knowledge of the fundamental value of gold. Given the various factors affecting the gold price and difficulties in determining its fundamental value due to the fact that it does not produce any income streams, these methods provide more accurate findings.

Bialkowski et al. (2012) test for the existence of a gold bubble by employing a methodology that incorporates estimating the fundamental price of gold using the convenience yield. Their findings contradict that of Homm and Breitung (2012) and Baur and Glover (2012), and they find that a gold bubble does not exist and that the explosive price can be fully explained by the fundamental value of gold. Given the increase in chartists in the gold market and the myriad of factors affecting the gold price, methodology involving the estimation of the fundamental value of gold in determining the existence of an asset bubble in the gold market is questionable (Baur & Glover 2011). Given the corrosive nature of a gold bubble on the store-value and safe-haven value of gold, it is pertinent to examine the safe-haven property of gold in a South African context. Whilst it is a generally accepted principle that gold is a safe haven, there is also a possibility that the existence of a gold bubble has destroyed this characteristic of gold as a financial asset.

## 2.3 Summary

Gold's store-of-value allows it to possess unique characteristics as a financial asset. Its value is so closely tied to long-run U.S. inflation that this measure is often cited as a measure of its long-run fundamental value. This high correlation in U.S. inflation rate and gold returns allow gold to act as an inflationary hedge. From a portfolio management perspective, gold is also used as an exchange rate hedge for dollar denominated investments and as a successful portfolio diversifier. It is a highly liquid and universally accepted asset with unique qualities which allow it to be used as a tool by investors for portfolio management purposes that extend beyond its value as a commodity.

Although gold is a useful tool in portfolio management, it does not generate a fixed stream of cash flows from which its value can be ascertained. Despite the long-run value of gold being closely tied to inflation, the short-run pricing of gold is determined by demand and supply factors. Whilst the supply of gold has remained relatively stable over recent times, the demand for gold has increased. Specifically, investor demand has increased with an influx of speculative traders in the gold market. The increase in the gold price in recent years is therefore inextricably linked to an increase in the demand for gold by investors.

Given the value of gold as a financial asset, there have been numerous developments in financial instruments allowing investors to gain access to movements in the gold price. Investors can either gain direct access to gold by investing in gold bullion bars or gold bullion coins. Alternatively, investors can gain access to the gold market through financial instruments such as gold ETF's, futures, options or gold mining shares. Financial instruments exposing investors to gold price movements also expose investors to a different set of risks associated with other variables, such as operational risks for gold mining shares and interest rate risk for option and future contracts. Gold ETF's also expose investors to a diminishing capital holding as the management fees are deducted as a reduction in the original representative share of gold holdings of the ETF.

During periods of high volatility and turbulent market conditions, investors have the tendency to flee-to-safety. Despite the vast contrasts in the literature concerning the hypotheses as to why equities and bonds exhibit a negative relationship during these periods, the majority of research highlights liquidity and unconditional claims during increasingly volatile periods as being the key ingredients in flight to safety episodes. Safe haven assets are therefore required to be highly liquid with non-contingent claims in order to satisfy investor's requirements

during these periods. Gold's store-value quality allows it to satisfy the unconditional claims requirement whilst its international use and acceptance allows it to possess high levels of liquidity. These qualities propagate its use as an alternative to bonds as a safe haven asset. Given that safe haven assets increase in price due to increased demand during volatile market conditions, it is probable that the increase in the price of gold over recent years is due to investors use of gold as a safe haven asset during their flight-to-safety.

There is an alternative explanation for the recent surge in the price of gold. Evidence of a gold bubble has been found in the gold market and it is widely postulated that it is this gold bubble that has driven the price of gold to such levels. The existence of an asset bubble in the gold market would destroy the store-value of gold as well as its safe-haven value, corroding its value as a stabilising force in the financial markets. This study will extend the understanding of the role that gold plays as a financial asset and move towards identifying factors that allow it to be used as a valuable tool for investment purposes in the South African market.



### **3 Data and methodology**

This chapter will outline the data and sample, as well as the methodology used in this research paper. This research is conducted purely from the perspective of the South African investor and as such, all implications are directly related thereto.

#### **3.1 Data**

Daily spot gold price data and MSCI Global Equity Index price data was obtained from DataStream and converted from the U.S. dollar to South African rands (ZAR) using the closing daily exchange rate. Daily prices for the All Share Index (ALSI) and the All Bond Index (ALBI) were obtained from DataStream. Price data will be used to calculate daily returns for each variable. Consistent with the methodology of Baur and Lucey (2010), the data will be analysed in the local South African currency as this study focuses on the characteristics of gold for South African investors. Inet Bridge was the software used to run the regressions.

The data will cover the period from 1 May 1998 to 1 August 2013. This period of study includes the period of the global recession and allows for the properties of gold to be examined over various economic periods, in a South African context. It has been found by Baur and Glover (2011) that the characteristics of gold as an investment are changing, as more chartists enter the gold market. Many of the observed price dynamics in the gold market over the last 40 years can be attributed to agents switching between fundamentalist and chartist strategies.

This study seeks to add to the South African investor's understanding of the characteristics and investment feasibility of gold in the current economic environment. For this reason, increasing the period of study beyond 15 years may lead to results that are indicative of a gold market characterised by a higher presence of fundamentalists, which is not representative of the current environment.

#### **3.2 Theoretical framework for gold as a safe haven or a hedge**

In order for gold to be a safe haven, it is required to exhibit a non-positive correlation with a portfolio during *extreme market conditions* (Baur & Lucey, 2010). This is contrary to the definition of a hedge which requires that gold possess a non-positive correlation with a portfolio on *average* (Baur & Lucey, 2010). A safe haven asset therefore possesses the specific quality of reducing losses during periods of market stress, whilst a hedge does not.

The theoretical framework for gold as a safe haven, a hedge or a diversifier are summarised in Table 1 below. This research aims to determine whether gold acts as a safe haven, diversifier or a hedge for South African shares, international shares and South African bonds given the theoretical framework in Table 1.

**Table 1: Theoretical framework for gold as a safe haven, a hedge or a diversifier**

Theoretical framework for gold as a safe haven, a hedge or a diversifier	
Gold as a safe haven	Gold exhibits a non-positive correlation with a portfolio during extreme market conditions
Gold as a hedge	Gold exhibits a non-positive correlation with a portfolio on average
Gold as a diversifier	Gold exhibits a positive (but not perfect) correlation with a portfolio on average

### 3.2.1 Hypothesis for gold as a safe haven or a hedge

If gold exhibits a non-positive correlation with the South African stock and bond market on average, it can be considered a hedge, whilst if it is found that it exhibits a non-positive correlation with the South African stock and bond market during extreme market conditions only, it will be considered a safe haven asset. From the theoretical framework two hypotheses can be tested in the South African market:

- Hypothesis 1: Gold is a hedge for bonds and stocks in the South African market and international stocks.
- Hypothesis 2: Gold is a safe haven for stocks and bonds in the South African market and international stocks.

### 3.3 Research methodology for gold as a safe haven or a hedge

The methodology used in this study to determine whether gold is a safe haven or a hedge for the South African stock and bond market will replicate that used by Baur and Lucey (2010). The principal regression model is:

$$r_{gold, t} = a + b_1 r_{stock, t} + b_2 r_{stock, t(q)} + c_1 r_{bond, t} + c_2 r_{bond, t(q)} + e_t \quad (1)$$

$$h_t = a e_{2t-1} + \gamma e_{2t-1} D(e_{t-1} < 0) + \beta h_{t-1}$$

where  $r_{gold}$ ,  $r_{stock}$ , and  $r_{bond}$ , are the returns on gold, the ALSI and the ALBI prices respectively. The terms  $r_{stock, t(q)}$  and  $r_{bond, t(q)}$  account for the asymmetries of extreme shocks in the market and are included in order to focus on falling stock and bond markets (Baur & Lucey, 2010). Negative shocks in the lowest percentiles (Appendix C) occur during periods of extreme market stress such as during 2008 and 2009, where the markets fall drastically and experience large negative returns during a trading day. The role of gold in times of extreme stock and bond market situations is analysed by including regressors that contain stock and bond returns that are in the lower  $q$  percentile, such as the 5%, 2.5% and 1% percentile. If the return is larger than the  $q^{th}$  percentile, the value of  $r_{stock, t(q)}$  and  $r_{bond, t(q)}$  is zero. These regressors will capture the relationship of gold returns with stock and bond returns during periods when stocks and bonds are experiencing significantly lower than normal returns. These conditions generally occur during recessionary periods. A dynamic regression model is used, which assumes that the error term exhibits conditional autoregressive heteroskedasticity modelled via a GARCH process for the errors in (1). The results of this regression will provide implications for the South African investor, investing in the South African stock and bond market.

Following the methodology of Baur and Lucy (2010), a regression will also be run to examine the relationship between the gold price and the ZAR based returns of the MSCI Global Equity Index. This regression model is:

$$r_{gold, t} = a + d_1 r_{int. stocks, t} + d_2 r_{int. stocks, t(q)} + e_t \quad (2)$$

$$h_t = \alpha e_{2t-1} + \gamma e_{2t-1} D(e_{t-1} < 0) + \beta h_{t-1}$$

where  $r_{gold}$  and  $r_{int. stocks}$ , are the returns on gold and the MSCI Global Equity Index prices respectively. The terms  $r_{int. stock, t(q)}$  account for the asymmetries of extreme shocks in the market and are included in order to focus on falling international stock markets (Baur & Lucey, 2010). The results of this regression will provide implications for the South African investor, investing in international stock markets.

### 3.3.1 Relations of the model and hypotheses

Hypothesis 1: Gold is a hedge for bonds and stocks in the market

If  $b_1$  is zero or negative, it implies that gold is a hedge for stocks, as the assets are uncorrelated (negatively correlated) with one another on average.

If  $c_1$  is zero or negative, it implies that gold is a hedge for bonds, as the assets are uncorrelated (negatively correlated) with one another on average.

If  $d_1$  is zero or negative, it implies that gold is a hedge for international stocks, as the assets are uncorrelated (negatively correlated) with one another on average.

Hypothesis 2: Gold is a safe haven for stocks and bonds in the South African market and international stocks.

The safe haven property of gold for South African stocks and bonds and international stocks for a South African investor is tested via the parameters  $b_2$ ,  $c_2$  and  $d_2$  respectively. In accordance with the methodology of Baur and Lucey (2010), if the total effect in extreme bear markets for stocks and bonds in non-positive (sum of  $b_1$  and  $b_2$  for South African stocks, sum of  $c_1$  and  $c_2$  for South African bonds and sum of  $d_1$  and  $d_2$  for international stocks), gold serves as a safe haven for South African stocks and bonds and international stocks for South African investors as they are uncorrelated or negatively correlated with one another. A negative correlation during extreme bear markets implies that the price of gold increases in a manner that compensates investors for losses incurred with stock and bond investments (Baur & Lucey, 2010).

The structure of the model in (1) and (2) assumes that contemporaneous stock or bond prices can affect the price of gold, which is consistent with the safe haven hypothesis. If stock and bond returns are extremely negative, investors will buy gold and this will cause the price of gold to increase (Baur & Lucey, 2010). If the price of gold is not affected during periods of adverse market conditions, investors neither buy nor sell gold over these periods (Baur & Lucey, 2010).

### **3.3.2 Portfolio analysis**

The average cumulative returns for two portfolios comprising of stocks and gold for the period spanning 50 and 100 trading days after the occurrence of an extreme negative stock return will be analysed in accordance with the methodology of Baur and Lucey (2010). This will reveal the average evolution of stock and gold returns after an extreme negative stock market shock.

An extreme negative stock market shock is defined as an event where the extreme negative stock return is smaller than the 5% percentile of the distribution of returns. Cumulative returns will be calculated for gold and stocks following the extreme shock as follows:

$$CR_i = \frac{(Price_{i,t+x}) - (Price_{i,t})}{Price_{i,t}} \quad \text{where } x = (1, \dots, 50) \quad (3)$$

This will show how gold and stocks perform in the period between the initial shock at  $t$  and  $t+x$  trading days (Baur & Lucey, 2010). As the prices of stocks recover, it is expected that the safe haven value of gold is eliminated. This process examines the evolution of the safe haven property of gold and the price impact in the gold market (Baur & Lucey, 2010).

Minimum variance portfolios will also be constructed over the full sample period and the economic crisis period (2008 to 2009) using daily returns for gold, the ALSI and the MSCI Global Stock Index. The optimal weightings will be examined over these periods in order to further examine the evolution of gold returns in different economic states. The variance of a portfolio is calculated as follows:

$$\sigma_{port} = \sqrt{\sum_{i=1}^n w_i^2 \sigma_i^2 + \sum_{i=1}^n \sum_{j=1}^n w_j w_i Cov_{ij}} \quad (4)$$

Where  $\sigma_{port}$  is the standard deviation of the portfolio,  $w_i$  is the weights of an individual asset class in the portfolio and are determined by the proportion of the value of the portfolio,  $\sigma_i$  is the standard deviation of the rates of return for asset class  $i$  and  $Cov_{ij}$  is the covariance between the rates of return for asset class  $i$  and  $j$ . In order to calculate the minimum variance portfolio, one would solve equation (4) for the asset weights that would produce the minimum standard deviation of the portfolio.

### 3.3.3 Assumption of the models

The structure of model (1) assumes that contemporaneous stock or bond prices can affect the price of gold, which is consistent with the safe haven hypothesis. If stock and bond returns are extremely negative, investors will buy gold and this will cause the price of gold to increase (Baur & Lucey, 2010). If the price of gold is not affected during periods of adverse market conditions, investors neither buy nor sell gold over these periods (Baur & Lucey, 2010). A further assumption is that gold does not influence stock or bond prices and there is no feedback effect in model (1). This assumption is supported by prior research (Baur & Lucey, 2010).

## 4. Empirical Analysis and Results

This section will present the descriptive statistics for the JSE All Share Index, the JSE All Bond Index and the MSCI Global Stock Index. The results for regression model (1) and regression model (2) will then be presented and discussed and this section will conclude with a summation of the results.

### 4.1 Descriptive statistics

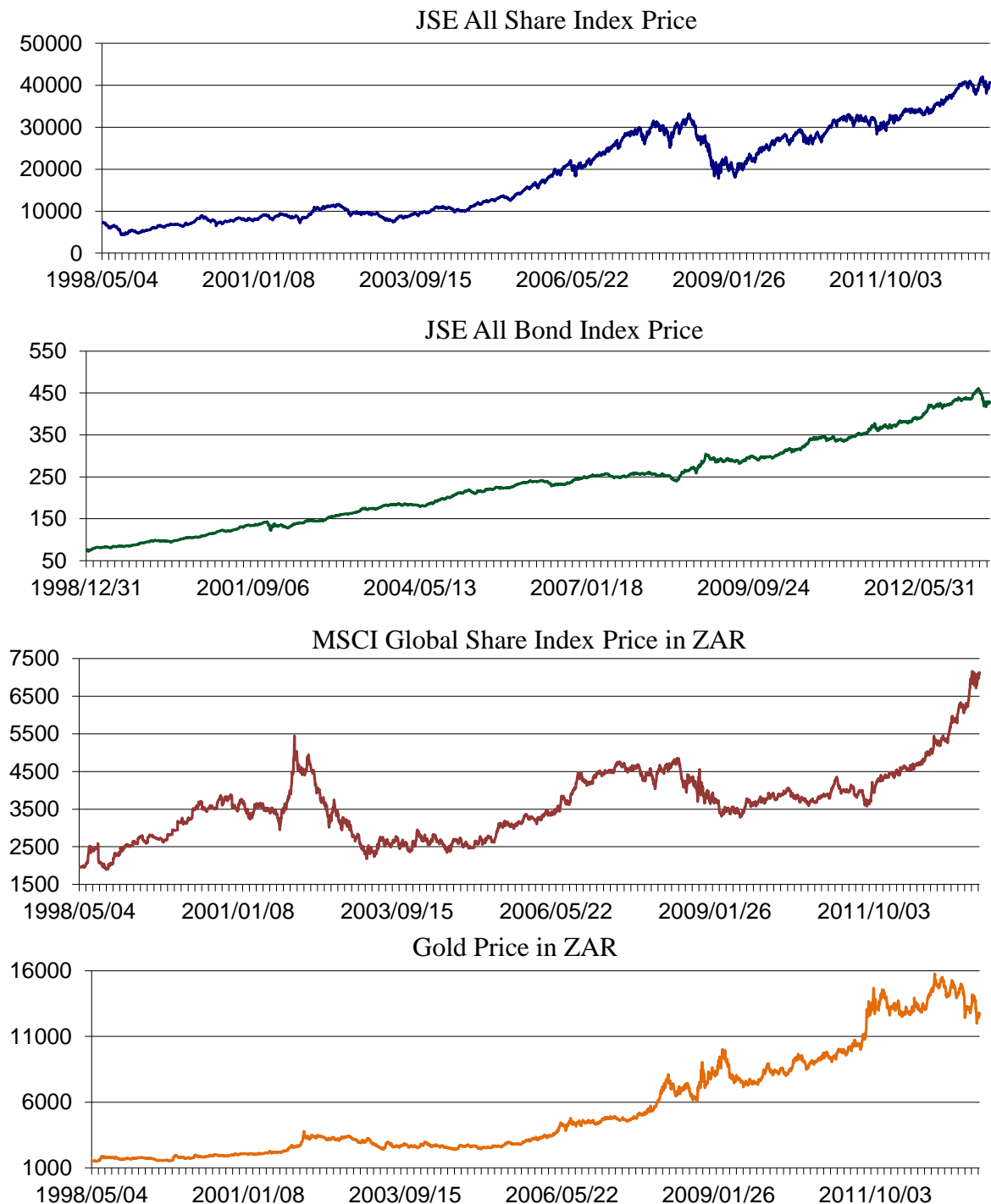
Table 2 displays the descriptive statistics for South African shares, South African bonds, gold and international shares (details in Appendix A). Through the analysis of daily returns, it was found that gold, South African shares and international shares were more risky than South African bonds (as measured by the standard deviation of daily returns). Furthermore, South African shares displayed higher levels of risk than international shares, from a South African investor's perspective. The return distribution for South African equities, bonds and international equities all display negative skewness and all return distributions display leptokurtosis. These results highlight the fact that gold is not considered a safe asset with low levels of volatility, comparable to the bond market. This is consistent with the findings of Jaffe (1989) who noted that the high levels of volatility of gold returns expose the high levels of riskiness of gold as an individual asset and portray an uncommon characteristic of safe haven assets.

**Table 2: Descriptive statistics for ALSI, ALBI, Gold and MSCI Global Stock Index**

	ALSI	ALBI	Gold	MSCI
Mean (%)	0.03	0.04	0.05	0.03
Standard Error	0.0002	0.0001	0.0002	0.0002
Standard Deviation	0.0124	0.0042	0.0138	0.0121
Kurtosis	6.8944	38.3795	15.4854	17.6682
Skewness	-0.2587	-1.3001	0.6798	-0.2634
Minimum	-0.0790	-0.0756	-0.1110	-0.1665
Maximum	0.0683	0.0495	0.1735	0.0888
Count	4000	4000	4000	4000

Figure 2 shows the prices for the JSE All Share Index, the JSE All Bond Index, and the MSCI Global Share Index in South African rands and gold in South African rands for the full sample period. It is clearly evident that there is an inverse relationship between the price of

gold and share prices (both South African and internationally) during the 2008 to 2009 period. It was during this period that the full effects of the economic recession were felt and it is expected that if gold does act as a safe haven asset, the price should be uncorrelated with risky assets.



**Figure 2: South African and international share prices, South African bond prices and the ZAR gold price from 1 May 2008 to 1 August 2013.**

Consistent with the findings of Baur and Lucey (2010), gold was found to be relatively risky in terms of its standard deviation and the maximum and minimum values. This suggests that whilst gold may display safe haven qualities, it is not in itself a safe asset and can be considered to be relatively risky asset. This lends support to the observation that gold and bonds are not interchangeable assets, despite the existence of empirical evidence that both assets do exhibit safe haven properties.

## **4.2 South African Equities**

The results for regression model (1) are shown in Table 3 and Table 4. This section will discuss the results of the model in relation to the JSE All Share Index, which is used as a proxy for the South African equities market. The co-efficient for the average effect of contemporaneous South African shares on gold is -0.04744 and this effect is highly significant at a 5% level of significance. As the co-efficient shows that South African equities are negatively correlated with gold on average, the theoretical framework suggests that gold acts as a hedge for South African shares on average.

Baur and Lucey (2010) establish the safe haven status by summing the coefficients up to the safe haven variable of interest. For example if one were interested in whether gold were a safe haven if the ALSI return were in the lowest 2.5% of returns, one would sum the coefficients of the hedge variable and the safe haven 5% and safe haven 2.5% variables, which include  $b_1$ ,  $b_2$  5% and  $b_2$  2.5% - which gives -0.0122. This would effectively give us the safe haven variable of interest and in order for gold to be considered a safe haven asset, this variable would have to exhibit no correlation or a negative correlation with gold.

The results of the safe haven variable are negative for all percentiles, implying that gold does in fact act as a safe haven asset for South African equity investors. However, the results are only significant for the lowest one percentile. Therefore, gold will display safe haven qualities for the South African equity investor when shares fall to the lowest one percentile of returns. These conditions were prevalent during the 2008 economic recession and during this period gold did in fact experience significantly higher returns than South African equities.



**Table 3: Results for the JSE All Share Index**

JSE All Share Index						
	Coef est	Std err	t-stat	p-value	Sum coef	
b <sub>1</sub>	-0.04744	0.0208	-2.2725	0.0231		**
b <sub>2</sub> (5 <sup>th</sup> percentile)	0.0161	0.0339	0.4751	0.6350	-0.0313	
b <sub>2</sub> (2.5 <sup>th</sup> percentile)	0.0191	0.0369	0.5183	0.604 0	-0.0122	
b <sub>2</sub> (1 percentile)	-0.0968	0.0257	-3.7610	0.0001	-0.1090	***
1 lag						
b <sub>1</sub>	0.002718	0.021223	0.128092	0.8980		
b <sub>2</sub> (5 <sup>th</sup> percentile)	-0.00069	0.034428	-0.02011	0.9840	0.0020	
b <sub>2</sub> (2.5 <sup>th</sup> percentile)	-0.01227	0.037462	-0.32739	0.7430	-0.0102	
b <sub>2</sub> (1 percentile)	-0.01759	0.026126	-0.67331	0.5010	-0.0278	

Note: \* denotes 10% l.o.s    \*\* denotes 5% l.o.s.    \*\*\* denotes 1% l.o.s.

The Akaike Information Criteria was used to determine the optimal lag length and it led to a specification of no lags for the JSE All Share Index. The result for gold as a hedge and for gold as a safe haven for all levels using one lag is insignificant. From a practical perspective, this implies that investors holdings gold *at the time* of severe bear markets would profit from the safe haven properties of gold. Investors that only invest in gold *once* extreme bear market conditions are prevalent would not experience the same level of protection from losses. This finding, together with the fact that gold acts as a hedge for South African equities lends validity to the belief that all South African portfolios should include some level of investment in gold. It is highly probable that investing in gold as a safe haven asset only after shares have fallen below the one percentile of returns will prove to be a futile exercise and will provide very little protection for the South African investor.

### 4.3 South African Bonds

The results for model (1) in relation to returns for the JSE All Bond Index are shown in Table 4. A highly significant coefficient of -0.1508 for contemporaneous ALBI and gold returns indicate that gold acts as a hedge for the South African bond market. Whilst the safe haven coefficients for contemporaneous bond returns are all negative, these results are not significant.

**Table 4: Results for the JSE All Bond Index**

JSE All Bond Index					
	Coef est	Std err	t-stat	p-value	Sum coef
$c_1$	-0.1508	0.0214	-7.0241	0.0000	***
$c_2$ (5 <sup>th</sup> percentile)	0.0093	0.0409	0.2281	0.8200	-0.1415
$c_2$ (2.5 <sup>th</sup> percentile)	0.0353	0.0449	0.7873	0.4310	-0.1061
$c_2$ (1 <sup>st</sup> percentile)	0.0451	0.0290	1.5558	0.1200	-0.0609
1 lag	Coef est	Std err	t-stat	p-value	Sum coef
$c_1$	-0.0663	0.0214	-3.0920	0.0020	***
$c_2$ (5 <sup>th</sup> percentile)	0.0531	0.0414	1.2823	0.2000	-0.0131
$c_2$ (2.5 <sup>th</sup> percentile)	-0.1418	0.0455	-3.1138	0.0018	-0.1550 ***
$c_2$ (1 <sup>st</sup> percentile)	0.0257	0.0291	0.8833	0.3770	-0.1292
Note: * denotes 10% l.o.s.    ** denotes 5% l.o.s.    *** denotes 1% l.o.s.					

The Akaike Information Criteria determined a specification of one lag length for the South African bond market. Consistent with the methodology of Baur and Lucey (2010), the results of this specification requires that the lagged effect needs to be added to the overall contemporaneous effect for the South African bond market. Whilst this results in negative safe haven coefficients for all levels, the safe haven effect is only significant at the lowest two and a half percentile. This implies that gold only acts as a safe haven for falling bond markets within a certain range. The results also indicate a significant lagged effect of gold as a hedge for South African bonds.

#### 4.4 International Stocks

Table 5 presents the results for model (2). The coefficient for the average effect of contemporaneous international stocks on gold is 0.2704 and this is highly significant, demonstrating that for a South African investor, gold does not act as a hedge for international stocks. This variable demonstrates that gold is positively but not perfectly correlated with international share returns, allowing gold to act as a diversifier in portfolios of South African investors investing in international shares. The coefficient for the safe haven variable in the regression is significantly positive for the lowest one percentile of returns and significantly negative for the lowest fifth percentile of returns. The sum of the coefficients is positive

throughout, implying that gold is not a contemporaneous safe haven for South African investors investing in international equities.

**Table 5: Results for the MSCI Global Stock Index**

MSCI Global Stock Index						
Gold	Coef est	Std err	t-stat	p-value	Sum coef	
d <sub>1</sub>	0.270448	0.018927	14.28873	0		***
d <sub>2</sub> (5 <sup>th</sup> percentile)	0.087868	0.034883	-2.51894	0.01811	0.18258	**
d <sub>2</sub> (2.5 <sup>th</sup> percentile)	0.021812	0.041127	0.53036	0.59600	0.204392	
d <sub>2</sub> (1 <sup>st</sup> percentile)	0.091072	0.029231	3.11556	0.00185	0.295464	***
1 lag						
d <sub>1</sub>	-0.0434	0.01969	-2.20393	0.02759		*
d <sub>2</sub> (5 <sup>th</sup> percentile)	-0.14908	0.036901	-4.03996	0.000055	-0.19248	***
d <sub>2</sub> (2.5 <sup>th</sup> percentile)	0.035637	0.043278	0.82345	0.41	-0.15684	
d <sub>2</sub> (1 <sup>st</sup> percentile)	-0.00209	0.030378	-0.09686	0.945	-0.15893	
Note: * denotes 10% l.o.s    ** denotes 5% l.o.s.    *** denotes 1% l.o.s.						

The Akaike Information criteria was used to determine optimum lag length and led to a specification of one lag for international stock returns. Consistent with the methodology of Baur and Lucey (2010), the results of this specification requires that the lagged effect needs to be added to the overall contemporaneous effect for international share returns. The resultant sum of coefficients for the fifth percentile of returns is -0.0099 and is highly significant. This implies that the lagged effect is stronger than the contemporaneous effect of gold as a safe haven for international stocks at the lowest five percentile. These results suggest that gold is only a safe haven for international share returns after international equities have experienced moderately negative returns (in the lowest fifth percentile). The results demonstrate that in the lowest percentiles, gold does not demonstrate safe haven properties for South African investors investing in international shares. Gold does however act as a hedge for lagged international equity returns and this effect is significant at a 5% level of significance.

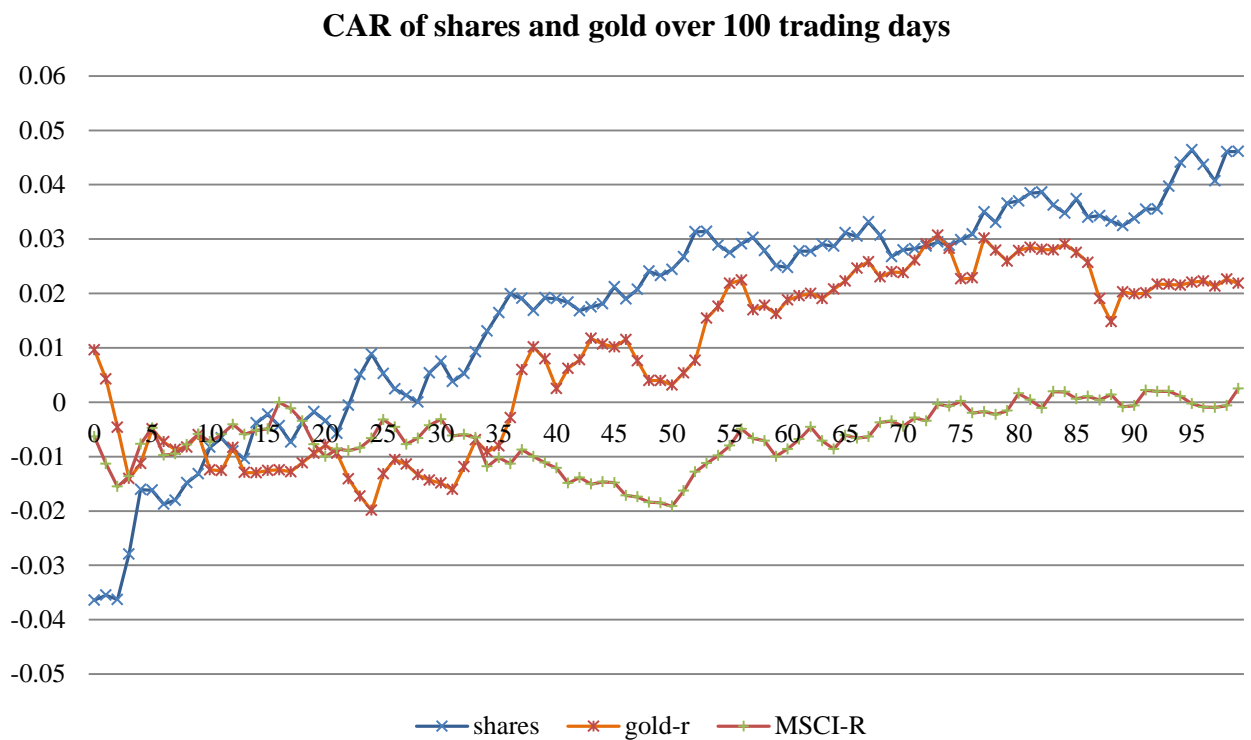
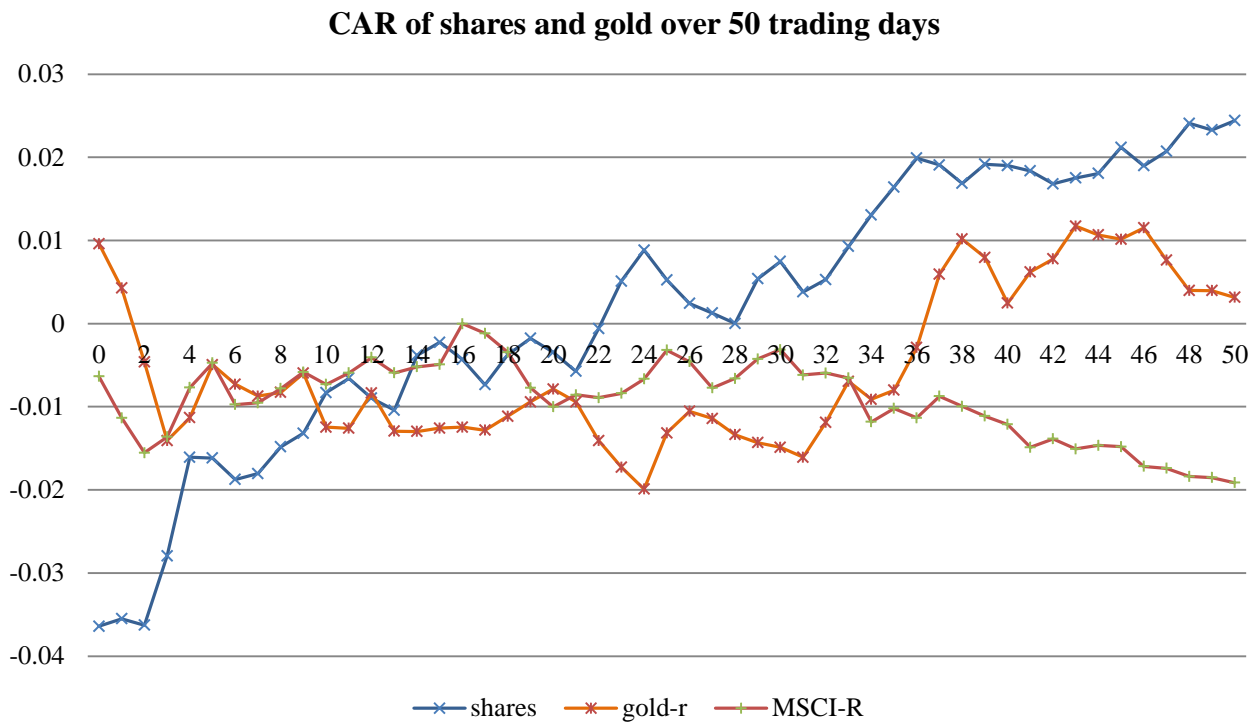
## 4.5 Portfolio Analysis

The cumulative returns for a portfolio comprising of gold, JSE All Share Index and MSCI Global Share Index for the period spanning 50 and 100 trading days after an extreme negative shock has occurred is examined in this section. This demonstrates the practical implications of our findings in the previous section and displays the evolution of shares and gold returns through time. The regression models do not show how gold performs after an extreme negative shock in the stock market and this section seeks to address this question.

Figure 3 shows the cumulative average stock and gold returns (CAR) after an extreme negative shock in the South African and international share market smaller than the fifth percentile for the full sample. This clearly demonstrates that the return for gold is positive on the day that an extreme negative shock occurs in the stock market. Furthermore, the safe haven effect of gold is eliminated after two trading days. Two trading days following the extreme negative shock the positive returns on gold are reduced to zero. This is consistent with the findings of Baur and Lucey (2010) who found that the safe haven effects of gold are short lived and were eliminated after 15 days following an extreme negative shock in the United States of America and United Kingdom.

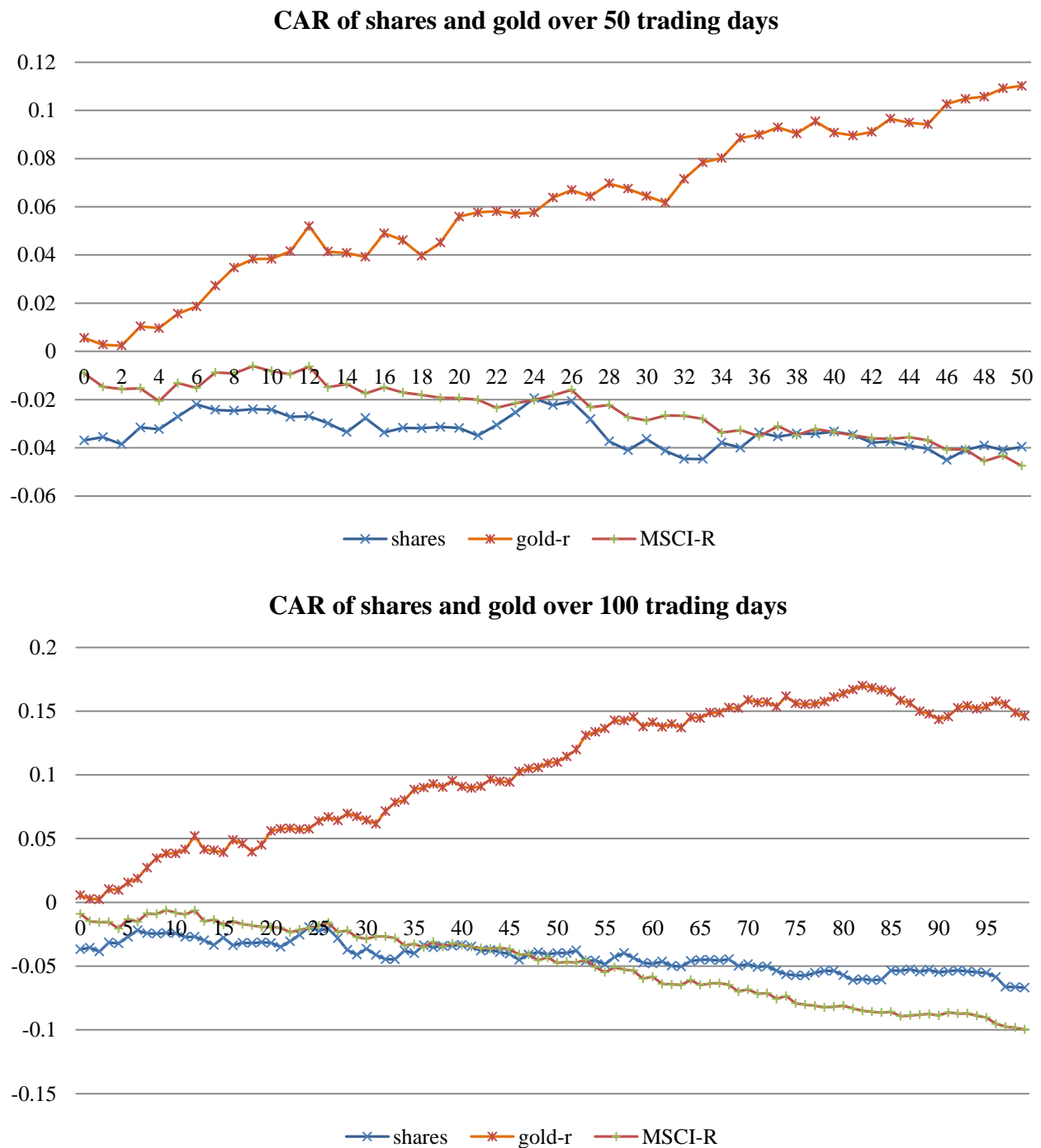
Baur and Lucey (2010) explained this phenomenon as being due to the dual function of gold as a hedge for shares. This is also consistent with our findings in the previous section which shows that gold is a hedge for South African shares on average. The safe haven effect is eliminated once the South African equity market begins to recover and begins assuming the role of a hedge.

The evolution of gold returns in relation to global equity returns is also demonstrated in Figure 3. Consistent with the findings for South African equities, it is evident that gold acts as a safe haven for global equities and that this effect is eliminated after two days. Furthermore it is clear that whilst gold does act as a hedge for global equities on average, this effect is weaker than that found for South African equities. This is consistent with the regression results that show that gold acts as a hedge for global equities at a 5% level whilst it acts as a hedge for South African equities at a 2.5 % level. This is possibly due to the fact that gold is denominated in the same currency as the MSCI Global stock index.



**Figure 3: Portfolio analysis showing the average evolution of returns for South African shares and gold after a negative shock in the fifth percentile for the full sample**

Given the short term nature of the safe haven effect exhibited by gold and the fact that the economic crisis was characterised by a series of negative shocks in the South African equities market, it is pertinent to examine the evolution of returns for South African shares and gold using the dates in this period which exhibit a negative shock in the fifth percentile exclusively. These results are shown in figure 4.



**Figure 4: Portfolio analysis showing the average evolution of returns for South African shares and gold after a negative shock in the fifth percentile for 2008-2009**

During 2008 and 2009 a total of thirty seven severe market shocks (within the lowest fifth percentile of South African equity returns) occurred. Many of these were within seven days of one another (Appendix C). Figure 4 displays the results of this analysis which show that, even over this turbulent period, gold continues to act as a safe haven for both South African and global equities. The combined qualities of gold as a safe haven and a hedge for South African and global equities allows gold returns to offset negative returns incurred by South African equity investors.

#### 4.5.1. Minimum Variance Portfolios

In order to fully evaluate the practical implications of gold as a safe haven and a hedge for international and South African equity markets, the asset weightings were calculated for the minimum variance portfolio containing gold, the ALSI and the MSCI Global Index. This section seeks to determine the optimum weighting assigned to each asset class over the entire sample period as well as the economic crisis period. The 2008 to 2009 crisis period was examined separately due to the severity and frequency of the negative market shocks over this period.

**Table 6: Results for minimum variance portfolios for full sample period and economic crisis period**

	<b>2008-2009</b>	<b>Full Period</b>
ALSI (Weighting)	0.2192	0.3298
Gold (Weighting)	0.3059	0.2476
MSCI (Weighting)	0.4749	0.4226
Annualised $\sigma$	19.13%	9.35%
ALSI (Weighting)	0.4646	0.5570
Gold (Weighting)	0.5354	0.4430
Annualised $\sigma$	23.16%	14.72%

It is evident from the results in Table 6 that during extreme market condition (such as those experienced in the 2008 financial crisis) a higher proportion of gold is included in the minimum variance portfolio. It is also evident from these results that global diversification is beneficial over all periods as a portfolio constructed with three asset classes (gold, the ALSI and the MSCI) has a lower standard deviation than a portfolio constructed using only gold

and the ALSI. These results verify the robustness of the results of the regression and provide evidence to support the notion that increasing the weighting of gold in a South African investor's portfolio during extreme market condition can serve to minimise the effects of falling equity prices.



## 5. Conclusion

The findings of this research show that, for South African investors investing in South African equities, gold acts as a hedge on average. Furthermore, gold will display safe haven qualities for the South African equity investor when shares fall to the lowest one percentile of returns. These conditions were prevalent during the 2008 economic recession and during this period gold did in fact experience significantly higher returns than South African equities. The result for gold as a hedge and for gold as a safe haven for all levels using one lag is insignificant. From a practical perspective, this implies that investors holdings gold at the time of extreme bear markets would profit from the safe haven properties of gold. Investors that only invest in gold once extreme bear market conditions are prevalent would not experience the same level of protection from losses.

In relation to the finding for gold as a safe haven or a hedge for the South African bond market, it was found that gold does act as a hedge on average. Furthermore, it was found that gold only acts as a contemporaneous safe haven for falling bond markets within a certain range (within the lowest two and a half percentile). The results also indicate a significant lagged effect of gold as a hedge for South African bonds.

The findings further demonstrate that for a South African investor, gold does not act as a contemporaneous hedge for international stocks. Rather, it was found that gold is positively but not perfectly correlated with international share returns, allowing gold to act as a diversifier in portfolios of South African investors investing in international shares. The findings also demonstrate that gold is not a contemporaneous safe haven for South African investors investing in international equities however, it was found that the lagged effect is stronger than the contemporaneous effect of gold as a safe haven for international stocks at the lowest five percentile. These results suggest that gold is only a safe haven for international share returns after international equities have experienced moderately negative returns (in the lowest fifth percentile). Gold also acts as a hedge for lagged international equity returns.

When the cumulative returns for a portfolio comprising of gold and the JSE All Share Index for the period spanning 50 and 100 trading days after an extreme negative shock has occurred is examined it is evident that the return for gold is positive on the day that an extreme negative shock occurs in the stock market. Furthermore, the safe haven effect of gold is eliminated after 2 trading days. This is consistent with the findings of Baur and Lucey (2010)

who found that the safe haven effects of gold are short lived. As it was found that gold is a hedge for South African shares on average this phenomenon can be explained as being due to the dual function of gold as a hedge for shares.

When the cumulative returns for a portfolio comprising of gold and the MSCI Global Stock Index for the period spanning 50 and 100 trading days after an extreme negative shock has occurred is examined it is evident gold acts as a safe haven for global equities and that this effect is eliminated after two days. Furthermore it is clear that whilst gold does act as a hedge for global equities on average, this effect is weaker than that found for South African equities. This is consistent with the regression results that show that gold acts as a hedge for global equities at a 5% level whilst it acts as a hedge for South African equities at a 2.5% level.

During 2008 and 2009 a total of thirty seven severe market shocks within the fifth percentile of South African equity returns occurred. Many of these shocks occurred within seven days of one another. The findings in this research report suggest that, even over this turbulent period, gold continues to act as a safe haven for both South African and global equities. The combined qualities of gold as a safe haven and a hedge for South African and global equities allows gold returns to offset negative losses incurred by South African equity investors.

The results of the minimum variance portfolios showed that the results for gold as a safe haven for international and South African equity markets are robust. It is evident from these results that during extreme market condition (such as those experienced in the 2008 financial crisis) a higher proportion of gold is included in the minimum variance portfolio. It is also evident from these results that global diversification is beneficial over all periods as a portfolio constructed with three asset classes (gold, the ALSI and the MSCI) has a lower standard deviation than a portfolio constructed using only gold and the ALSI. These results provide evidence to support the notion that increasing the weighting of gold in a South African investor's portfolio during extreme market condition can serve to minimise the effects of falling equity prices. A prudent investor would therefore increase their holdings in gold over the recessionary period. This is consistent with the findings of The World Gold Council (2010) who found that investor demand for gold increased substantially over the recessionary period. Given that supply remained relatively stable and that demand increased (mainly due to investor demand), a future area of research could address whether the safe

haven value of gold causes an increase in the price of gold to levels consistent with an asset bubble, as postulated by Baur and Glover (2012).

Areas of future research could also include analysing the effects of including share and bonds returns in multi-factor pricing models for gold and further analysing the effects that share and bonds returns have on commodity returns. This could provide important implications for portfolio management. Furthermore, one could investigate the return generation process of gold returns in order to examine asset allocation through market cycles.

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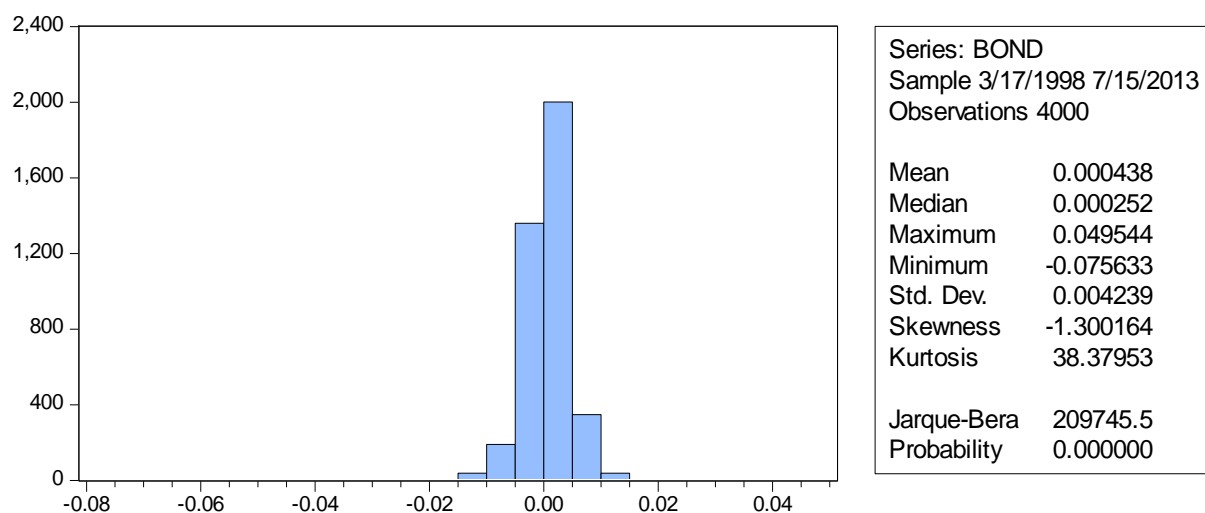
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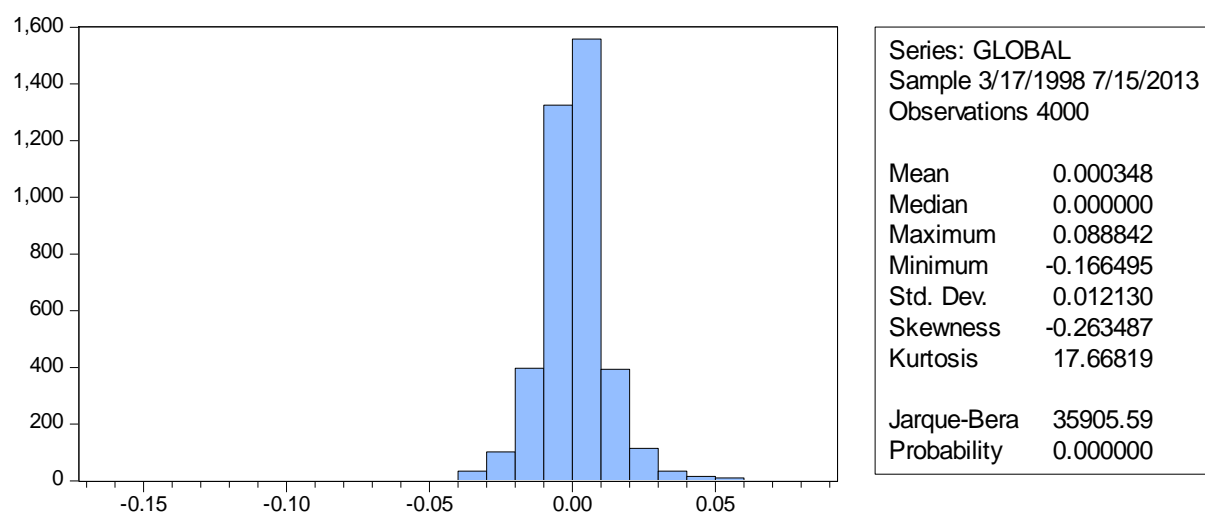
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## Appendix A

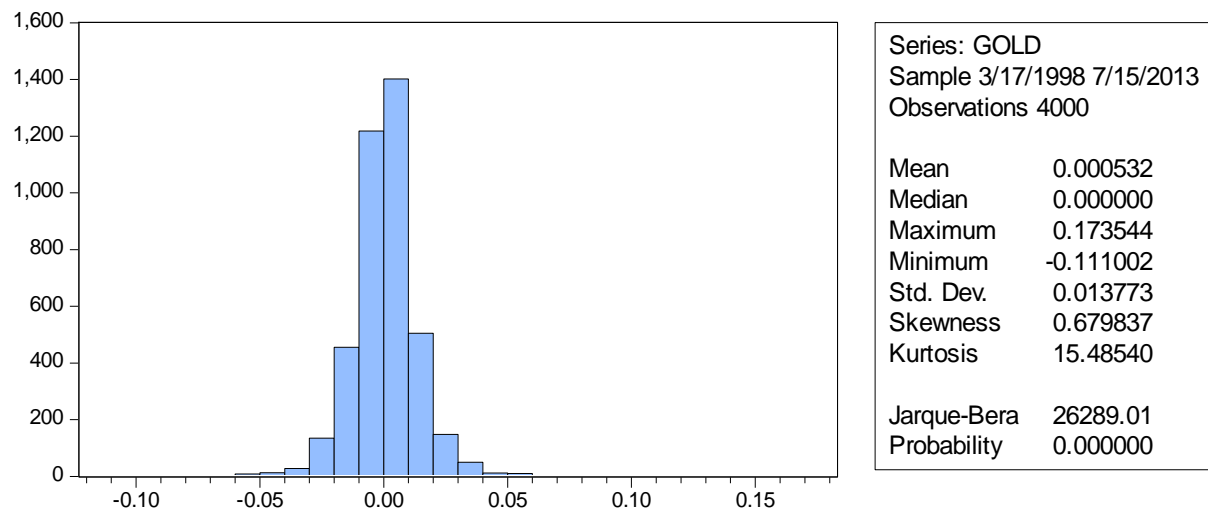
**Figure 1A- Normality of the ALBI data series**



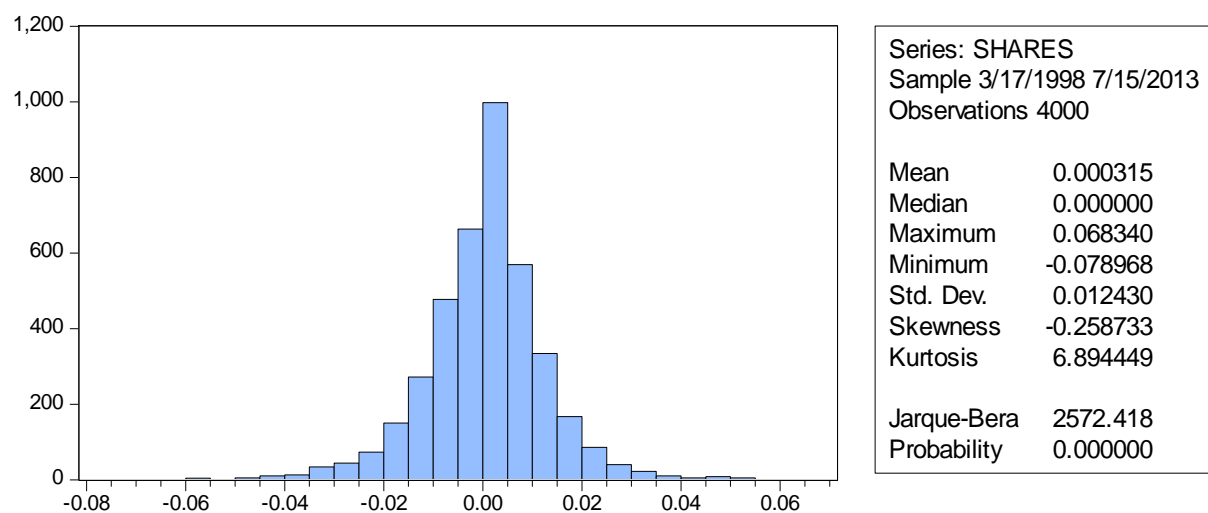
**Figure 2A- Normality of the MSCI global stock index data series**



**Figure 3A- Normality of the gold data series**



**Figure 4A- Normality of the ALSI data series**



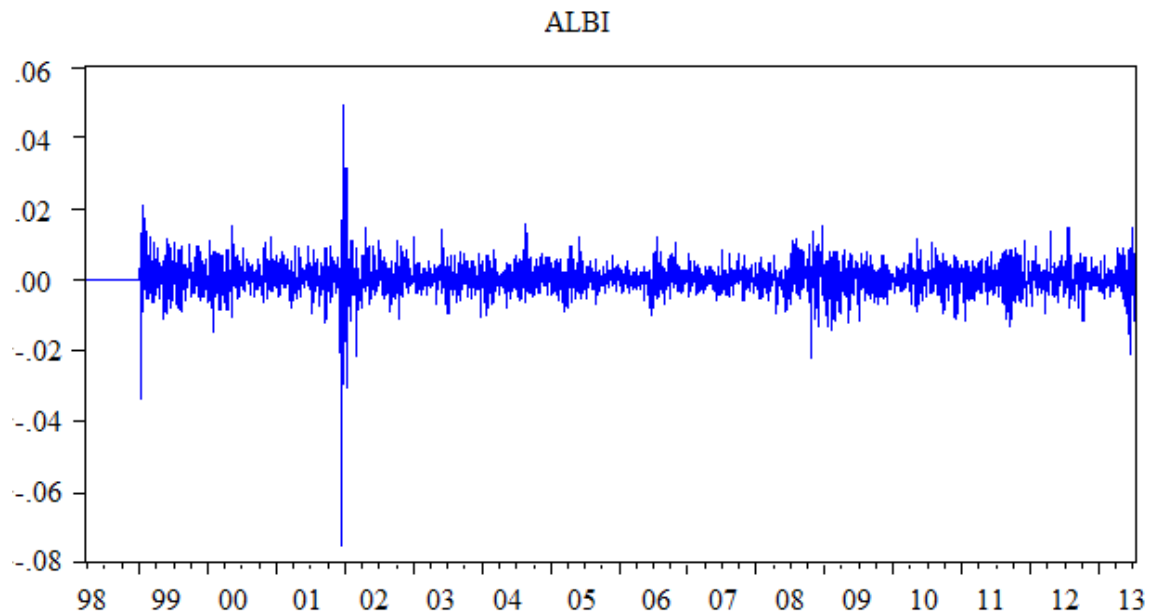
All data series have a mean close to zero and are leptokurtotic. The Jarque-Bera test is a test for normality with large values indicating non-normality. The p-values of all are also given and we can reject the null hypothesis for normality at the conventional 5% and 1% level of significance for each variable.



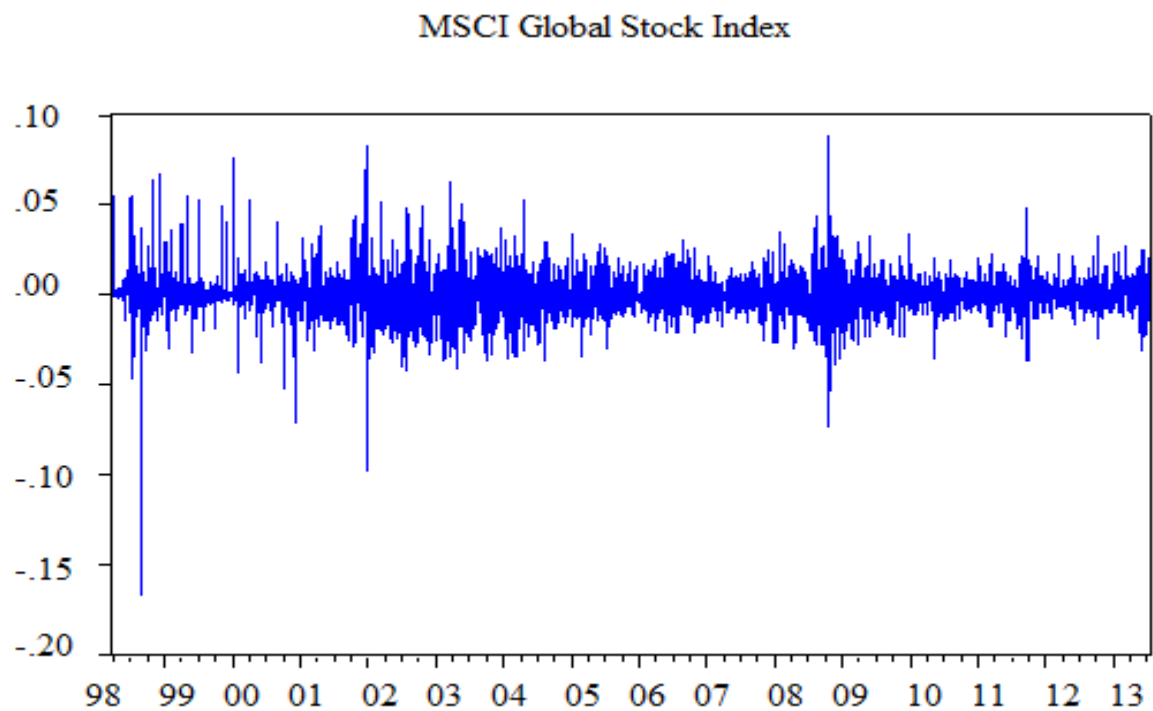
## Appendix B

E-Views was used for statistical testing. The results of the augmented Dickey-Fuller test are shown below for each data series.

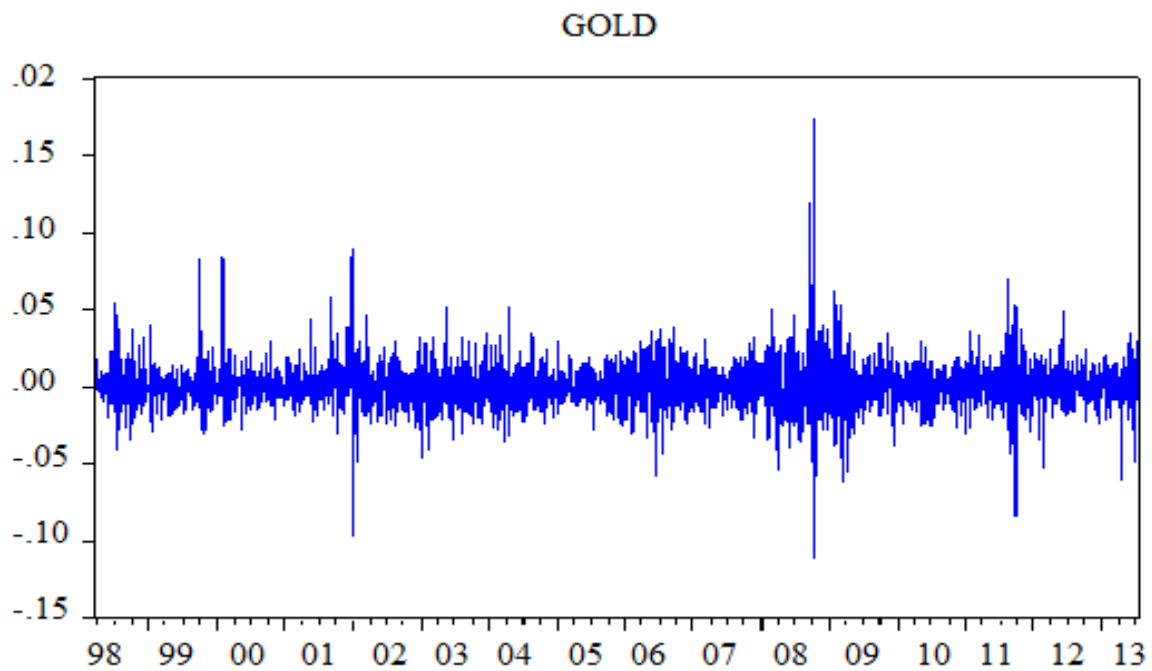
**Figure 1B- Mean reversion of the ALBI data series**



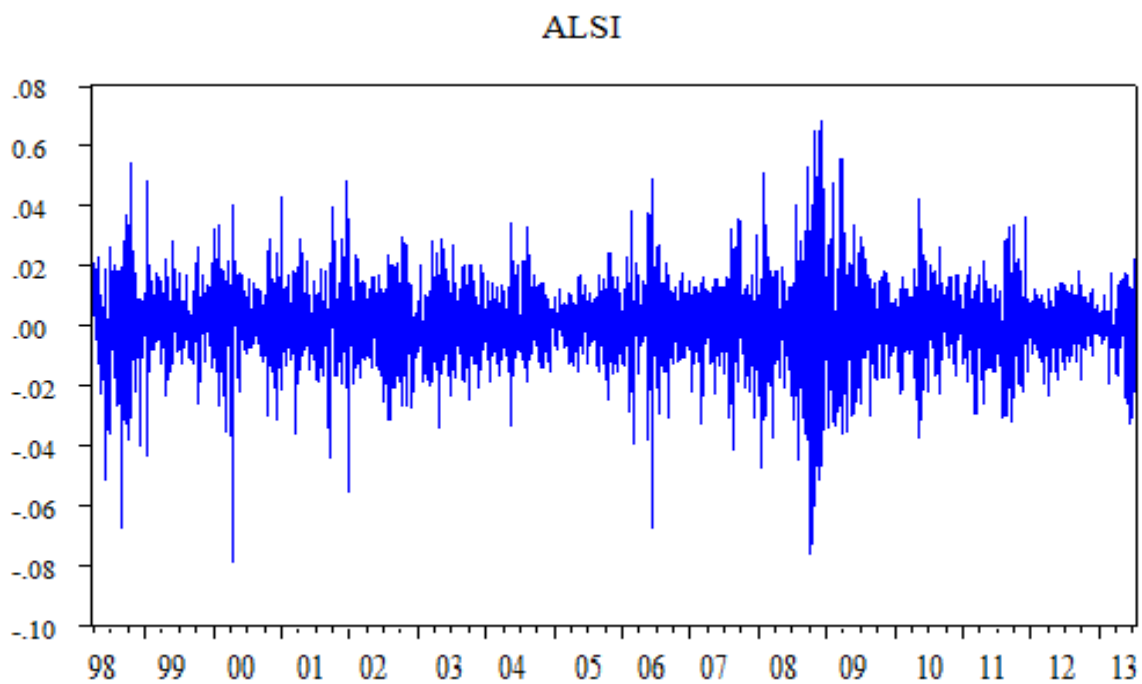
**Figure 2B-Mean reversion of the MSCI Global Stock Index data series**



**Figure 3B- Mean reversion of gold data series**



**Figure 4B- Mean reversion of ALSI data series**



The visual tests display the mean reverting tendencies of each data series. All the series seem mean reverting at zero with no trend thus it can expect to find them stationary.

**Table 1B- Results for augmented Dickey-Fuller Test for ALBI data series**

Null Hypothesis: BOND has a unit root

Exogenous: None

Lag Length: -1 (Automatic - based on SIC, maxlag=30)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-28.08233	0.0000
Test critical values: 1% level	-2.565541	
5% level	-1.940903	
10% level	-1.616646	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(BOND)

Method: Least Squares

Sample (adjusted): 3/24/1998 7/15/2013

Included observations: 3995 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BOND(-1)	-0.919322	0.032737	-28.08233	0.0000
R-squared	0.453548	Mean dependent var	1.06E-06	
Adjusted R-squared	0.453000	S.D. dependent var	0.005679	
S.E. of regression	0.004200	Akaike info criterion	-8.106225	
Sum squared resid	0.070383	Schwarz criterion	-8.098349	
Log likelihood	16197.18	Hannan-Quinn criter.	-8.103433	
Durbin-Watson stat	2.003657			

**Table 2B- Results for augmented Dickey-Fuller Test for MSCI data series**

Null Hypothesis: GLOBAL has a unit root

Exogenous: None

Lag Length: -1 (Automatic - based on SIC, maxlag=30)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-60.51669	0.0001
Test critical values: 1% level	-2.565540	
5% level	-1.940903	
10% level	-1.616646	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(GLOBAL)

Method: Least Squares

Sample (adjusted): 3/18/1998 7/15/2013

Included observations: 3999 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLOBAL(-1)	-0.956211	0.015801	-60.51669	0.0000
R-squared	0.478086	Mean dependent var	-1.69E-06	
Adjusted R-squared	0.478086	S.D. dependent var	0.016783	
S.E. of regression	0.012125	Akaike info criterion	-5.986883	
Sum squared resid	0.587746	Schwarz criterion	-5.985309	
Log likelihood	11971.77	Hannan-Quinn criter.	-5.986325	
Durbin-Watson stat	1.997116			

**Table 3B- Results for augmented Dickey-Fuller Test for gold data series**

Null Hypothesis: GOLD has a unit root

Exogenous: None

Lag Length: 0 (Automatic - based on SIC, maxlag=30)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-66.67324	0.0001
Test critical values: 1% level	-2.565540	
5% level	-1.940903	
10% level	-1.616646	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(GOLD)

Method: Least Squares

Sample (adjusted): 3/18/1998 7/15/2013

Included observations: 3999 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GOLD(-1)	-1.053045	0.015794	-66.67324	0.0000
R-squared	0.526490	Mean dependent var	-2.50E-06	
Adjusted R-squared	0.526490	S.D. dependent var	0.020005	
S.E. of regression	0.013766	Akaike info criterion	-5.732969	
Sum squared resid	0.757640	Schwarz criterion	-5.731395	
Log likelihood	11464.07	Hannan-Quinn criter.	-5.732411	
Durbin-Watson stat	2.004133			

**Table 4B- Results for augmented Dickey-Fuller Test for ALSI data series**

Null Hypothesis: SHARES has a unit root

Exogenous: None

Lag Length: 0 (Automatic - based on SIC, maxlag=30)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-58.90331	0.0001
Test critical values: 1% level	-2.565540	
5% level	-1.940903	
10% level	-1.616646	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(SHARES)

Method: Least Squares

Sample (adjusted): 3/18/1998 7/15/2013

Included observations: 3999 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SHARES(0)	-0.929241	0.015776	-58.90331	0.0000
R-squared	0.464620	Mean dependent var	3.22E-08	
Adjusted R-squared	0.464620	S.D. dependent var	0.016953	
S.E. of regression	0.012405	Akaike info criterion	-5.941245	
Sum squared resid	0.615191	Schwarz criterion	-5.939671	
Log likelihood	11880.52	Hannan-Quinn criter.	-5.940687	
Durbin-Watson stat	2.001736			

As expected, all the data series are stationary at the conventional 5% and 1% level of significance. E-view calculates the optimal lag length for these tests automatically as seen in the third line from the top. As long as the test statistic is smaller than the critical value at the given level of significance we can reject the null hypothesis of a unit root (and thus we would have stationarity). This is the case for all the variables and thus we can conclude that the data series are stationary.

## Appendix C

**Table 1C-** Negative shocks in 2008 and 2009

Days between shocks	Date	ALSI	Gold (ZAR)	MSCI (ZAR)
88	2009/08/17	-3.03%	-0.26%	-1.27%
8	2009/05/21	-2.95%	0.94%	-2.39%
23	2009/05/13	-2.97%	1.46%	-0.99%
21	2009/04/20	-3.53%	3.48%	-1.29%
31	2009/03/30	-3.61%	0.25%	-2.77%
7	2009/02/27	-2.85%	1.43%	0.56%
18	2009/02/20	-3.34%	1.71%	-2.46%
19	2009/02/02	-3.19%	-3.46%	-1.56%
1	2009/01/14	-3.40%	0.02%	-1.57%
25	2009/01/13	-2.83%	-0.42%	-1.28%
16	2008/12/19	-3.45%	-1.20%	0.59%
2	2008/12/03	-3.09%	-1.55%	1.23%
11	2008/12/01	-4.65%	-1.10%	-1.66%
7	2008/11/20	-5.15%	3.88%	-3.17%
2	2008/11/13	-2.97%	0.16%	-0.27%
5	2008/11/11	-4.64%	1.00%	-0.18%
1	2008/11/06	-4.02%	3.59%	-0.92%
12	2008/11/05	-3.28%	-2.13%	-1.46%
1	2008/10/24	-5.99%	2.90%	-3.15%
1	2008/10/23	-3.46%	-5.84%	-5.34%
7	2008/10/22	-4.71%	2.72%	2.42%
5	2008/10/15	-7.24%	17.35%	8.88%
2	2008/10/10	-3.14%	-5.89%	-3.20%
2	2008/10/08	-2.86%	5.05%	-0.75%
4	2008/10/06	-7.58%	6.61%	-1.54%
3	2008/10/02	-3.36%	-0.89%	-0.08%
6	2008/09/29	-5.94%	6.12%	-3.43%
14	2008/09/23	-3.82%	1.63%	1.12%
4	2008/09/09	-3.56%	-2.40%	-1.50%
4	2008/09/05	-3.00%	0.23%	-1.75%
31	2008/09/01	-3.10%	-0.94%	0.16%
29	2008/08/01	-4.48%	-1.82%	-2.49%
105	2008/07/03	-3.16%	-2.28%	-1.20%
44	2008/03/20	-3.76%	-2.53%	1.59%
8	2008/02/05	-3.03%	-0.61%	-1.50%
7	2008/01/28	-3.10%	2.68%	0.87%
39	2008/01/21	-4.72%	-0.50%	-1.02%