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Commodities and the South African Investment Portfolio

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at the

UNIVERSITY OF THE WITWATERSRAND

Supervisor: Signature:

DECLARATION

I, Jason Ross Rodrigues declare that the research work reported in this dissertation is my own, except where otherwise indicated and acknowledged. It is submitted for the degree of Masters of Management in Finance and Investment as the University of the Witwatersrand, Johannesburg. This thesis has not, either in whole or in part, been submitted for a degree or diploma to any other universities.

Signature of candidate: Date:

Abstract

This study aims to make a contribution to the better understanding of the role commodities play in a portfolio, specifically in a South African investment portfolio. It considers the interactions between a fully collateralised commodity index and South African equities, bonds, property and cash. The study uses historical data to asses if commodities provide addition benefits to an investment portfolio, namely, additional returns, diversification and as an inflation hedge. The analyses used in this study are performance analysis, correlation studies and portfolio optimisation. Based on the evidence presented in this study we show that there were some benefits to adding commodities to a South African investment portfolio, namely, using commodities to diversify a portfolio and as an inflation hedge. However, commodities did not provide sufficiently large enough returns to justify their high volatility and as such would not be an appropriate stand alone investment in the South African context.

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1. Introduction

In recent years there has been increased interest in commodities in South Africa as an additional asset class to an investor's portfolio. As a result, several local banks have created various products that aim to give an investor access to commodities. There has been the launch of commodity exchange traded funds (ETFs), warrants, exchange traded notes (ETNs) and domestic medium term notes (DMTNs), all of which offer the investor access to various underlying commodities and have a number of different payoffs.

Worldwide, commodities have become a stable part of an investor's portfolio. Currently, there are $435bn invested in commodities through commodity index swaps, medium term notes and exchange traded products.

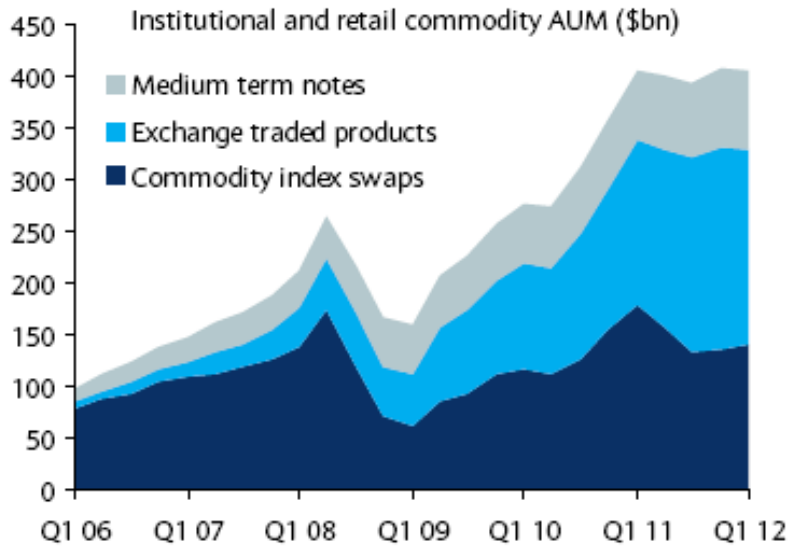


Figure 1: Total commodity AUM ended Q1 12 at $435bn[1]

Traditionally, most asset allocations have focused on three primary asset classes; shares, bonds and cash. The addition of commodities as an asset class has been shown to add a number of benefits to a portfolio. Supporters of commodities as an asset class claim that the asset class has low correlations to equities and bonds, produces high returns, acts as a hedge against inflation and provides diversification to a portfolio.

Much research has been done on commodities as an asset class and their benefits. However, these studies have been focused on US portfolios, shares and bonds. This study

[1] Barclays Capital Commodities Research, The Commodity Investor, 18 April 2012.

aims to further the existing research and expand on it by looking at commodities from the South African perspective with the South African portfolio and investor in mind.

There are several ways to gain access to commodities; this study will focus on the type of exposure gained from a fully collateralised total return commodity index.

1.1 Problem Statement of Study

The purpose of this study is to investigate whether commodities have a place in a South African investment portfolio. Specifically, it will focus on the main benefits that have previously been identified as reasons for their inclusion in a portfolio: absolute returns, inflation hedging and portfolio diversification.

This study aims to address the following important questions when considering investing in commodities:

(i) Do commodities provide equity like returns?
(ii) Can commodities be used as an inflation hedge?
(iii) Does the inclusion of commodities in a portfolio have a diversification benefit?
(iv) Is it better to take on the foreign exchange risk associated with commodity investments or to hedge one's exchange rate risk?

If commodities are found to either provide equity like returns, act as an inflation hedge or have a diversification benefit for a portfolio, then commodities will certainly have a place in a South African portfolio.

We aim to make an empirical contribution to better understanding commodities in a South African portfolio and inform South African investors of the existence of commodities as an asset class. We hope that this study will play an important role in determining how and when commodities should be added to a portfolio.

If commodities do provide benefits to a South African portfolio then they will be an important investment alternative in the future. The findings presented in this study will be useful to various financial market practitioners.

1.2 Background Literature

A number of studies have highlighted the benefits of adding commodity futures to a traditional portfolio, Greer (1978, 2000), Bodie (1983), Jensen at al (2000, 2002), Ibbotson (2006). These studies support the view that commodity futures produce positive investment returns, diversify a portfolio and act as an inflation hedge.

On the other hand, Elton, Gruber and Rentzler (1987, 1990) found that professionally managed publicly traded commodity funds did not have sufficient returns to justify a stand-alone investment nor to justify their addition to a portfolio.

Following this a number of studies have tried to address these conflicting results. Schneeweis, Savanayana and McCarthy (1991) show that the benefits of adding commodity futures to a portfolio vary significantly over time and that most of the previous studies have used a relatively short period of data, indicating that the results are sensitive to the various time periods studied.

Robert Greer is recognised as the first researcher to define an index of unleveraged commodities and advocate it as a separate asset class suitable for institutional investors.

In Greer's 1978 article the author shows that by including commodities futures, that are bought long and without margin, together with equities, one is able to create a more efficient portfolio that is hedged against inflation. Furthermore, commodities offer a conservative investor better risk-adjusted returns than a traditional portfolio of shares and debt.

Greer argues that commodity futures have two types of risk: 'price risk' which is caused by the fluctuations in the price of commodities and 'financial risk', caused by the leverage the trader takes on when entering into a commodities future contract (the trader typically only has to put between 5% and 15% of the contract's value as margin). By removing this 'financial risk', by only going long (buying) the commodity future and allocating the full value of the contract in short-term debt, the author shows that for a period from January 1960 to July 1974 the unleveraged commodity contract is less risky than shares, and therefore is a conservative investment class.

Greer creates an 'Inflation Protection Programme' that has a large portion of the investment in shares and the remaining portion in commodities. The main objective of this programme was to increase the stability of the real rates of return compared to an investment in shares alone. When this programme is compared to the share benchmark, S&P 425, from 1960 to 1974 it was found to offer stable increased rates of return with lower levels of risk.

Bodie (1983) explores how the addition of commodity futures contracts to a traditional investment in shares, cash and treasury bills can improve the risk-return profile in an inflationary environment.

Bodie uses the mean-variance analysis originally developed by Harry Markowitz (1952) to study the effects of adding commodity futures to a traditional portfolio investment. This analysis requires the means and standard deviations of the real rates of return of the various asset classes as well as the correlations among them. This analysis was carried out over a period of 28 years from 1953 to 1981.

In determining the real rate of return of commodity futures, Bodie created a well diversified portfolio of equally weighted commodity futures over this period. The data was generated by assuming a 'buy-and-hold' strategy i.e. where the future contracts are entered into quarterly, are held for three months and then liquidated. The number of different commodity futures varied from 13 in 1953, 22 in 1970 and 18 in 1981, based on the availability of reliable data.

The author argues that the commodity futures contracts will yield a positive rate of return when there are unanticipated increases in the spot price. These unanticipated increases in the commodity spot prices occurred simultaneously to unanticipated increases in inflation. Bodie found that when comparing the real rate of return of the commodity futures with that of the rate of inflation (CPI), the commodity futures tended to perform well in the years where inflation was high.

Bodie noted that real rates of return of treasury bills, bonds and shares were negatively correlated with inflation and positively correlated with each other, while commodity futures were positively correlated with the rate of inflation and negatively correlated with the three other asset classes. This indicates that commodity futures can assist in reducing the risk levels in a portfolio through diversification.

In the analysis, it was not clear to Bodie as to what mean value he should assume for the rate of return for the commodity futures. He assumed two values, 0% and 2%. Under the assumption that the mean rate of return on the commodity futures is 0%, the mean rate of return of the portfolio will remain unchanged; however the addition of the right amount of commodity futures reduced the standard deviation of the portfolio by 0.24% at the minimum end of the risk-return curve and 0.21% at the maximum end of the curve. When a 2% mean rate of return was assumed for the commodity futures, the effect was an upward shift in the entire curve. Therefore, for a given level of risk, the portfolio with commodities will achieve a higher mean real rate of return.

Elton, Gruber and Rentzler (1987) analysed the performance of professionally managed publically traded commodity funds for six years from July 1979 to June 1985. This limited period of study was due to a lack of available data since these funds had not been in existence for very long.

The authors found the returns of these funds to be highly variable, with standard deviations two to three times that of shares and bonds. This high variability was consistent from year to year and the authors expect it to continue into the future.

Additionally, the management fees and transaction costs of these commodity funds were found to be very high when compared to the more traditional fixed income and equity funds. The authors estimated the annual management fees and transaction costs to be 19.2% of total assets under management.

Based on the high variability of returns and high management and transaction costs, the authors found that the commodity funds offer neither an alternative to shares and bonds nor an enhancement to an existing portfolio of shares and bonds.

In Greer (2000) the author examines the nature of commodity index returns. He develops a model that shows that commodity futures prices are a function of participants' expectations regarding the commodity's actual future price and that the actual future price of the commodity contracts, in turn, is driven by expected supply and demand.

He then looks at the inherent return from an unleveraged commodity index and identifies that the source of the returns comes from a number of factors: T-bill return from the collateralised component, an insurance component, the expectation that commodity prices are not highly correlated with each other and expectational variance.

Greer then back-tests his theory using historical data, comparing the return of the Chase Physical Commodity Index with its individual constituents. This indicates that the returns come from more than just the changes in commodity prices and that the return is on average positive and comparable to shares both in risk and return. Additionally, the commodity prices within the indices are not highly correlated with each other.

He carries out an analysis of the correlation between shares, bonds and inflation that confirms that unlevered commodity indices are negatively correlated with shares and bonds and positively correlated with the rate of inflation. The data also indicated that commodity indices are even more positively correlated with unexpected inflation.

Jensen et al (2000) investigated the period from 1973 to 1997 using Markowitz optimisation over a range of risk levels giving significant weight to commodity futures. During this period the authors found that the inclusion of commodity futures enhanced the portfolio's returns.

The authors found that commodity futures were a poor stand alone investment due to their lower return and higher standard deviation. The correlation results suggested that commodity futures may provide an additional diversification benefit. Commodity futures were found to be negatively correlated to shares, treasury bills, corporate bonds and real estate. In the context of a portfolio, the risk-reward optimisation gave significant weights to commodities allowing an investor to achieve a more favourable portfolio. This benefit was greater at moderate levels of risk.

Jensen et al (2002) then performed the analysis during various monetary policy conditions; expansive and restrictive. During restrictive monetary policy periods, commodity futures showed bettered risk/reward performance as a stand-alone investment. Additionally, commodity futures had significant weight in the efficient portfolio at various levels of risk. On the other hand, during expansive monetary policy periods commodity futures had very poor risk/reward performance and had virtually no weight in the efficient portfolio. This analysis points to the fact that commodity futures are an effective hedge for inflation.

Jensen et al (2002) confirmed previous studies that by adding commodity futures to a traditional portfolio of shares, bonds and cash significantly enhance the portfolio's performance. The authors examined a longer period than previous studies, a period of 27 years from January 1973 to December 1999, thereby providing a better indication of the performance of commodity futures.

This article goes further and looks at the benefits of tactically allocating commodity futures, based on monetary policy, to an otherwise diversified portfolio. The authors used a simple strategy that took a short position in commodity futures during the expansive phase of the monetary cycle and a long position in the restrictive phase of the cycle. The returns from this simple strategy were even better than the returns from a buy-and-hold strategy. This suggests that by including short commodity futures in a portfolio can improve the portfolio's performance.

Jensen et al (2002) expand their analysis to six commodity sub-indices, instead of limiting the analysis to a composite index, since the various sub-indices will perform differently during various cycles in the Federal Reserve monetary policy. The authors found that metals, energy and agricultural futures provided higher returns during periods of restrictive monetary policy (increases in the interest rate) than during expansive monetary policy

(decreases in the interest rates). While livestock contracts did better during expansive monetary policy periods than restrictive monetary policy periods.

Jensen et al (2002) considered the performance of both an actively managed (MLM index) and an unmanaged (passive) futures strategy. They found that the managed index generally outperformed the unmanaged index. For an average risk portfolio, the authors found that the annual returns increased by approximately 100 basis points by adding unmanaged futures and 300 basis points by adding managed futures.

In 2006, Pacific Investment Management Company (PIMCO) commissioned a report into the role of commodities in a strategic asset allocation from Ibbotson Associates. Ibbotson (2006) found that including commodities in a portfolio resulted in an 'improved historical efficient frontier', which allocated large portions of the portfolio to commodities. For various risk levels, the improvement in historical returns was approximately 133 basis points.

Ibbotson (2006) developed an expanded version of the hypothetical market portfolio, creating expected returns based on CAPM. The author used this to create forward-looking efficient frontiers. The inclusion of commodities improved the forward-looking efficient frontiers. Over a variety of risk levels, standard deviations between 2.4% and 22.4%, the average improvement was approximately 35 basis points with the allocation to commodities varying from 0% to as much as 25%.

Using the Black-Litterman model where CAPM expected returns were combined with expected returns based on the building blocks methodology, Ibbotson (2006) found once again that the inclusion of commodities in the portfolio led to a better efficient frontier. The average improvement at each levels of risk was approximately 36 basis points, while the allocation to commodities ranged from 0% to 28%.

No matter which model and commodity returns were used, Ibbotson (2006) found that including commodities improved the risk-return profile of the efficient frontier. In addition, commodities played a large role in the strategic asset allocation.

There are a large number of studies on the pros and cons of commodities as a stand-alone investment and the benefits of the inclusion of commodities in a portfolio. I have highlighted, what I believe to be, the key articles that have made meaningful contributions to this area of study.

In this study we will use similar methodology to Jensen et al (2000) and Ibbotson (2006) to contribute to the existing research on commodities. We will examine the impact of the addition of commodity futures to a South African portfolio typically comprising of South African shares, bonds and cash, and try to establish if commodities have any beneficial value that warrant their inclusion in a South African portfolio. Additionally, special attention will be given to the exchange rate risk associated with the inclusion of this foreign asset into a domestic portfolio.

1.3 Methodology

We will use historical data to answer the questions of the study. The analysis will include performance analysis, correlation studies and optimization using Harry Markowitz's mean variance optimization, Markowitz (1952).

1.4 Outline of Study

We will structure the study in the following manner; Chapter 2 lays the foundation of some of the important aspects needed to understand commodities and the South African portfolio. Chapter 3 will look at the data and methodology used to show if commodities do in fact have a place in the South African investment portfolio. Chapter 4 will discuss the results of the various analyses done. It aims to answer the key questions of the study as set out in Section 1.1 above. In the last portion of the study, Chapter 5, we provide conclusions as to whether or not commodities have a place in the South African investment portfolio.

2. Concepts, Definitions and the South African Environment

In this chapter of the study we will define all the building blocks required to perform our analysis in Chapter 3.

2.1 Commodities as a separate asset class

It is difficult to find a consistent definition of what constitutes an asset class or a list showing the various asset classes. However, asset allocation within a portfolio depends on the ability to define these asset classes and invest in them. Therefore, it becomes difficult to allocate a portion of one's portfolio to an asset class without having a clear framework for identifying an asset class.

Greer (1997) defines an asset class as 'a set of assets that bear some fundamental economic similarities to each other, and that have characteristics that make them distinct from other assets that are not part of that class.' Based on this definition, his framework, defines three broad asset classes ('super classes'): capital assets, consumable/transformable assets and store of value assets, Greer (1997). These three 'super classes' all have distinct economic features and together incorporate the entire universe of assets available to investors.

Capital assets, such as equities, bonds and real estate, provide a consistent source of value. This source of value is measured by taking the net present value of the expected future cash flows. Hence, the price of a capital asset will change with the investor's discount rate, decreasing as the discount rate increases and increasing as the discount rate decreases.

Consumable or transformable assets are assets that can be consumed, transformed into another asset and has economic value. However, a consumable/transformable asset does not have an ongoing stream of future value but has a single cash flow. The best known consumable or transformable asset to investors is physical commodities, for example metals, grains, livestock and energy products. Therefore, consumable/transformable assets cannot be valued using net present value analysis. Their value is derived from particular supply and demand characteristics within a given market.

Store of value assets, such as fine art and foreign exchange, cannot be consumed nor does it generate income, it purely is a store of the value of the asset.

There are times when the lines between these 'super classes' can be blurred. Take gold for example, it is both a consumable/transformable asset and a store of value asset and in addition a capital asset because it can be leased (generating a stream of cash flows).

If this framework and definitions are to be useful to an investor, one would expect the correlations within an asset class to be high while the correlations between asset classes to be lower. Greer (1997), performed such an analysis and found this to be the case.

Based on the above article, I believe commodities to be an additional asset class and that they have a different risk and return profile to the other 'super classes' therefore giving investors the opportunity to invest in commodities.

2.2 A Typical South African Investment Portfolio

Most of the research that has studied the benefits of including commodities in a portfolio has considered three main asset classes in the portfolio: shares, bonds and cash. A few have included real estate as a fourth asset class. Based on this it would be conservative to look at these four asset classes in the South African sense and as the basic building blocks of a typical South African portfolio.

To test this hypothesis, we have looked at a sample of 7 diversified portfolios managed by large institutions in South Africa. We have excluded growth funds and income funds as these are typically comprised of various bonds with differing maturities. The results are presented below in Table 1[2] below.

[2] Data taken from the relevant companies' websites fund fact sheets. Weights as at 31 May 2012.

		Domestic Assets					International Assets
Fund Managers	**Fund Name**	**Equity**	**Property**	**Bonds**	**Cash**	**Commodities**	
Absa Asset Management	Balanced Fund	47.48%	0.00%	36.48%	6.90%	0.00%	9.15%
Allan Gray	Balanced Fund	47.00%	0.60%	9.70%	14.90%	2.60%*	25.10%
	Stable Fund	25.00%	0.40%	8.40%	38.10%	2.70%*	25.50%
Coronation	Absolute	56.00%	1.60%	15.70%	0.50%	0.00%	26.20%
	Balanced Plus	40.90%	3.50%	12.80%	16.70%	0.00%	26.10%+
	Market Plus	49.50%	8.30%	15.50%	-0.40%	0.00%	27.10%
Stanlib	Balanced Fund	48.68%	0.00%	17.50%	14.27%	0.00%	19.50%

* Gold + includes 0.9% in commodities

Table 1: Sample of South African institutional portfolios

It is evident from the data in Table 1, that the three main domestic asset classes are equities, bonds and cash. Real estate has significantly lower weights than the other three asset classes; however it is still present in the portfolios.

Therefore, we will define a typical South African portfolio as one comprising of four asset classes: equities, bonds, cash and real estate.

Both of the Allan Gray funds sampled above have a commodity component. The fund fact sheets highlight that this commodity allocation is Gold.

2.3 The South African Portfolio and Regulation

The South African retirement industry is governed by the Pension Funds Act 24 of 1956. This Act empowers the Minister of Finance to create regulations limiting the amount and the extent to which pension funds may invest in particular assets. The amended National Treasury Regulation 28, which sets out the limits for various asset classes, applies to all private retirement fund assets, currently estimated to be worth R1.1 trillion. The regulation may be extended to include the Government Employees Pension Fund with an additional R1 trillion in assets.

The amended Regulation was finalised on the 4th of March 2011 and became effective from 1 July 2011. The asset limits are set out in Appendix 1, but of importance to this study is the allowable allocation to commodities.

Commodities are recognised as their own asset class and are limited to 10% of the portfolio. This allocation can be either fully allocated to gold or across a number of commodities to a maximum allocation of 5% in each commodity.

In the previous version of the regulation, commodities were not defined as an asset class and would have fallen into the 'other' category with a maximum allocation of 2.5%. Additionally, most commodities are dollar denominated and therefore considered a foreign asset by the South African Reserve Bank and National treasury. These foreign assets were limited to 15% in the previous regulation.

This previous regulation made it difficult for asset manager to allocate a significant portion of their portfolio to commodities. Furthermore, derivatives were not defined previously and also fell into the 'other' category resulting in less allocation to commodities.

2.4 How to Gain Exposure to Commodities

There are various ways, some true and others perceived, to gain exposure to commodities. In this section, we shall discuss this and explain why a fully collateralised commodity index is the most effective way of doing so.

Acquisition of the Physical Commodity

An investors' immediate thought in trying to gain commodity exposure would be to own the physical commodity, for example an ounce of gold or a barrel of oil. The investor would need some sort of storage facility to house these commodities; transportation to get the commodities to the warehouse and perhaps insurance on these commodities. Most commodities are perishable and cannot be stored for long periods of time. All of this makes the acquisition of the physical commodity neither feasible nor practical.

Investment in Commodity Related Shares

Many investors believe that they can get commodity exposure through the acquisition of shares in a commodity company. This is not the same as having direct commodity exposure i.e. direct exposure to commodity prices and changes in the prices. By purchasing a share in a commodity company one is taking on all the characteristics and risk inherent in a normal equity: management style and talent, financial structure of the company, dividend policy,

accounting policies and additional exposure in various subsidiaries. Most importantly, one might be exposed to any commodity hedges the company has in place to protect it from price movements. Ultimately, one would not benefit fully from the changes in commodity prices. In a study by Gorton et al (2005), it was shown that the shares of commodity companies are more correlated to the S&P500 than to the price of the commodity that the company produces.

Commodity Futures

For an investor to gain direct exposure to commodities one must invest in commodity futures. A futures contract is an agreement to buy or sell the underlying asset at specific price at a predetermine date in the future. Investing in futures will require the investor to have a brokerage account and deposit initial margin for the futures he wishes to buy. This margin is usually 5% to 15% of the value of the futures contract, which leads to the investor having additional leverage. Changes in the price of the futures contract may lead to additional margin calls to meet the required minimum margin in the account at all times. For instance, if one has bought a futures contract and the price of the future decreases one will have to place more money into your account to keep the position. Due to the large leverage, small price movements may lead to large gains of losses. Additionally, maintaining a long only position in a commodity future has additional costs and has to be managed in order to avoid taking delivery of the underlying commodity (if the future is held to expiry).

To maintain long exposure in a particular commodity one would have to roll the future prior to expiration, i.e. one would have to sell the future that is due to expire (close your position) and purchase a new future which will expire later in the future. This roll will have costs associated with it: transaction costs for selling and buying the futures and the gain or loss associated with the roll (roll yield).

In a contango market, where the future prices are higher than the spot price, a loss will be incurred when rolling the futures contract. Figure 2 below shows an example of a contango market.

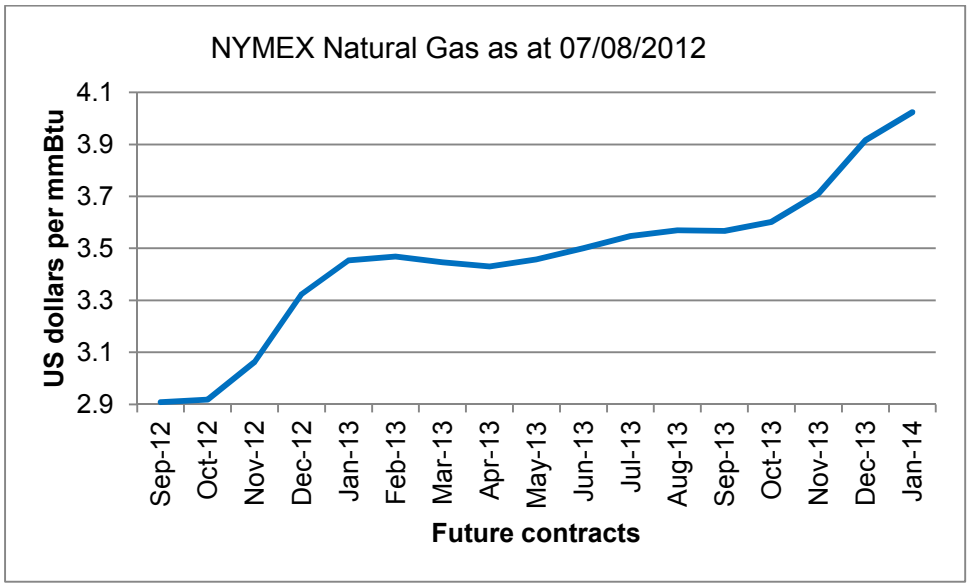


Figure 2: Example of a contango forward curve[3]

In a backwardated market, where the future prices are lower than the spot price, a gain will be realised when rolling the futures contract. Figure 3 below shows an example of a backwardated market.

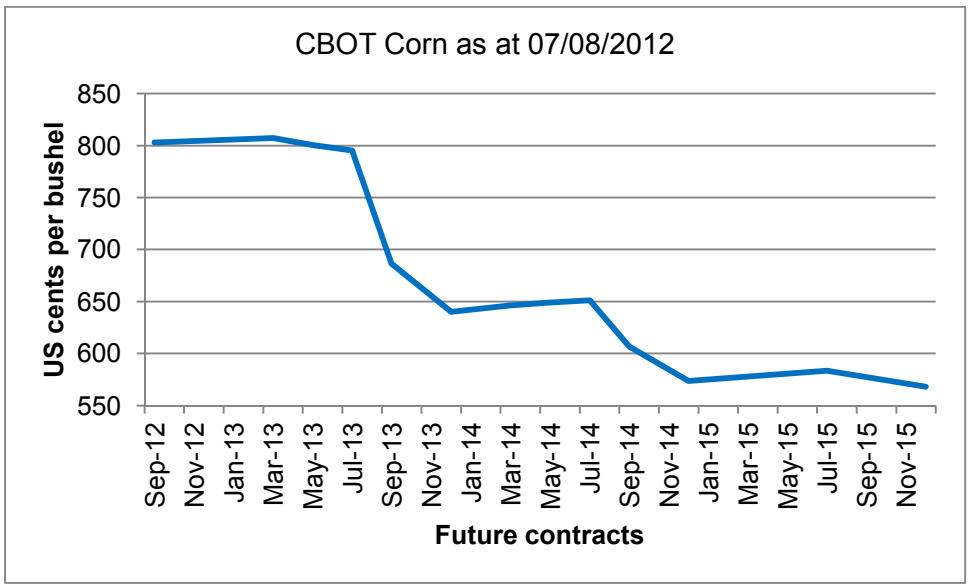


Figure 3: Example of a backwardated forward curve[4]

[3] Data from the CME Group (www.cmgroup.com)
[4] Data from the CME Group (www.cmgroup.com)

Figure 4a

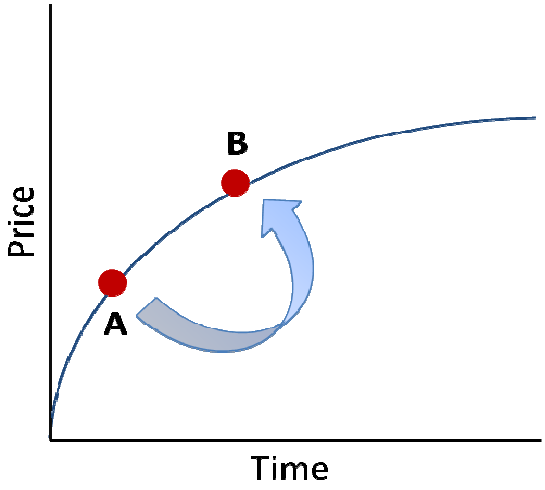


Figure 4b

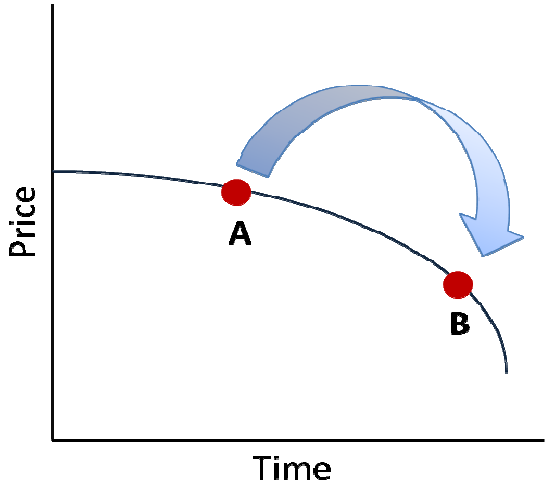


Figure 4: The mechanics of rolling futures

A Contango Market

Figure 4a above, shows the mechanics of rolling futures in a contango market. As contract A is close to expiry the investor will have to close out this position and enter into a new position with a later expiry, contract B. The investor will close out his position in A by selling contract A and re-establish a long position by purchasing contract B. The investor will be selling contract A for less than the cost of purchasing contract B (price at point A on the graph is below the price of point B on the graph). Therefore, in a contango market the investor will experience a negative roll yield, i.e. will incur a loss when rolling future contracts.

A Backwardated Market

Figure 4b above, shows the mechanics of rolling futures in a backwardated market. As contract A is close to expiry the investor will have to close out this position and enter into a new position with a later expiry, contract B. The investor will close out his position in A by selling contract A and re-establish a long position by purchasing contract B. The investor will be selling contract A for more than the cost of purchasing contract B (price at point A on the graph is above the price of point B on the graph). Therefore, in a backwardated market the investor will experience a positive roll yield, i.e. will yield a gain when rolling future contracts.

Commodity Indices

A commodity index measures the returns of a passive (buy and hold) strategy in a variety of underlying commodity futures. There are three types of commodity indices: the spot index, excess return index and a total return index.

A spot index measures the performance of the nearest dated future (this is referred to as spot in commodity markets). This index is a non investable index as it does not take into account roll yield when having to maintain a long position in each commodity.

The excess return index measures the performance of holding (having a long position) in the nearest dated futures. This index is simply the spot index and the roll yield associated with maintaining a long position in each underlying commodity future.

Excess Return Index = Spot Index + Roll Yield.

The total return index measures the performance of holding the nearest dated futures and the performance of the collateral placed for those futures positions. The collateral assumed in most commodity indices is the Treasury Bill. This removes the leverage associated with commodity futures. Therefore;

Total Return Index = Spot Index + Roll Yield + T-Bills.

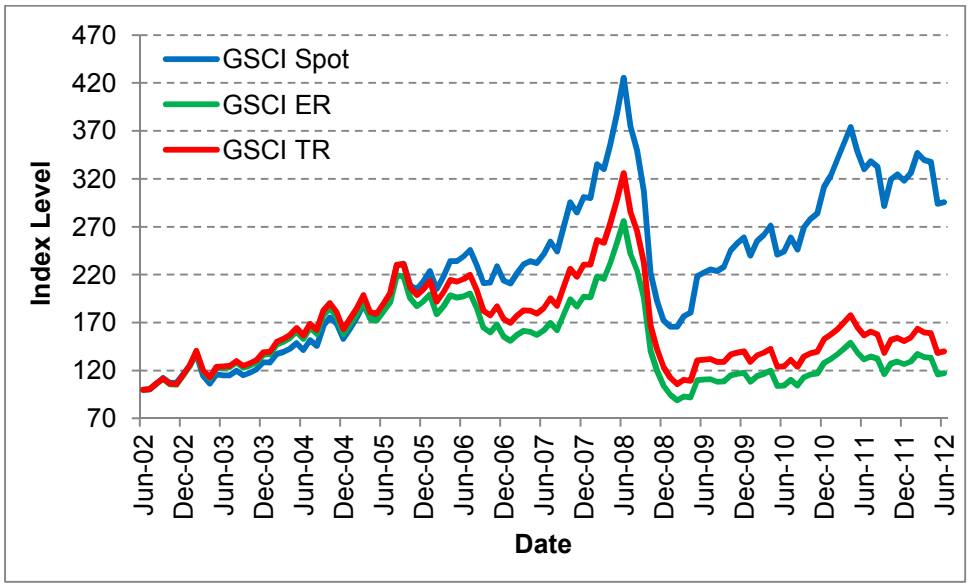


Figure 5: Comparison of SPGSCI spot, excess and total return indices

Figure 5 above shows the historical performance of the Goldman Sachs Commodity Index[5] (GSCI) spot, excess return and total return indices over a ten year period. We have taken the 28th of June 2002 as the initial level of 100. The spot index significantly outperforms the excess and total return indices (195.62% compared with 17.28% and 39.88% respectively).This is expected as this index purely reflects the performance of the nearest dated commodity futures and does not take into account the cost of rolling or maintaining this long exposure.

When the cost (roll yield) of maintaining this long position in the nearest dated future is taken into account, the result is the excess return index. From Figure 5 above, when comparing the performance of the spot index (195.62%) to the excess return index (17.28%), it is evident from the reduced returns that this roll yield has been significantly negative over the ten year period. This is as a result of the majority of the commodity futures in the index being in contango over the ten year period.

Further, by including the interest (90 day Treasury bill) earned on the collateral on the futures the resultant index is the total return index. Due to the additional return earned on this collateral, the total return index performed better than the excess return index, 39.88% versus 17.28%.

Following on from this discussion, it is possible to decompose the return earned on the total return index into its various components. This is illustrated in Figure 6 below.

The various components are; spot return, roll yield and treasury bills with the following relationships:

$$\text{Roll Yield} = \text{Excess Return Index} - \text{Spot Index}$$

and,

$$\text{Treasury Bill Return} = \text{Total Return Index} - \text{Excess Return Index}$$

[5] In Section 2.5 we describe this index in greater detail.

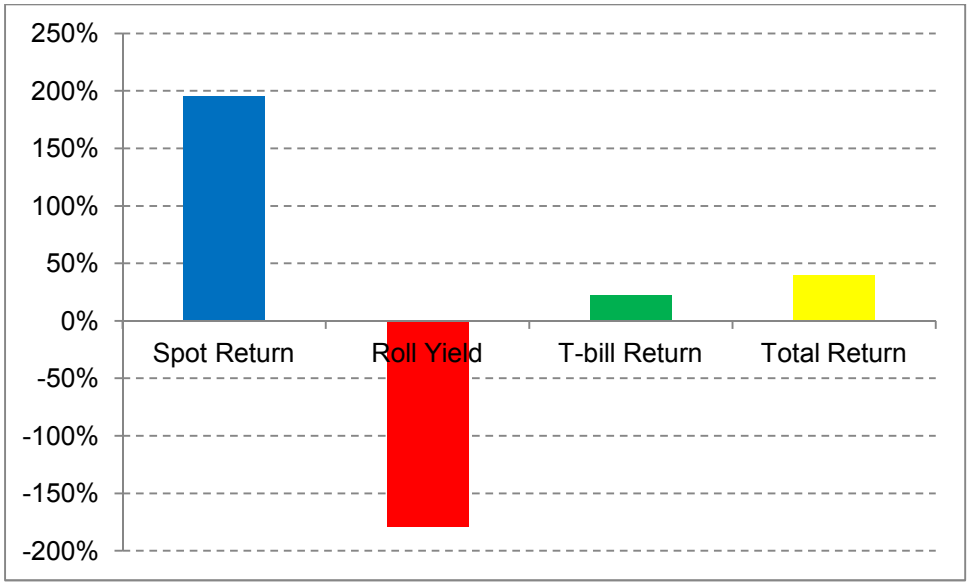


Figure 6: Decomposition of GSCI total returns over 10 years

2.5 The Various Commodity Benchmarks

The three most widely used and best known commodity indices are the Standard and Poor's Goldman Sachs Commodity Index (S&P GSCI), the Dow Jones UBS Commodity Index (DJ-UBS CI) and the Reuters/Jefferies CRB Index (RJ-CRB).

The S&P GSCI was created to provide investors with a reliable and investable benchmark for investors. The index was first published in 1991, but the methodology used to calculate this index was used with historical data to create data history going back to 1970, resulting in the longest history of available commodity indices. The S&P GSCI is calculated on a world production basket of active and liquid commodity nearby futures. The expiring futures are then rolled forward to the next commodity futures (as per the methodology described above). The weight of each commodity in the index is based on the last five years of production output for each commodity.

The DJ-UBS CI was created in 1998 and has back filled data from 1991. The weights of the index are based on world production and liquidity, with liquidity being the dominant factor. Additionally, there are restrictions on the weightings of individual commodities as well as groups of commodities to ensure that the index remains diversified. The maximum amount allowed in any sub-class of commodities is 33% of the index and no single commodity may exceed 15% of the index or be less than 2% of the index weight.

The Commodity Research Bureau (CRB) first constructed and published the index in 1957. The index has had ten revisions since 1957 to ensure the index remains representative of the current market environment. The most recent revision was in 1995. The index currently contains 19 commodities grouped into four groups. Group 1 includes only petroleum products with a fixed weight of 33%. The three remaining groups are based on liquidity and are equally weighted within in group to ensure that the index is diversified. The Index is rebalanced monthly to its fixed weightings.

Table 2, on the following page, shows the 2012 weightings in each commodity for the various commodity indices.

	S&P GSCI	DJUBS CI	Jeffries CRB
Crude Oil	34.90%	8.16%	23%
Brent Crude	16.50%	4.73%	
Unleaded Gasoline	4.70%	3.33%	5%
Heating Oil	5.20%	3.13%	5%
GasOil	7.10%		
Natural Gas	2.10%	10.85%	6%
Energy	70.50%	30.20%	39.00%
Aluminium	2%	5.20%	6%
Copper	3.10%	6.84%	6%
Lead	0.40%		
Nickel	0.60%	2.12%	1%
Zinc	0.50%	3.01%	
Industrial Metals	6.60%	17.17%	13.00%
Gold	3%	9.52%	6%
Silver	0.40%	3.01%	1%
Precious Metals	3%	13%	7%
Wheat	2.90%	6.87%	1%
Kansas Wheat	0.70%		
Corn	4.50%	8.14%	6%
Soybeans	2.30%	9.46%	6%
Cotton	1.20%	1.45%	5%
Sugar	2%	3.56%	5%
Coffee	0.90%	1.97%	5%
Coccoa	0.20%		5%
Soybean Oil		3.43%	
Orange Juice			1%
Agriculture	14.70%	34.88%	34.00%
Feeder Cattle	0.50%		
Live Cattle	2.70%	3.66%	6%
Lean Hogs	1.50%	1.97%	1%
Livestock	4.70%	5.63%	7.00%

Table 2: Index Weights and Constituents[6]

[6] Sources: S&P Dow Jones (2012), Dow Jones (2012) and Thomson Reuters/Jeffries (2012)

2.6 Commodity indices and their returns

Greer (2000 & 2005) creates a framework and develops a commodities pricing model based on a number of previous commodity price theories. In this pricing model Greer explored whether or not there is an inherent return to a passive unleveraged commodity index. In his model, Greer argued that the component of returns of such an index are made up of: Treasury Bill (T-Bill) rate, risk premium, rebalancing, convenience yield and expectation variance.

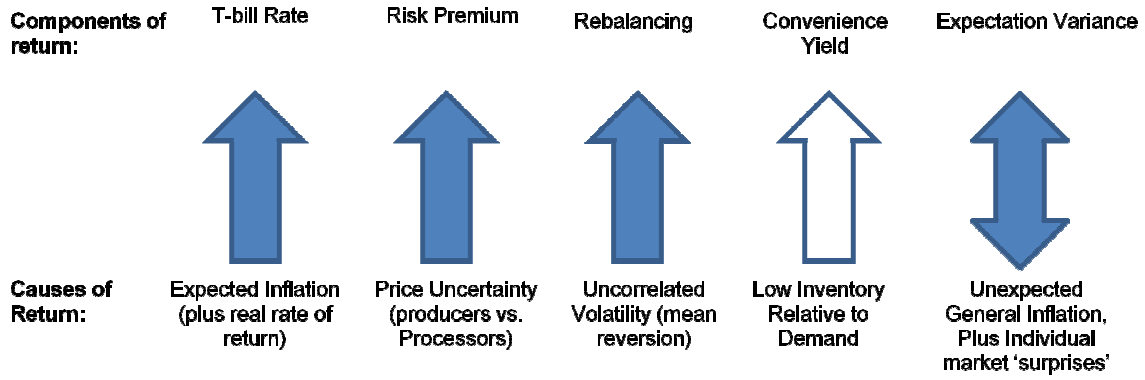


Figure 7: Commodity indices – return component[7]

T-Bill Rate: This is the return on the collateral, since the futures positions are fully collateralised. Commodity futures indices assume that the collateral is invested in Treasury Bills. This T-Bill rate has been shown to have returned an expected rate of inflation plus a real rate of return, Greer (2005).

Risk premium: Gorton (2005) defines risk premium as the difference between the current futures price and the expected future spot price. If the future's price today is below that of the future spot price, the holder of the future will on average earn a positive return. In contrast, if the futures price is above the expected future spot price, the seller of the future will earn a positive return.

Keynes' (1930) and Hick's (1939) developed the theory of 'normal backwardation' based on the fact that risk premium would generally accrue to the buyers of the futures. They conceived of a world in which producers would always look to hedge their price risk. For instance, a producer of grain would sell futures in order to lock in the future price of his output and obtain insurance against the price risk of the grain at the time of harvest. Speculators would purchase these futures and provide the insurance; however they would

[7] Reproduced from Greer (2005).

demand a futures price which is below the spot price expected to prevail in the market at the time of maturity of the future.

To illustrate this, consider an example adapted from Greer (2000). Assume that the current price of cattle is 67c and that market participants expect the price of cattle to be 72c in the future. The spot price in the future can vary from 60c to 90c as a result of various market events and conditions. As a producer, your breakeven price is 65c.

To ensure your future profits, you go into the futures market in an attempt to find someone to buy your cattle at 72c. However, at this price you have no willing buyers as they are assuming your price risk for an expected return on zero. However, at a lower price of 70c investors are willing to take on the long position (buy the future) with the expectation of earning an 'insurance premium' or 'risk premium' of 2c at maturity. Figure 8 below illustrated this risk premium.

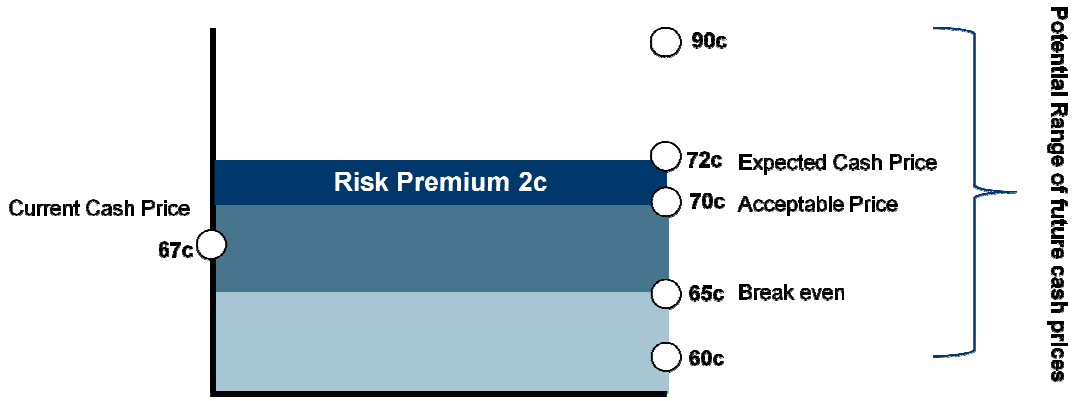


Figure 8: Commodity Futures Pricing Model – Risk Premium

Rebalancing: This third return relates to the expectation that commodity prices are not highly correlated to each other (for example wheat is not highly correlated to Brent crude). Each commodity responds to different supply and demand restrictions within its own market. A change in expected supply in one commodity market will not affect expected supply constraints within another commodity market. In a fixed value weighted index, as the prices of the commodities fluctuate the index will rebalance by selling the futures that go up and buying those that go down to maintain the initial weights. This construction should provide an incremental return should the constituents in the index be uncorrelated.

Convenience yield: Note that this arrow is lighter than the other arrows - this is to show that this feature occurs sometimes in some commodity markets when there is restricted supply. When there is expected tightness in a commodity market, consumers of this commodity (for

example energy refiners) will purchase the future in an effort to ensure the supply. This results in an increase in the nearest dated future price as consumers are paying for certainty in supply. This results in a backwardated forward curve (explained in a later section).

Expectation Variance: is the variance between the expected future price of the commodity future and the reality of this price in the future. If markets are efficient, then one would expect positive and negative expectational variances to even out over time. Even if this is not a source of long-term returns, it is certainly a factor in the pattern of returns. Greer (2000), argues that one would expect 'several negative deviations and a few large positive deviations' because supply disruptions are more likely than the opposite. This pattern of larger positive deviations results in commodity indices having a positive skew.

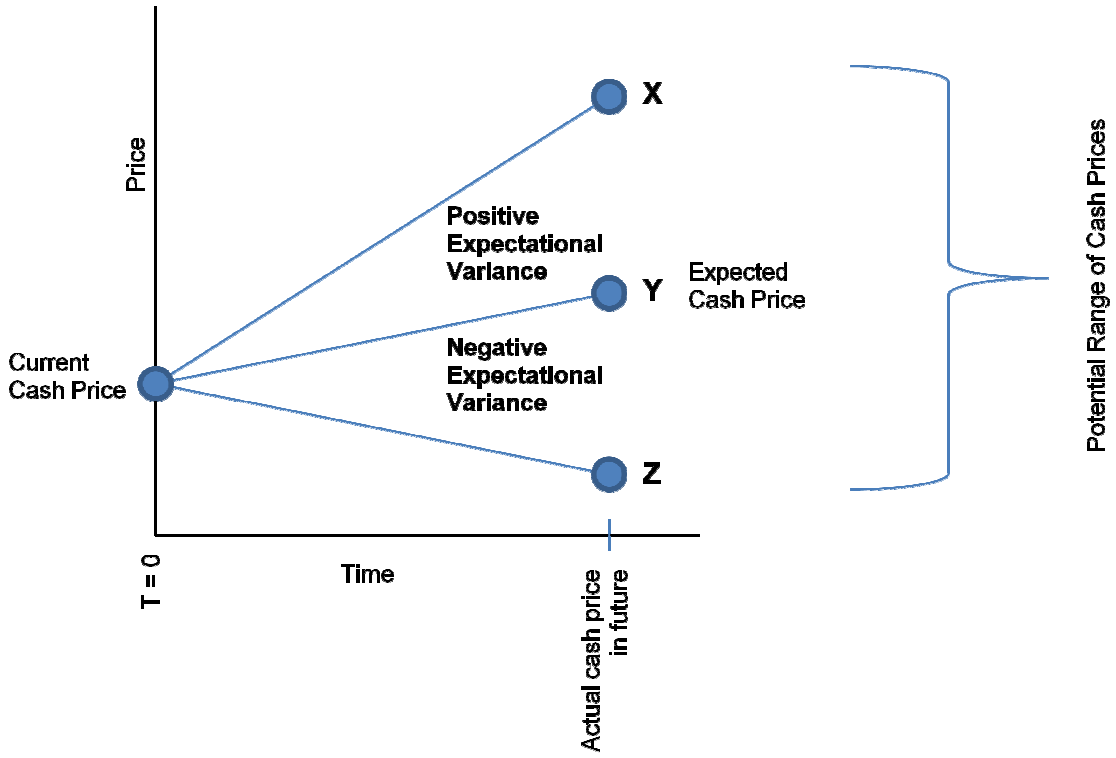


Figure 9: Expectational Variance[8]

[8] Source: Greer (2000)

3. Data and Methodology

In this section we will define the time horizon of the study, how this time horizon is split and the various proxies that will be used to carry out the analysis. Particular attention is given to the commodity benchmarks and the creation of a proxy for this asset class.

3.1 Sample data

We will examine the monthly returns from June 2002 to June 2012, a period of ten years, with 121 monthly observations. The use of ten years of data should allow us to create more robust statistical results and hence provide a better general indication of the performance of commodity futures. We hope that the longer time period assists in making the analysis less sensitive to short periods of extreme performance, especially during the financial crises of 2007-2008.

We will look to separate the ten year time period roughly in two, the first portion being before the financial crises during 'normal' market conditions and the second portion being during and after the financial crises during 'extreme' market conditions.

As pointed out in the earlier section, most South African institutional investors focus their asset allocation on three main asset classes; shares, bonds and cash. Additionally, some will include property in their asset allocation decision. We will focus on these four asset classes.

We will consider the following indices as proxies for the various asset classes in this study:

Asset Class	Proxy/Benchmark Index	Description
Equities	FTSE/JSE All Share Index	The FTSE/JSE Africa All Shares Index is a market capitalization weighted index. Companies included in this index make up the top 99% of the total pre-free floatmarket capitalization of all listed companies on the Johannesburg Stock Exchange.
Bonds	ALBI	The ALBI Index is a composite index containing the top 20 vanilla bonds ranked dually by liquidity and market capitalisation. The index includes both government and corporate issued bonds with a variety of maturities.
Cash	STeFI Composite Index	The Alexander Forbes Short Term Fixed Interest (STeFI) Composite index is a proprietary index that measures the performance of Short Term Fixed Interest or money market investment instruments in South Africa. It is a benchmark index constructed by Alexander Forbes, calculated and published by SAFEX and has become the industry benchmark for cash equivalent investments.
Property	FTSE/JSE Property Loan Stock Index	The FTSE/JSE Property Loan Stock Index consists of all ordinary securities listed on the JSE which are classified by the JSE as a property loan stock security. A minimum free float of 15% is required. Constituents are normally added at the quarterly reviews.

Table 3: Asset Classes and their proxies

3.2 The commodity index

Due to the significant differences in the weightings of the commodity indices listed above, they each have very different historical return and characteristics, as shown in Table 4 below. As a result of this, we will create an index, the composite index, which will take equal weightings of the S&P GSCI, DJ-UBS CI and the RJ-CRM index.

	S&P GSCI TR	*DJ-UBS TR*	*RJ-CRB TR*	*Composite*
Mean	7.74%	7.47%	10.04%	8.42%
Standard Deviation	27.82%	20.32%	21.81%	22.89%
Minimum	-60.08%	-50.27%	-48.17%	-52.44%
Maximum	76.01%	41.56%	51.05%	56.21%

Table 4: Historical Annual Returns and Standard Deviation of Commodity Indices

Table 4 above shows the annual compound returns, their standard deviations, the maximum and minimum return for the three benchmark indices as well as the created composite index over a ten year period.

It is of interest to note that these three industry benchmarks for commodities have such different risk return profiles. This difference can be explained by the different weighting in each commodity in the various indices. For example if one compares the S&P GSCI to the DJ-UBS index, they have similar returns 7.74% and 7.47% respectively but have very different standard deviations of 27.82% and 20.32% respectively. This can be attributed to the significant difference in weightings in energy; the S&P GSCI currently has 70.50% in energy while the DJ-UBS index currently has a weighting of 30.20% in energy. The significant volatility in energy markets has contributed to the higher volatility in the S&P GSCI.

Figure 10 below shows the risk and return for each of the indices. From the graph it is evident that the three benchmark indices have varying risk and return characteristics. The composite index falls in the centre of the three benchmarks.

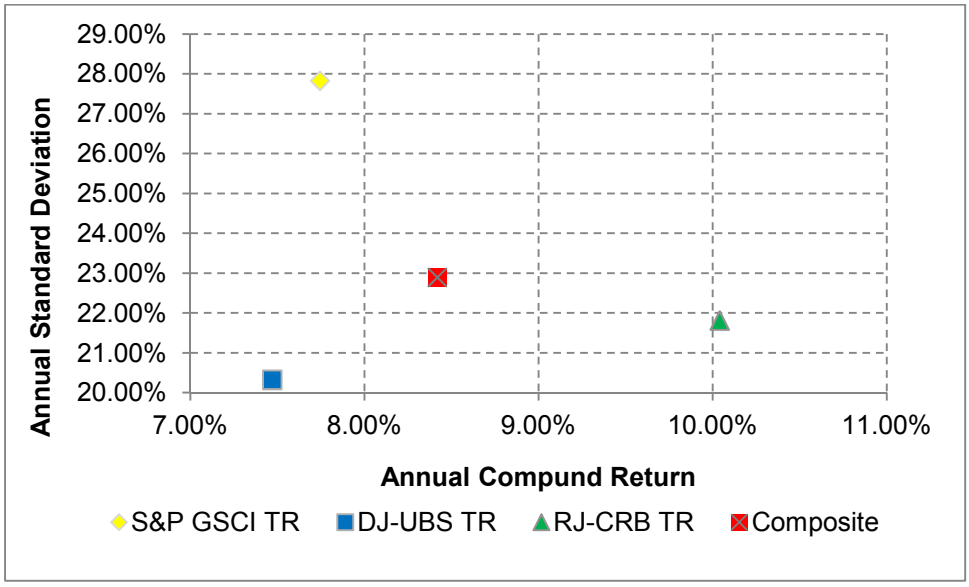


Figure 10: Commodity Indices: Risk-Return

This difference in weightings and resultant performance is also seen in the graph, Figure 11, below. The 28th of June 2002 is taken as the initial level of 100.

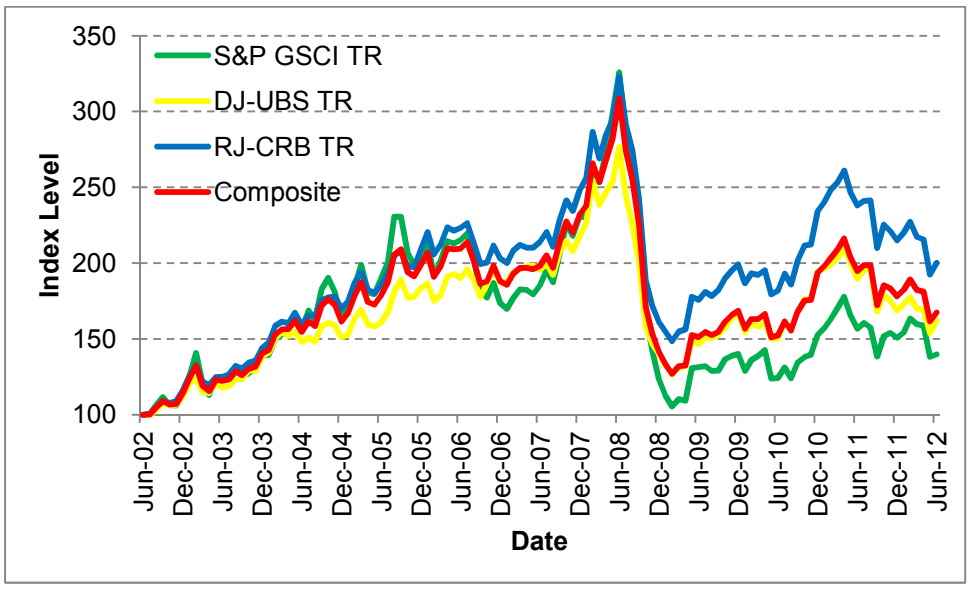


Figure 11: Historical performance of the various commodity indices

As these indices are dollar denominated, we will further have to look at two variations of the composite index:

(i) The composite index in USD (composite USD). In this instance we will assume that the foreign exchange risk can be completely hedged to produce a Quanto index. (i.e. a Quanto index being an index that pays dollar returns in rands – no foreign exchange risk)

(ii) The composite index in ZAR (composite ZAR). In this instance we will convert the monthly dollar returns to rands. This index will have two components of returns: the commodities in USD and the rand dollar exchange rate returns.

By analysing the composite index in both dollars and rands, we should be able to better understand whether the commodity investment for a South African investor should or should not contain additional foreign exchange risk.

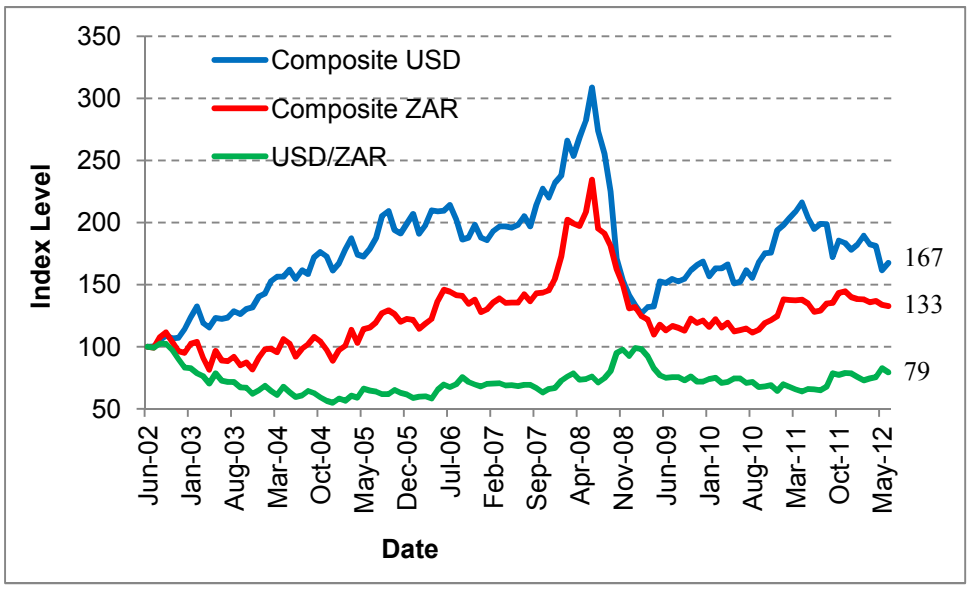


Figure 12: Comparison of Composite Index in USD and ZAR

In Figure 12 above, we compare the performance of the composite index in dollars and rands as well as the performance of the USD/ZAR exchange rate. We take the 28th of June 2002 as the initial level of 100 and convert the dollar returns into rands monthly. During a period of ten years the composite index in dollars outperformed the composite index in rands by 34%. This difference in performance can be attributed to the appreciation in the rand over the ten year period by 21%. On the 28th of June 2002 the USD/ZAR exchange rate was R10.30 and on the 29th June 2012 the USD/ZAR exchange rate was R8.16. From an

investors' point of view, if they are concerned with absolute performance this above historical performance would suggest that the commodity index investment should be in dollars, quanto'd with no additional exchange rate risk.

Below, in Table 5, we have summarised some of the key descriptive statistics. Over the ten year period both indices have had a similar level of volatility, the composite index in USD had an average annual volatility of 22.94%, while the composite index in ZAR had an average annual volatility of 21.39%. The average annual returns below reinforce the superior absolute performance of the index in dollars over the index in rands; 8.38% and 6.03% respectively.

Although the index in dollars attained a greater average annual return than the index in rands, the rand index had a much larger positive tendency. This is evident in that the average maximum return for the rand index was 72.87% while that of the dollar index was 55.70%. Additionally, this is reinforced in the skewness of both returns; the rand index had a slightly negative skew of -0.22 while the dollar index had a skew of -0.98.

	Composite USD	Composite ZAR	USD/ZAR
Mean	8.38%	6.03%	-0.29%
Standard Deviation	22.94%	21.39%	16.61%
Minimum	-52.28%	-51.68%	-34.24%
Maximum	55.70%	72.87%	50.49%

Table 5: Historical Annual Returns and Standard Deviation of the Composite Indices

Another important factor when decided if the commodity investment should be in dollars or rands is to look at the correlation between these indices and the dollar rand exchange rate. This assists in determining if there is a diversification benefit in converting your dollar returns to rands. Ideally, the returns should be negatively correlated so that the returns from one component is buffered by the returns of the other components. For example, if the commodity returns in dollars are low or negative the returns from the dollar rand exchange rate should, hopefully, be large and positive.

Looking at the correlation matrix in Table 6 below, we observe that the correlation between the annual returns of the composite index in dollars is negatively correlated to the annual returns of the USD/ZAR exchange rate, -0.54. This indicates that there is a diversification benefit in having the commodity investment in rands and it is advantageous in having this additional foreign exchange rate exposure.

In looking at the correlations between the composite index in rands and the composite index in dollars and the dollar rand exchange rate, it is interesting to note that the correlation between the two composite indices is fairly high (0.72), while the correlation between the composite rand index and the exchange rate are fairly low (0.18). Since the returns of the composite rand index in rands is made up of the returns of the composite index in dollars and the exchange rate returns, this implies that the majority of the returns of this index is driven by the commodity performance and not the exchange rate performance.

	Composite USD	Composite ZAR	USD/ZAR
Composite USD	1.00	0.72	-0.54
Composite ZAR	0.72	1.00	0.18
USD/ZAR	-0.54	0.18	1.00

Table 6: Annual Correlation Coefficients between the Composite Indices and USD/ZAR

It is also of interest to see how the correlations have changed over time. In Figure 13, we have calculated the one year monthly rolling correlation between the composite index in dollars and the exchange rate. The one year monthly average correlation of the ten year period was -0.33, emphasising the diversification benefit of having the exchange rate exposure. Although the correlation was initially high in 2003 (at almost 0.60), it had steadily decreased over the ten year period and at the end of June 2012 it was -0.90 (almost perfectly negatively correlated).

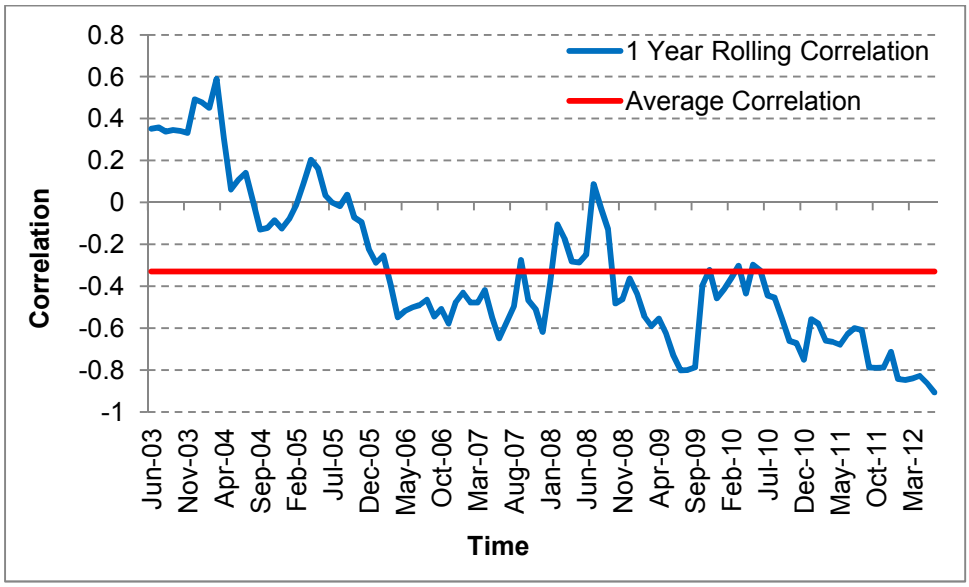


Figure 13: Rolling One Year Correlation between the USD Composite Index and USD/ZAR

4. Results

In the chapter that follows we aim to answer the questions set out in the problem statement of the study using various.

4.1 Historical Return and Risk

Using historical monthly data from June 2002 to June 2012, we have looked at the historical performance of the four proxies mentioned earlier and the two versions of the composite commodity index.

Figure 14, shows how R100 invested at the end of June 2002 would have grown over a ten year period if it was invested in the various proxies. Over this ten year period neither of the commodity composite indices performed particularly well when compared to the other asset classes; the dollar composite index had a return of 67% while the rand composite index had a return of 33%. These returns are lower than an investment in property, equities and cash which had returns of 375%, 216% and 119% respectively.

Looking at the graph below, it is evident that both commodity composite indices had a major drawdown during the financial crises of 2007/2008. This drawdown was significantly larger than that of the other asset classes. Figure 14 shows that the maximum drawdown for the commodity indices was ~52% while that of equities and property was 40% and 26% respectively. These drawdowns where observed at the beginning of 2009 for a one year period. As a result the returns from the commodity investments were significantly reduced. In Figure 15 and Figure 16, we split up the ten year time period into two five year periods to better understand how the financial crises affected the returns of the various benchmarks.

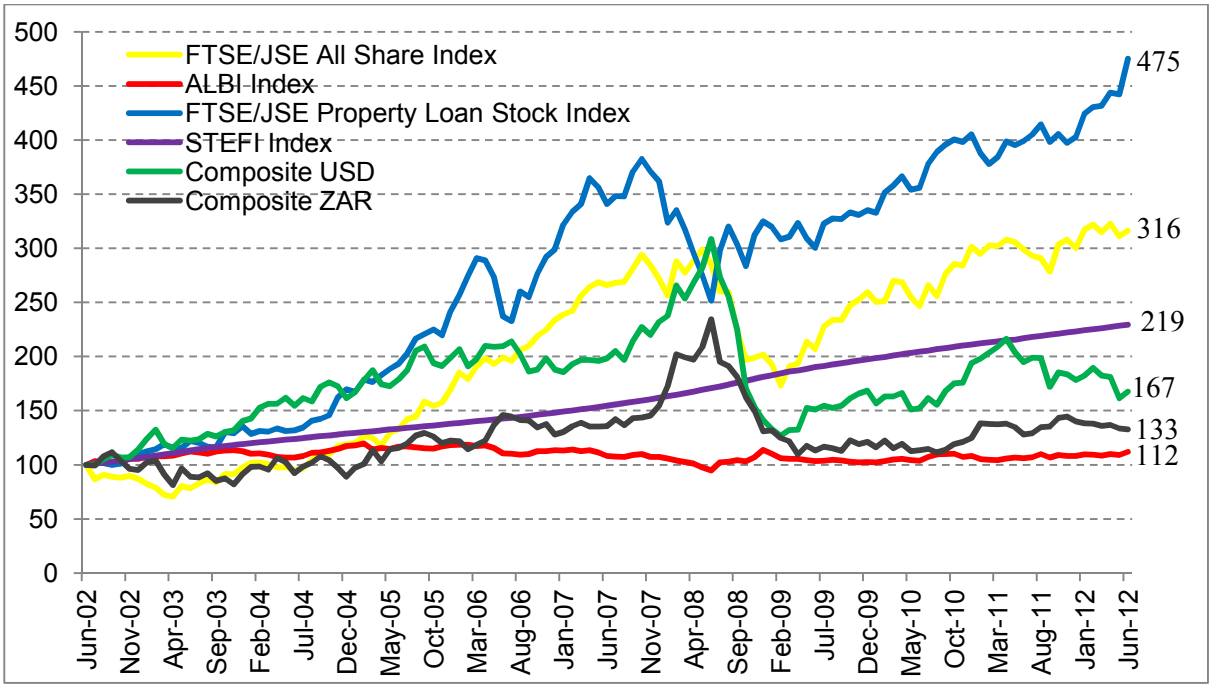


Figure 14: Historical Performance, June 2002 to June 2012

Further analysis of the returns of the various proxies over the ten year period is illustrated in Table 7 below. Both commodity indices had similar volatilities to equities, however with approximately half the returns. The returns of the commodity indices are comparable to that of cash, however with significantly more risk (approximately ten times). Based on this analysis over the ten year period, commodities do not appear to be an attractive investment alternative due to their low returns and high volatility.

	Equities	Bonds	Property	Cash	Composite USD	Composite ZAR
Mean	17.58%	0.53%	17.71%	8.62%	8.38%	6.03%
Standard Deviation	22.02%	5.16%	18.74%	2.10%	22.94%	21.39%
Minimum	-39.80%	-12.38%	-26.18%	5.66%	-52.28%	-51.68%
Maximum	68.33%	12.17%	64.82%	13.22%	55.70%	72.87%

Table 7: Historical Returns and Risk, June 2002 to June 2012

We now look at the returns of the various proxies over two five year periods in an effort to better understand the affects of the large draw downs in returns during the financial crisis. In Figure 15 and Table 8 we analyse the performance and volatility of the proxies from June 2002 to June 2007 and we will consider this period to be 'normal' market conditions.

During the five year period from June 2002 to June 2007 the performance of the commodity composite indices performed better than over the entire ten year period. The composite index in dollars outperformed the composite index in rands, cash and bonds a return of 98% versus returns of 54%, 35% and 8% respectively.

When compared to equities and property, both commodity indices underperformed. Equities offered a return of 166% while property offered a return of 240%. For an investor purely interested in returns it is ambiguous as to whether or not commodities should be considered as an investment, as they outperform bonds and cash, but underperform equity and property.

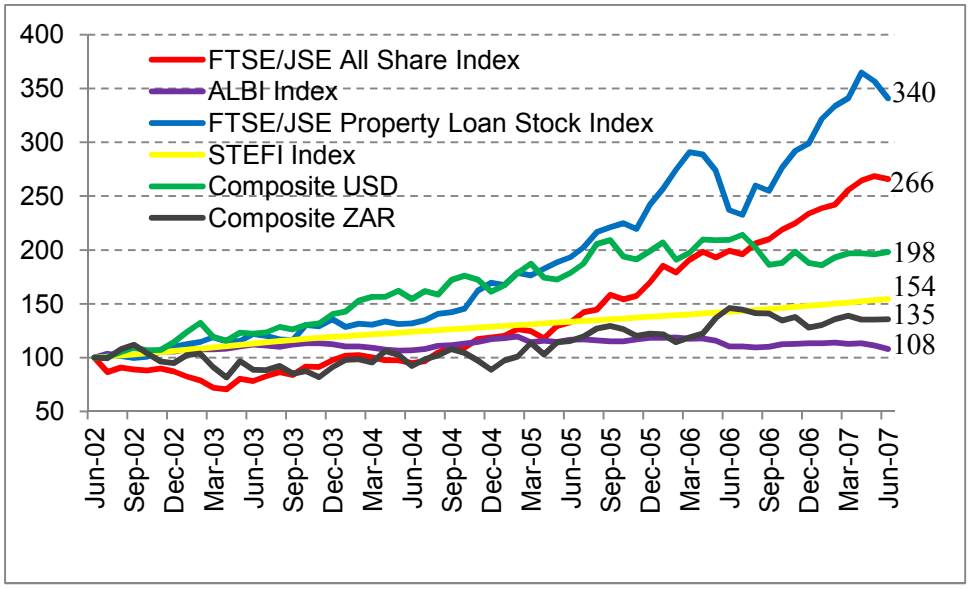


Figure 15: Historical Performance, June 2002 to June 2007

Looking at the volatilities of these returns, we see from Table 8 below, that the volatilities of the commodity index are lower during these 'normal' market conditions than over the entire ten year period. These volatilities are now more in line (slightly less) than the volatility in returns from equities and property. Their maximum draw downs are also significantly less, for instance the dollar composite index had a maximum drawdown of 10.93% during normal market conditions compared to a maximum drawdown of 52.28% during the ten year period. This suggests that the majority of the volatility in the commodity indices came from the second five year period during extreme market conditions. This is emphasised in the analysis that follows in Figure 16 and Table 9.

	Equities	Bonds	Property	Cash	Composite USD	Composite ZAR
Mean	29.71%	1.65%	29.64%	8.74%	15.13%	9.13%
Standard Deviation	17.32%	5.15%	15.07%	2.08%	12.80%	13.91%
Minimum	-21.63%	-5.75%	8.08%	6.98%	-10.93%	-23.94%
Maximum	68.33%	12.17%	64.82%	13.22%	36.35%	37.80%

Table 8: Historical Returns and Risk, June 2002 to June 2007

From June 2007 to June 2012, the world experienced one of the worst financial crises in history. The graph below, in Figure 16, clearly illustrates this with large declines in returns particularly prevalent throughout 2008 with small but steady increasing returns after 2009. The commodity indices recorded significant annual returns leading up to June 2008: the dollar composite index had an annual return of 72.87% as at June 2008 and the rand composite index had an annual return of 55.70% ending in June 2008. These returns far outperform those of the other asset classes. However, these large positive returns were quickly and suddenly eroded away; the dollar composite index dropped 52.28% while the rand composite index dropped 51.68% in 2009. During this five year period the returns of the composite index were negative; -2% for the rand index and -15% for the dollar index.

The rebound in equities and property was stronger than that of the commodities, with property having a 39% return and equities having a 19% return over the five year period. The losses during the crises were also lower than that of commodities for equities and property with maximum draw downs of 39.80% and 12.18% respectively.

The only asset class that provided steady positive returns over this extreme period was cash with a return of 48% over 5 years.

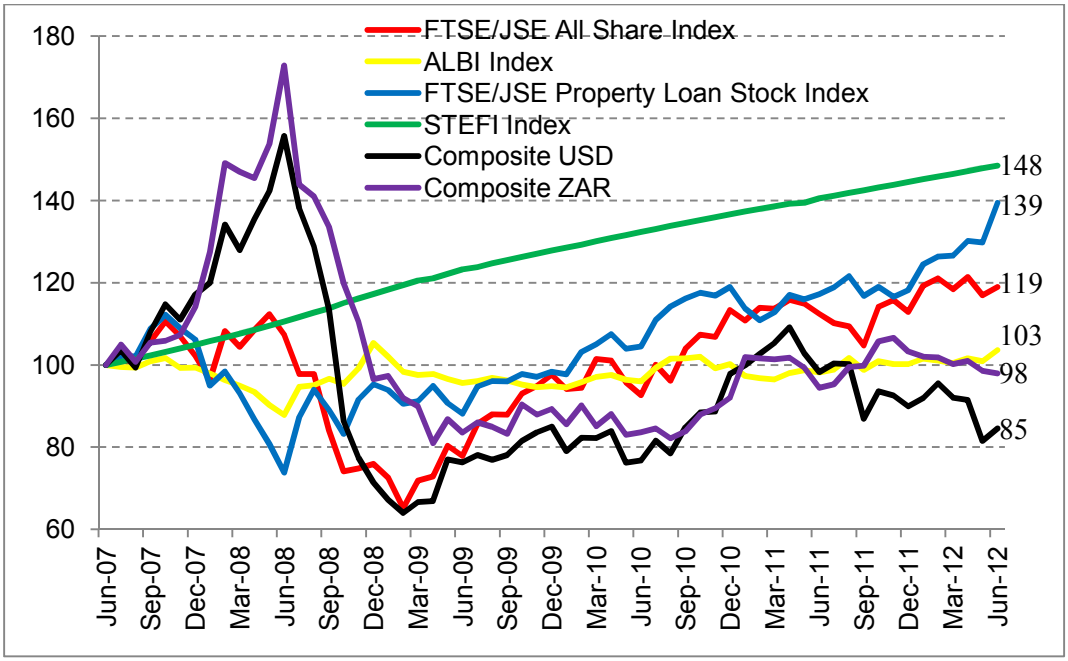


Figure 16: Historical Performance, June 2007 to June 2012

During these extreme market conditions the commodity indices had on average negative annual returns, -1.37% for the dollar index and -0.92% for the rand index, while the remaining asset classes had low but positive returns over the same period (Table 9 below). Additionally, commodities had significant volatility when compared to the other asset classes. During this five year period of extreme market conditions commodities would certainly not have been an attractive investment due to their negative returns and high volatility.

	Equities	Bonds	Property	Cash	Composite USD	Composite ZAR
Mean	4.64%	0.87%	6.34%	8.34%	-1.37%	-0.92%
Standard Deviation	20.96%	4.38%	12.04%	2.31%	28.00%	24.60%
Minimum	-39.80%	-12.18%	-26.18%	5.66%	-52.28%	-51.68%
Maximum	44.95%	8.83%	21.06%	12.00%	55.70%	72.87%

Table 9: Historical Returns and Risk, June 2007 to June 2012

Although commodities appeared to be solid performers during normal market conditions they do not seem to be an attractive stand alone investment when compared to other South African asset classes.

4.2 Correlation Analysis

We next examine the interaction of commodities with the four South African asset classes in an effort to establish if there is a benefit for their inclusion in a South African portfolio. For commodities to be beneficial in a portfolio of South African investments, one would want them to have low to negative correlations with other asset classes. This would create diversification within the portfolio, so that the various included asset classes move in different directions during various market conditions acting as a buffer for one another.

We first look at the correlations between commodities and the other asset classes over the ten year period and then the two five year periods with annual returns to get a sense of their long term interactions. We then look at one year rolling correlations, based on monthly returns, to get a feel for how these correlations have changed over time.

In Table 10, we present the correlation coefficients of annual returns over the ten year period from June 2002 to June 2012.

Firstly, looking at the composite index in dollars, we see that the index has low positive and negative correlation to bonds, property and cash (-0.23, 0.11 and -0.14 respectively). The index has a positive correlation of 0.52 with equities. Although positive, this correlation is not significantly large enough to be of concern.

Secondly, looking at the composite index in rands, the correlations with the other asset are lower than the index in dollars. This suggests that there is an additional diversification benefit of having the commodity investment in rands with the foreign exchange risk. The correlation of the index to bonds, property and cash is -0.50, -0.04 and -0.36 respectively and an improved lower correlation to equities of 0.43.

Based on the above analysis, commodities do have a diversification benefit to the South African portfolio. Further, the investor is able to enhance this diversification by having their commodity investment in rands.

	Equity	Bonds	Property	Cash	Composite USD	Composite ZAR
Equities	1.00	-0.22	0.67	-0.53	0.52	0.43
Bonds	-0.22	1.00	0.39	0.09	-0.23	-0.50
Property	0.67	0.39	1.00	-0.33	0.11	-0.04
Cash	-0.53	0.09	-0.33	1.00	-0.14	-0.36
Composite USD	0.52	-0.23	0.11	-0.14	1.00	0.72
Composite ZAR	0.43	-0.50	-0.04	-0.36	0.72	1.00

Table 10: Correlation Coefficients of Annual Returns, June 2002 – June 2012

We now present the correlations between the four South African asset classes and the commodity indices over the two five year periods.

Table 11 below shows the interactions between the various asset classes from June 2002 to June 2007 based on annual returns, while Table 12 shows the correlation from June 2007 to June2012.

	Equity	Bonds	Property	Cash	Composite USD	Composite ZAR
Equity	1.00	-0.52	0.54	-0.80	-0.25	0.72
Bonds	-0.52	1.00	0.24	0.51	0.35	-0.43
Property	0.54	0.24	1.00	-0.51	-0.13	0.35
Cash	-0.80	0.51	-0.51	1.00	0.38	-0.72
Composite USD	-0.25	0.35	-0.13	0.38	1.00	0.14
Composite ZAR	0.72	-0.43	0.35	-0.72	0.14	1.00

Table 11: Correlation Coefficients of Annual Returns, June 2002 – June 2007

	Equity	Bonds	Property	Cash	Composite USD	Composite ZAR
Equity	1.00	-0.23	0.51	-0.63	0.76	0.35
Bonds	-0.23	1.00	0.61	-0.17	-0.48	-0.48
Property	0.51	0.61	1.00	-0.53	0.05	-0.34
Cash	-0.63	-0.17	-0.53	1.00	-0.51	-0.42
Composite USD	0.76	-0.48	0.05	-0.51	1.00	0.81
Composite ZAR	0.35	-0.48	-0.34	-0.42	0.81	1.00

Table 12: Correlation Coefficients of Annual Returns, June 2007 – June 2012

Comparing the correlation of the composite index in dollars for the two periods we can see that the index does have a diversification benefit during both periods, with low and negative correlations (except for the correlation with equities in the second year period of 0.76).

It is however unclear as the whether the correlations were better during the first five year period, under normal market conditions, or over the second five year period, during extreme market conditions, as the correlation to equities and property increased while that of bonds and cash decreased.

Therefore, commodities in dollars with no foreign exchange risk offer an attractive diversification benefit during both normal and extreme market conditions.

Looking at the composite index in rands over the two periods, there has been an improvement in correlations in equities, bonds and property. This indicates that the additional foreign exchange exposure bettered the correlations during extreme market conditions.

During the first five year period it is unclear if the commodity index in rands or dollars offered better lower correlations. The correlations for equities and property worsened with the additional foreign exchange exposure while that of bonds and cash improved. This shows that during normal market conditions an investor could take on a commodity investment in either dollars or rands and benefit from some diversification.

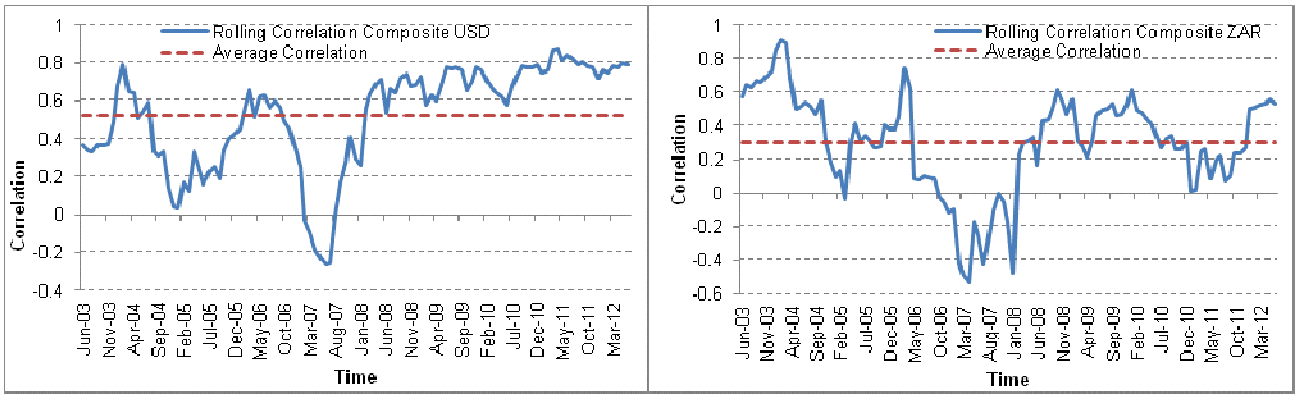
Figure 17 to Figure 20 below present the one year rolling correlations, based on monthly returns, of the two commodity indices and the four other asset classes. This assists us in visualising how the correlations have progressed over time. The figures below indicate that commodities do have relatively low and negative correlations to the other asset classes.

In the first set of figures below, Figure 17a to Figure 17c, we compare the commodity indices to equities. The average one year correlation of equities to the composite index in dollars was 0.52, while the correlation to the composite index in rands was 0.30 over the ten year period. Evident from the two graphs in Figure 18a is that commodities in rands, with the added foreign exchange risk, are less correlated to equities and the increases in correlation are buffered by the foreign exchange movements (this is evident from June 2008 to September 2011 – during and after the financial crises).

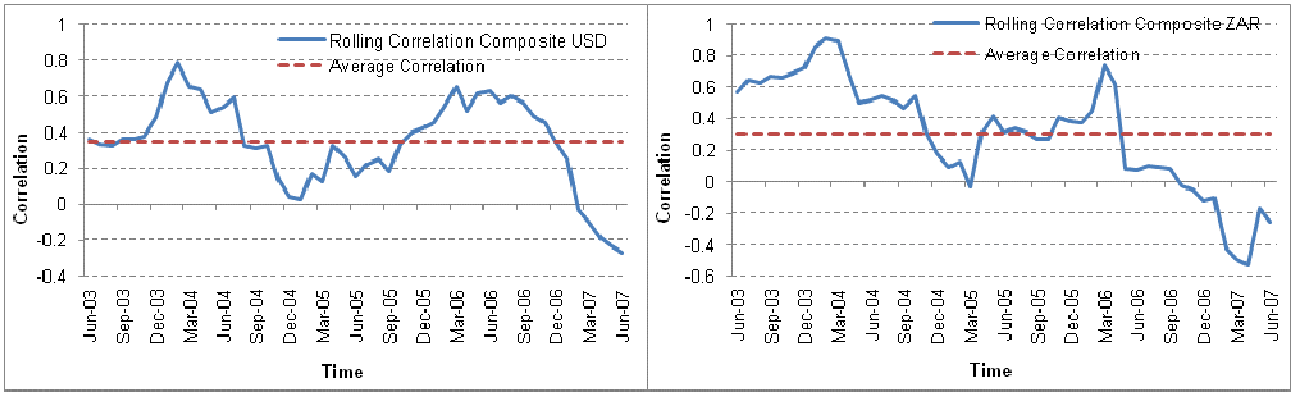
Over the first five year period from June 2002 to June 2007, the correlation of equities to the index in dollars and the index in rands was 0.35 and 0.31 respectively. During the second five year period the correlations were 0.73 and 0.36 respectively. This indicates that commodities were more correlated to equities during extreme market conditions (one would

expect this as all asset classes are affected by extreme market condition, especially during and after the financial crises of 2008) than in normal market conditions. In addition, the additional foreign exchange risk helped buffer and reduce correlations during extreme and abnormal market conditions; this is seen in the average correlation dropping significantly from 0.73 to 0.36.

17a) June 2002 to June 2012



17b) June 2002 to June 2007



17c) June 2007 to June 2012

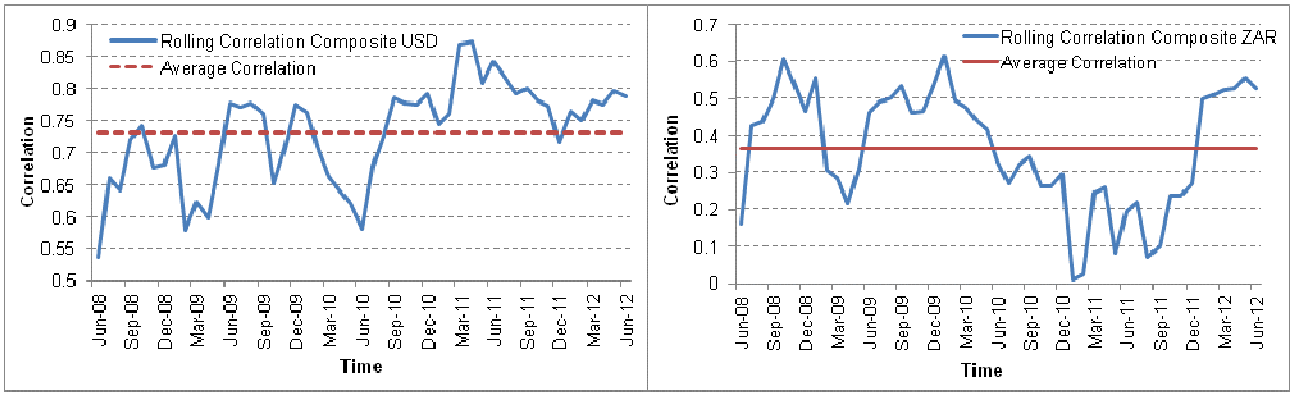
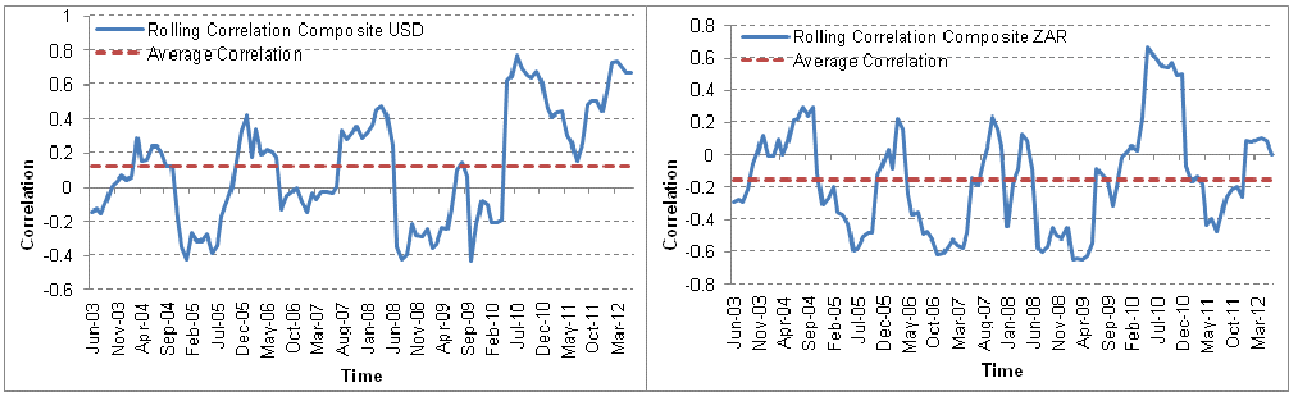


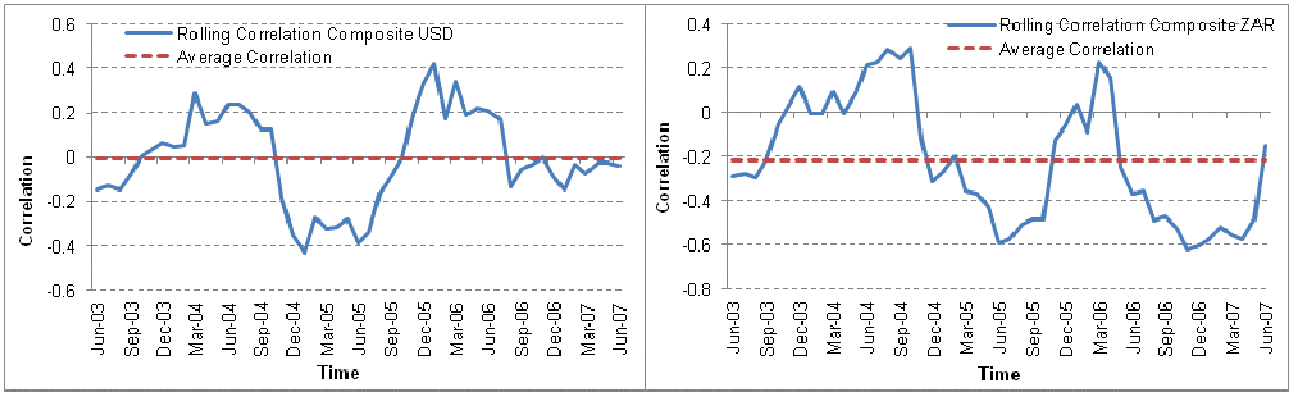
Figure 17: Rolling Correlations – Equities versus commodity indices

We next look at the relationship between the commodity indices and property; this is shown in Figure 18a to Figure 18c below. The average one year correlation between property and the composite index in dollars and rands was 0.12 and -1.15 over the ten year period. Over the first five year period the correlation to property of the composite index in dollars was -0.01 and that of the commodities index in rands was -0.22. In the second five year period the correlations were 0.20 and -0.11 respectively. This shows that commodities have a very low and negative correlation to property highlighting their diversification benefit to a portfolio; additionally the commodity index in rands will provide an additional diversification benefit. These low and negative correlations were consistent during both normal and extreme market conditions.

18a) June 2002 to June 2012



18b) June 2002 to June 2007



18c) June 2007 to June 2012

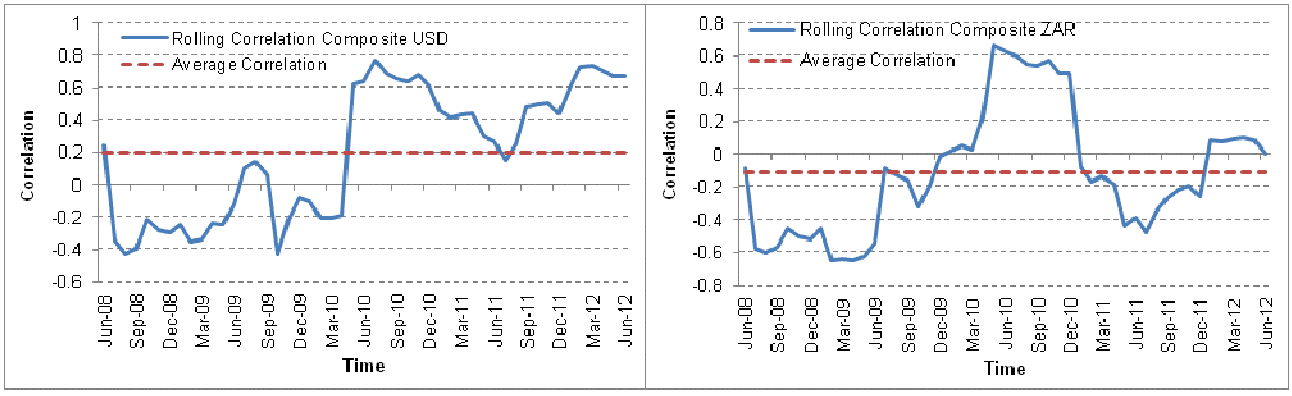
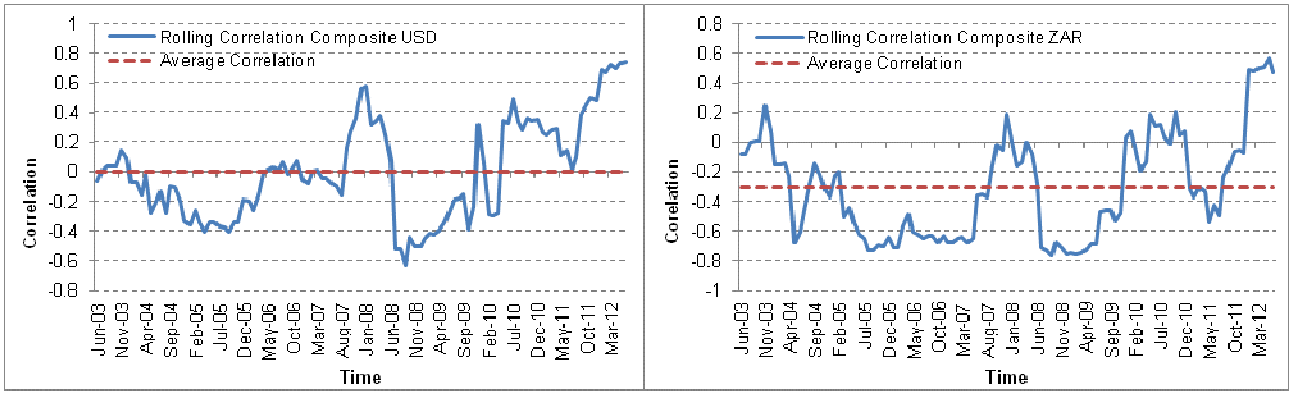


Figure 18: Rolling Correlations – Property versus commodity indices

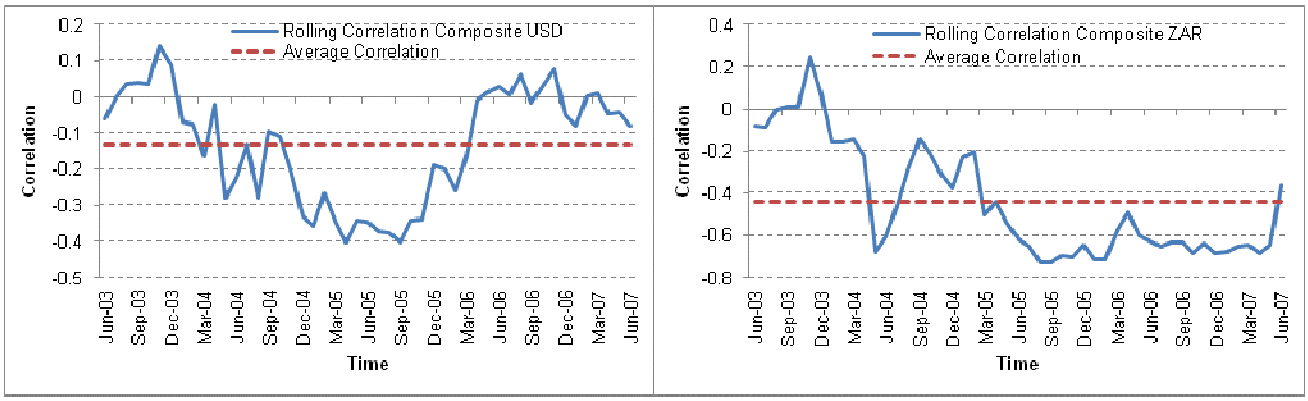
Then we look at bonds and the commodities, Figure 19a to Figure 19c below, shows the average one year correlations for the composite index in dollars was 0 and that of the composite index in rands was -0.31. From June 2002 to June 2007 the correlations were -0.13 and -0.44 respectively, while from June 2007 to June 2012 they were 0.07 and -0.23

respectively. This indicates that the commodity exposure in rands had a diversification benefit and that the correlations were better (lower) in the first five year period during normal market conditions.

19a) June 2002 to June 2012



19b) June 2002 to June 2007



19c) June 2007 to June 2012

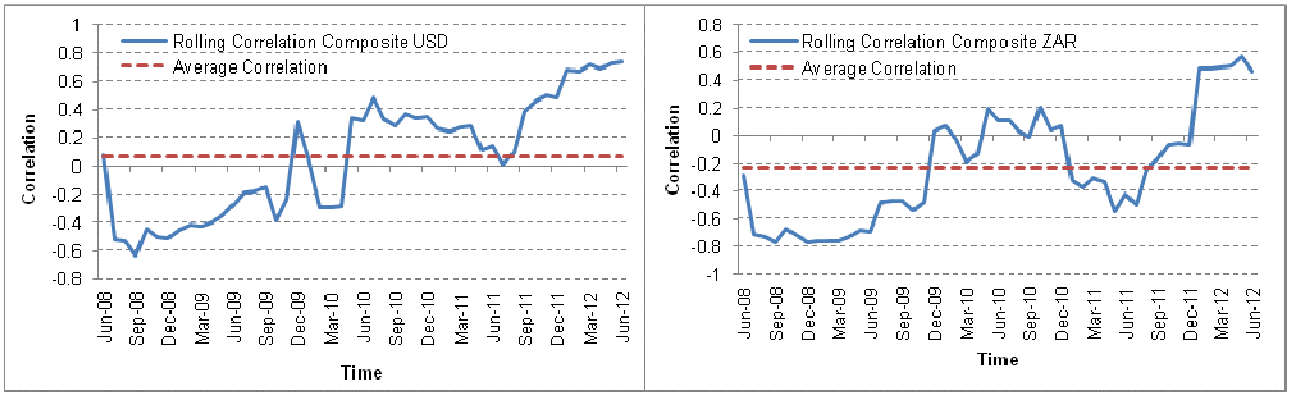
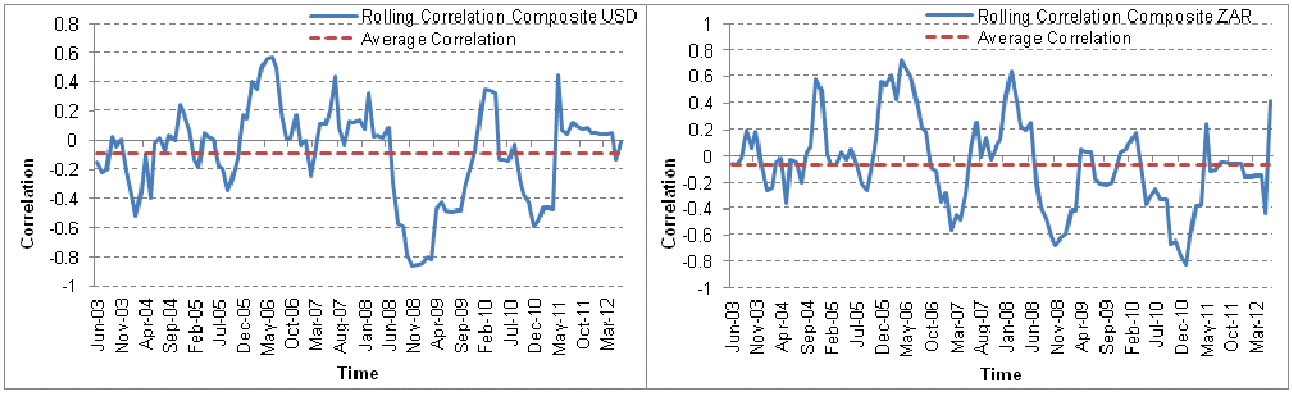


Figure 19: Rolling Correlations – Bonds versus commodity indices

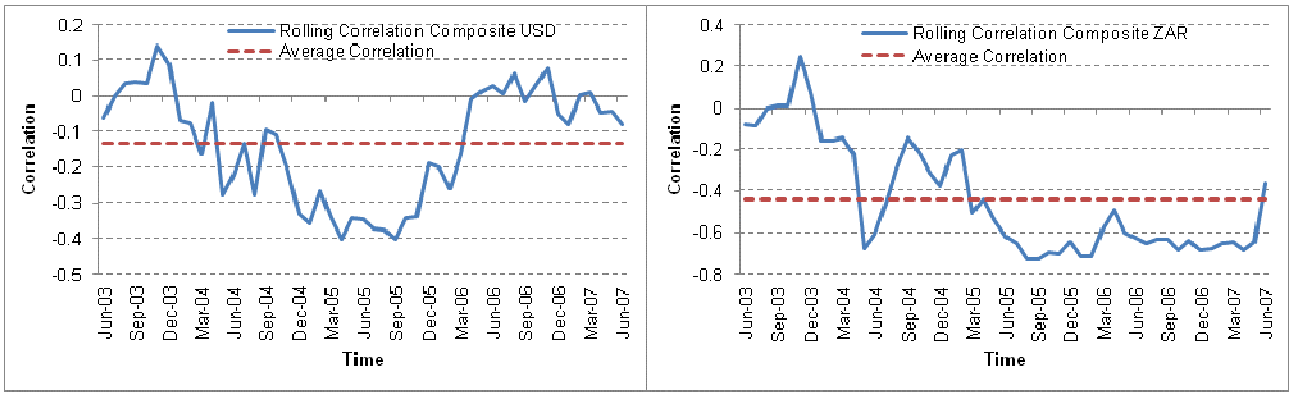
Similarly, Figure 20a to Figure 20c show the relationship with cash, the average one year correlations for the composite index in dollars and that of the composite index in rands was -

0.09 and -0.06 respectively. Over the first five year period the correlations were 0.01 and 0.04 respectively, while over the second five year period they were -0.23 and -0.23 respectively. In this instance, having the commodity exposure in rands had no additional benefit.

20a) June 2002 to June 2012



20b) June 2002 to June 2007



20c) June 2007 to June 2012

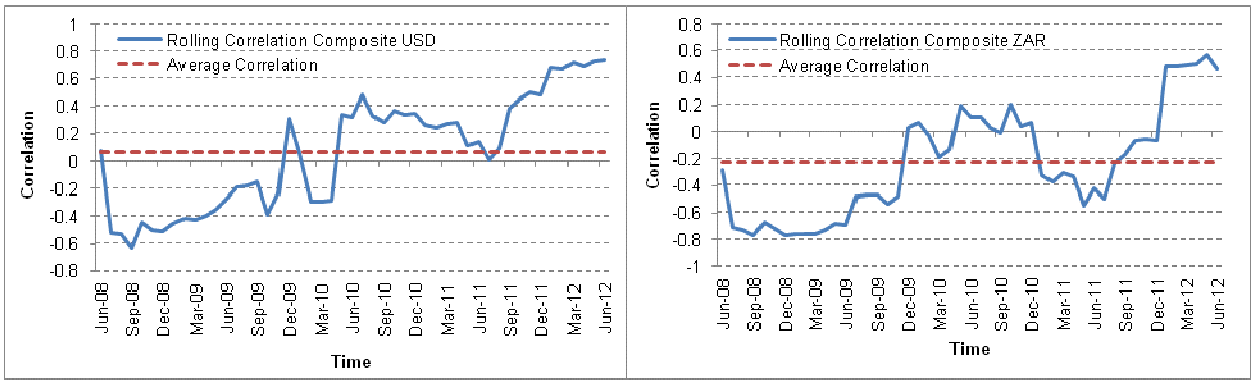


Figure 20: Rolling Correlations – Cash versus commodity indices

From the above analysis it is evident that commodities have low and negative correlations to the other four South African asset classes, with the exception of the correlation between equities and the commodity index in dollars during extreme market conditions (0.73 correlation from June 2002 to June 2007). Based on this, commodities would certainly play a role in a South African investment portfolio as they would offer a diversification benefit. In addition, based on historical data, the commodity exposure should be in rands to further reduce correlations and hence improve this diversification benefit. This additional foreign exchange exposure buffers and reduces the increasing correlation during extreme market conditions.

4.3 Commodities as an Inflation Hedge

In analysing the effect of inflation on the performance of commodities we will divide the ten year period into inflationary cycles based on the South African Repurchase Rate (Repo). The South African Reserve Bank uses monetary policy to achieve its main goal of inflation targeting; as such the changes in the Repo rate are an appropriate benchmark for the various inflationary cycles.

We define an expansionary period, a period of low inflation, as a period where the Repo has been reduced over several consecutive periods and we define a contractionary period, a period of high inflation, as a period where the Repo has been increased over several consecutive periods.

Based on these definitions, we split up the ten year period, from June 2002 to June 2012 as follows:

- First expansion period (low inflation): 31 January 2003 to 30 November 2005
- First contraction period (high inflation): 30 November 2005 to 30 September 2008
- Second expansion period (low inflation): 30 September 2008 to 30 June 2012

We have omitted the period from 30 June 2002 to 31 January 2003 due to it being a relatively short period of six months to analyse. This period would have been the end of the last contractionary period.

In Figure 21 below, we show how the Repo has changed over the ten year period and the classification of the various inflationary cycles described above: the red portions indicating the expansionary cycle (low inflation) and the green portion the contractionary cycle (high inflation).

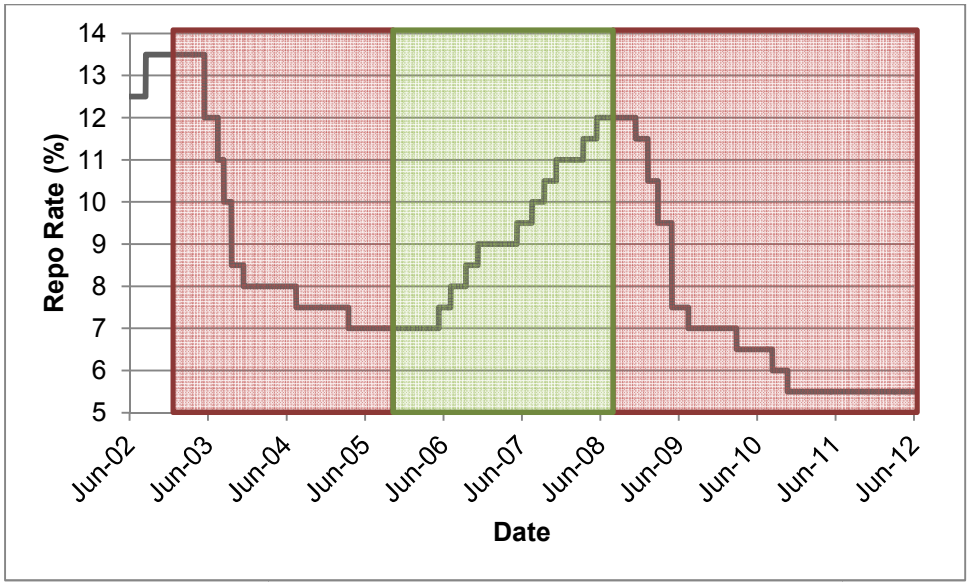


Figure 21: The South African Repurchase Rate and Inflationary Cycles

Based on the periods defined above, we now present the historical performance and risk for each of the periods.

In Table 13 and Table 15 we analyse the performance and volatility of the various asset classes during expansionary monetary policy conditions, when interest rates and inflation are low. It is evident from the data that both commodity indices offered lower returns with higher volatility during these two expansionary periods.

During the first expansionary period (Table 13, below), 31 January 2003 to 30 November 2005, the composite index in dollars offered a mean return of 21.82% with a standard deviation of 9.20% while the composite index in rands offered a mean return of 12.40% with a standard deviation of 11.35%. These returns were 8% to 11% lower than the returns from equity and property, while the standard deviations were similar to equity and slightly lower than property. Although the standard deviations of the commodity indices were lower than property, they had a lower skew than that of property. The skew for the composite index in dollars was 0.16 and the skew for the composite index in rands was -0.16, while that of property was 0.34. This indicates that the volatility in property returns were more often positive than the commodity indices. When comparing the return per unit of risk both composite indices underperformed equities and the composite rand index underperformed property.

During the second expansionary period (Table 15, below), 30 September 2008 to 30 June 2012, both commodity indices provided lower returns than equity and property, with the

composite index in rands having lower returns than cash. The volatility of the commodity returns were also greater than the other asset classes resulting in low return to unit risk. In addition, the large volatility in the commodity returns were also negatively skewed during this period. The composite index in dollars had a skew of -0.33, while the composite index in rands had a skew of -0.85 compared to skews of -0.93 for bonds, 0.87 for equity, 0.96 for cash and -0.26 for property.

Based on the above analysis of the two expansionary periods, it is evident that commodities do not offer attractive returns.

In Table 14 we look at the performance and risk associated with the various asset classes during a contractionary period, one with high inflation. During this period both commodity indices offered higher returns than bonds, property and cash. The returns on the composite index in rands were similar to that of equities while the performance of the composite index in dollars was 7.18% lower than equities. The volatilities of the commodity indices were 3% to 5% higher than equities and 2% to 5% lower than property. Although the volatility of returns was lower for equities, they had a large negative skew of -0.86 over the period while composite index in dollars had a positive skew of 0.46 and the composite index in rands had a positive skew of 0.68. This indicates that although there was more volatility in the commodity returns, these returns were more often positive.

Based on this analysis of the performance and volatility of returns during a period of high inflation, it is evident that commodities perform better during periods of high inflation than low inflation. Further, the composite index in rands outperformed the composite index in dollars. Therefore, commodities do provide a hedge against inflation.

	Equity	Bonds	Property	Cash	Composite USD	Composite ZAR
Mean	29.37%	2.76%	29.22%	8.60%	21.82%	12.40%
Standard Deviation	9.19%	4.00%	15.84%	1.41%	9.20%	11.35%
Return/Unit Risk	3.20	0.69	1.84	6.10	2.37	1.09
Minimum	16.98%	-4.80%	8.08%	7.18%	6.53%	-5.29%
Maximum	46.94%	9.30%	55.23%	11.81%	36.35%	30.53%

Table 13: Historical Returns and Risk, 31 January 2003 to 30 November 2005 – Expansionary Monetary Policy

	Equity	Bonds	Property	Cash	Composite USD	Composite ZAR
Mean	21.67%	-5.25%	13.99%	9.08%	14.49%	21.56%
Standard Deviation	16.79%	3.23%	23.95%	1.21%	19.32%	21.62%
Return/Unit Risk	1.29	-1.63	0.58	7.50	0.75	1.00
Minimum	-20.44%	-12.38%	-26.18%	7.30%	-10.21%	-7.12%
Maximum	42.78%	-0.90%	49.77%	11.18%	55.70%	72.87%

Table 14: Historical Returns and Risk, 30 November 2005 to 30 September 2008 – Contractionary Monetary Policy

	Equity	Bonds	Property	Cash	Composite USD	Composite ZAR
Mean	15.95%	1.05%	11.44%	7.00%	8.20%	2.88%
Standard Deviation	11.38%	3.70%	6.50%	1.29%	16.98%	13.63%
Return/Unit Risk	1.40	0.28	1.76	5.42	0.48	0.21
Minimum	-0.41%	-9.95%	-0.68%	5.66%	-31.25%	-37.70%
Maximum	44.95%	7.08%	21.06%	10.31%	35.01%	21.11%

Table 15: Historical Returns and Risk, 30 September 2008 to 30 June 2012 – Expansionary Monetary Policy

4.4 Portfolio Optimisation

Portfolio theory, particularly Markowitz (1952), has established that one can improve an investment portfolio's returns by diversifying across various asset classes. Varying the allocation within an investment portfolio to various asset classes that are not correlated can reduce the risk level of a given investment portfolio without necessarily reducing performance.

In this last section we perform Markowitz optimisation over varying risk levels; for a given risk level the optimisation allocates various weights to each asset classes in an attempt to maximise the investment portfolio's returns. This process ultimately creates an efficient frontier of portfolios with maximum return for a given risk level i.e. maximising the return per unit risk.

Using the annual average returns and standard deviation for the entire ten year period from Table 7, we first construct the efficient frontier without commodities. Thereafter we include the composite index in dollars and then with the composite index in rands.

This optimisation does not allocate any portion of the portfolio over this period to either the commodity index in dollars or the index in rands. This is due to the low returns offered by the commodity indices with large standard deviation when compared to the other asset classes, resulting in very low return per unit risk in the commodity indices. This is shown below in Figure 22.

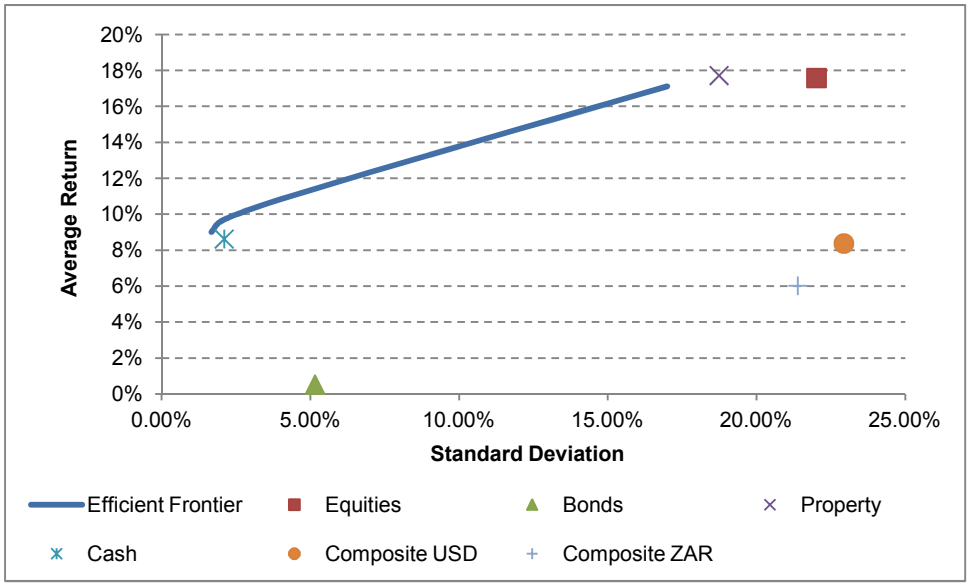


Figure 22: The efficient frontier without commodities, June 2002 to June 2012

In the following two graphs, Figure 23 and Figure 24, we look at the efficient frontiers from June 2002 to June 2007. It is evident in Figure 23 that the composite index in rands had no real effect on the efficient frontier and hence allocation in the portfolios. However, there was a small allocation of 3% to the commodities in rands in the optimal portfolio. This improved the return per unit risk by 0.40%, not significant.

However, when introducing the commodities in dollars to the portfolio there was an average improvement in returns of 0.78% between 2% and 15% standard deviations. This is illustrated below in Figure 24.

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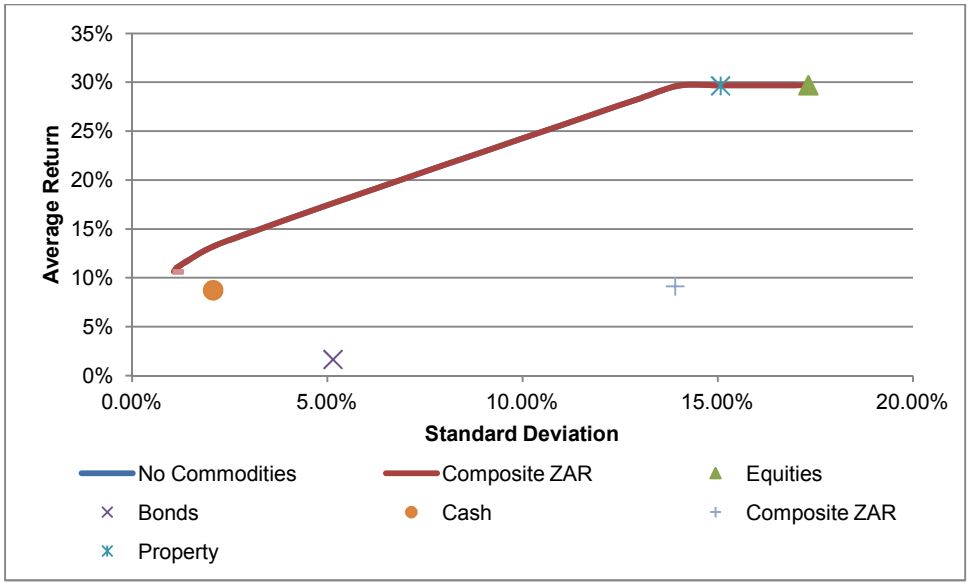


Figure 23: Efficient Frontier – Commodities ZAR, June 2002 to June 2007

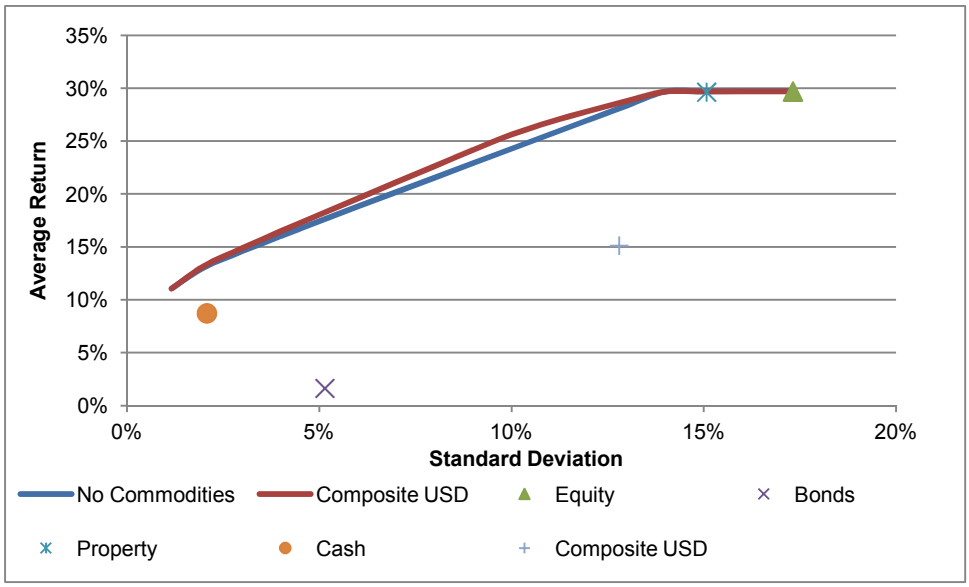


Figure 24: Efficient Frontier – Commodities USD, June 2002 to June 2007

In the table below, Table 16, we show how the allocation to commodities varies from 4% to 32% over the standard deviation range of 2% to 13%. In this range of standard deviation the average improvement in returns is 0.78% ranging from 0.13% to 1.35%.

This indicates that the inclusion of commodities in dollars to a South African investment portfolio has a diversification benefit over the first five year period.

Standard Deviation	2.00%	3.00%	4.00%	5.00%	6.00%	7.00%
Composite USD Allocation	4.23%	8.37%	12.22%	16.08%	19.83%	23.54%
Improvement in Returns	0.13%	0.30%	0.46%	0.62%	0.78%	0.94%

Standard Deviation	8.00%	9.00%	10.00%	11.00%	12.00%	13.00%
Composite USD Allocation	27.33%	31.04%	27.86%	19.71%	12.59%	6.03%
Improvement in Returns	1.10%	1.26%	1.35%	1.17%	0.85%	0.44%

Table 16: Allocation to commodities, June 2002 to June 2006

During the second five year period from June 2007 to June 2012, the optimisation did not allocate any portion of the portfolio to commodities; neither in rands nor dollars. As was evident in Table 9, this was an extremely volatile time for commodities with negative average returns and very low and negative return per unit of risk. As a result the commodity asset class was not an attractive addition to the South African investment portfolio.

Based on the analysis performed in this section, commodities in dollars appear to be a useful addition to a portfolio in normal market conditions, June 2002 to June 2007, by increasing the return of the investment portfolio for a given level of risk.

5. Discussion and Conclusion

The main purpose of this study was to investigate and determine whether commodities have a place in a South African investment portfolio. The study used historical data to find evidence if there was indeed a benefit in including commodities in an investment portfolio. The results of this study show that there were some benefits, namely, using commodities to diversify a portfolio and as an inflation hedge. However, commodities did not provide sufficiently large enough returns to justify their high volatility and as such would not be an appropriate stand alone investment in the South African context.

We initially created an equally weighted commodity index as a proxy for the asset class as the market benchmark indices had very different risk and return profiles. This enabled us to have a commodity benchmark that was representative of the asset class in general. Further, we looked at whether this investment into commodities should be in rands, with no foreign exchange risk, or in dollars, with the additional foreign exchange risk. We found that the commodity index in dollars provided greater absolute performance over the ten year period when compared to the index in rands. This resulted from the steady appreciation of the dollar rand exchange rate over the ten year period. Additionally, the negative correlation between the commodity index in dollars and the dollar rand exchange rate added further diversification to an investment in dollars.

The first question to be posed in the study was whether or not commodities provide equity like returns. This question also touches on whether or not commodities provide absolute returns and can therefore be considered a standalone investment. We began by looking at the entire ten year period and discover that commodities, both in dollars and rands, did not provide equity like returns due to their low average returns and high volatility (resulting in low Sharpe ratios) and therefore confirmed that commodities are not an attractive standalone investment. Even when looking at the first five year period, from June 2002 to June 2007 prior to the financial crises, we found that commodities still did not provide equity like returns although they were much closer in nature. During the second five year period, during the peak of the financial crises, commodities provided negative average returns with significant volatility; significantly worse than equities and the other asset classes.

Next we tried to establish if the inclusion of commodities in a South African investment portfolio had a diversification benefit. To have a diversification benefit we require that commodities have low and/or negative correlation to the other asset classes. During the full ten year period we found that commodities had very low to negative correlations to property, bonds and cash with slightly higher, but not meaningful, correlation to equities. Additionally,

we found that having the commodity investment in rands, with the additional foreign exchange exposure, provided an additional diversification benefit. The diversification benefit was further confirmed during both five year periods, with the dollar rand exposure being particularly useful during extreme market conditions.

Lastly we tried to establish whether commodities were useful as a hedge during times of inflation. We used the South African Repurchase Rate to define periods of high and low inflation. During the two expansionary periods identified, commodities did not offer attractive returns. However, during the contractionary period from November 2005 to September 2008 commodities did offer attractive returns which were significantly positively skewed, this was more pronounced in the commodity index in rands. Based on this analysis we believe commodities do provide a hedge for inflation.

It should be noted that the financial crises of 2008 affected all asset classes and in particular commodities negatively, leading to large draw downs and almost perfect correlation between asset classes (all moving downwards). We believe the low and negative correlations discussed in this study between commodities and the other asset classes to improve in the future.

The effects of these large draw downs with increased volatility were particularly prevalent in the portfolio optimisation. The optimisation made no allocation to commodities over the full ten year period from June 2002 to June 2007 and none to the second five year period from June 2007 to June 2012. However, during the first five year period (in the absence of the abnormal market event of the financial crises), the optimisation allocated significant portions of the investment portfolio to commodities resulting in increased returns for a given risk level.

At the time of writing this study, financial markets are beginning to return to normal, with investor confidence returning and more inflows into the various asset classes. We are also approaching the end of an expansionary monetary period, with low interest rates, in South Africa and predictions are that the South African Reserve Bank will start increasing the Repo Rate in the second half of 2014. We believe that these foreseeable normal market conditions and the new inflationary cycle will make commodities attractive to a South African investment portfolio.

Therefore, based on the results presented, commodities do provide a diversification benefit to a South African investment portfolio and they do act as an inflation hedge. We believe that commodities do have a role to play in the South African investment portfolio.

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7. Appendix 1: Regulation 28 limits[9]

Item	Categories of assets	Limits	
		Per issuer	For all issuers
1	CASH		100%
1.1	Notes and coins, any balance or deposit in an account held with a South African bank; A money market instrument issued by a South African bank including an Islamic liquidity management financial instrument; Any positive net balance in a margin account with an exchange; and Any positive net balance in a settlement account with an exchange, operated for the buying and selling of assets	25%	100%
1.2	Any balance or deposit held with a foreign bank; A money market instrument issued by a foreign bank including Islamic liquidity management financial instrument	5%	
2	DEBT INSTRUMENTS INCL ISLAMIC DEBT INSTRUMENTS		
2.1	Inside the Republic and foreign assets		
	a) Debt instruments issued by and loans to, the government of the Republic, and any debt or loan guaranteed by the Republic.		100%
	b) Debt instruments issued or guaranteed by the government of a foreign country	10%	
	c) Debt instruments issued or guaranteed by a South African bank against its balance sheet:		75%
	i. Listed on an exchange with an issuer market capitalisation of R20 billion or more, or an amount or conditions as prescribed	25%	
	ii. Listed on an exchange with an issuer market capitalisation of between R2 billion & R20 billion, or an amount or conditions as prescribed	15%	
	iii. Listed on an exchange with an issuer market capitalisation of less than R2 billion, or an amount or conditions as prescribed	10%	
	iv. Not listed on an exchange	5%	
	d) Debt instruments issued or guaranteed by an entity that has equity listed on an exchange, or debt instruments issued or guaranteed by a public entity under the Public Finance Management Act, 1999 (Act No. 1 of 1999) as prescribed:	10%	50%
	i. Listed on an exchange	10%	50%
	ii. Not listed on an exchange	5%	25%
	e) Other debt instruments	5%	25%
	i. Listed on an exchange	5%	25%

[9] Reproduced from South Africa (2011)

	ii. Not listed on an exchange	5%	15%
3	EQUITIES		75%
3.1	Inside the Republic and foreign assets a) Preference and ordinary shares in companies excluding shares in property companies, listed on an exchange: i. Issuer market capitalisation of R20 billion or more, or an amount or conditions as prescribed ii. Issuer market capitalisation of between R2 billion and R20 billion, or an amount or conditions as prescribed iii. Issuer market capitalisation of less than R2 billion, or an amount or conditions as prescribed	15% 10% 5%	75%
	b) Preference and ordinary shares in companies, excluding shares in property companies, not listed on an exchange	2.50%	10%
4	IMMOVABLE PROPERTY		25%
4.1	Inside the Republic and foreign assets a) Preference shares, ordinary shares and linked units comprising shares linked to debentures in property companies, or units in a Collective Investment Scheme in Property, listed on an exchange: i. Issuer market capitalisation of R10 billion or more, or an amount or conditions as prescribed, ii. Issuer market capitalisation of between R3 billion and R10 billion, or an amount or conditions as prescribed, iii. Issuer market capitalisation of less than R3 billion, or an amount or conditions as prescribed	15% 10% 5%	25%
	b) Immovable property, preference and ordinary shares in property companies, and linked units comprising shares linked to debentures in property companies, not listed on an exchange	5%	5%
5	COMMODITIES		10%
5.1	Inside the Republic and foreign assets a) Kruger Rands and other commodities listed on an exchange, including exchange traded commodities: i. Gold ii. Each other commodity	10% 5%	10%
6	INVESTMENTS IN THE BUSINESS OF A PARTICIPATING EMPLOYER INSIDE THE REPUBLIC IN TERMS OF:		
	a) Section 19(4) of the Pension Funds Act b) To the extent it has been allowed by an exemption in terms of section 19(4a) of the Pension Funds Act		5% 5%
7	HOUSING LOANS GRANTED TO MEMBERS IN ACCORDANCE WITH THE PROVISIONS OF SECTION 19(5)		95%
8	HEDGE FUNDS, PRIVATE EQUITY FUNDS AND ANY OTHER ASSET NOT REFERRED TO IN THIS SCHEDULE		15%
8.1	Inside the Republic and foreign assets		

	a) Hedge funds		10%
	i. Funds of hedge funds	5%	
	ii. Hedge funds	2.50%	
	b) Private equity funds		10%
	i. Funds of private equity funds	5%	
	ii. Private equity funds	2.50%	
	c) Other assets not referred to in this schedule and excluding a hedge fund or private equity fund		2.50%