Course: MMFI Program Thesis

Topic: Evaluation of Gold as an Investment Asset:

The South African Context

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Date: 28 February 2013

ABSTRACT

This study examines potential benefits of investing in various gold investment vehicles in terms of risk and return from a typical South African investor's perspective. Furthermore, the study examines the relationship between gold price and South African macroeconomic variables. Data used in the study comprises of monthly closing share price data of JSE listed gold mining companies, gold price, Krugerrand coin, NewGold ETF, FTSE/JSE all share index, gold mining index, unit trust index (gold & precious metals), real GDP, rand/dollar exchange rate, repo rate and CPI. It was found that gold bullion produced superior abnormal returns and yielded greater capital growth compared to the JSE all share index. However, the JSE all share index exhibit lower volatility compared to gold bullion. Abnormal returns for JSE listed gold mining companies tend to differ substantially from gold bullion abnormal returns. Gold mining companies exhibit added risk which cannot be attributed to the gold bullion. Gold has a potential to reduce systematic risk when added to a portfolio of stocks. A multiple regression model was estimated which relates gold price to South African macroeconomic variables. It was found that gold price depends on real GDP and rand/dollar exchange rate.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

The goal of this chapter is to provide background information for the study. The research problem is outlined. Research objectives and questions are given. Motivation for the study and gap in the literature are presented. The chapter is organized as follows: Section 1.2 presents the context of the study. Section 1.3 presents the research problem. Section 1.4 presents the objectives. Section 1.5 presents the research questions. Section 1.6 presents the gap in the literature. Section 1.7 covers the significance of the study. Section 1.8 covers the structure of the thesis and chapter summary concludes the chapter.

1.2 Context of the Study

Since the discovery of the Witwatersrand Goldfields in 1886, South African gold mining industry dominated the global mining industry for nearly 120 years. Between 1884 and 2004, the South African gold mining sector produced 33% of all the gold estimated above the earth's surface. The growth of the gold mining sector in South Africa (S.A.) led to a rapid development and industrialisation of the country. The gold sector played a pivotal role in the development of infrastructure (such as roads, rail and electricity), manufacturing and service industries. In 1887, Johannesburg Stock Exchange (JSE Limited) was formed for funding the mining sector. Parastatals (such as Eskom and Transnet) and financial institutions were formed as a result of the gold and diamond mining sectors. The gold mining sector has been a leading foreign exchange earner for the country for over a century. (Gold in South Africa, 2006)

Gold as a commodity played a crucial role in the economic development of South Africa historically. About 12% of mining income in the year 2009 was due to gold & uranium mining (Statistics South Africa, 2009). However, the role of gold in the South African economy reduced through the years as South Africa's position as a leading producer of gold diminished due to a drop in production and growth of other sectors such as information and telecommunication sector. South African gold production (extraction) has decreased from 675 tons in 1980 to 198 tons in 2009 (Statistics South Africa, 2012). South Africa is now the fifth largest producer of gold with China being the leading producer followed by Australia. Following the long history of success as one of the

world's largest producers of gold, the question is whether the current and prospective future South African based investors should consider gold as an asset that has value and that can assist them to diversify their portfolios.

Despite the general decline in the production of gold, the gold price has been rising substantially from the year 2001. What is more interesting is that the gold price continued to rise during the 2008/2009 recession (World Gold Council, 2010). World Gold Council (2010) attributed the strong performance during the recession largely due to a combination of factors which included continuation of safe haven inflows as a by-product of the financial crisis, investors' concerns about future inflation and negative sentiment on the outlook of the dollar, and a shift in the central bank management as western central banks slowed gold sales and developing nations increased their gold reserves.

The recent 2008/2009 recession had severe consequences on stocks globally. Stock prices fell drastically during this period. Blanchard (2011) noted that stock index for advanced economies fell by 60 points between October 2007 and March 2009 while the index for emerging economies fell by 80 points during the same period. Interest rate linked assets such as real estate tend to do well during a credit bubble (high credit availability). When the bubble collapses, many individuals suffer losses as property constitutes a considerable amount of individuals' personal wealth. Bonds exhibit default risk as there is a likelihood that the issuing government might default on its debt as was the case during the recent euro-zone sovereign debt crisis or that the issuing company might get bankrupt and be forced to shut down its operations as was the case with the collapse of Lehman Brothers. It is therefore, imperative for investors to diversify portfolios in order to mitigate significant losses during periods of economic instability when traditional asset classes experience substantial reduction or loss in value. Investors need to place more emphasis on alternative investments other than the main stream asset classes. Jaffe (1989) noted that investing in gold can play an important role in a diversified portfolio.

There are various reasons why investors buy gold. Some investors regard gold as a strategic asset that can be used as a means of portfolio diversification, others regard gold as an inflation hedge and a currency hedge such as hedging against the American (U.S.) dollar. One of the reasons why gold is considered a valuable investment option is due to its low or lack of correlation with main stream financial assets. Studies such as that undertaken by Dempster (2008) found the correlation

coefficient between gold and other assets in the U.S. (such as S&P 500 and Dow Jones Industrial average) to be close to zero. The lack of correlation between gold and other financial assets makes gold an attractive option especially during financial and economic downturns during which equities tend to be volatile and experience significant loss of value. Investors tend to move away from equities during a recession towards gold as gold is often perceived as a "safer" asset during a recession. Shafiee and Topal (2010) attributed the increase in gold price during a recession due to switching to the gold market as a result of lack of trust in financial markets by investors.

There are various ways in which to South African based investors can invest in gold. These investment avenues are typically accessible to ordinary individual investors due to low cost and simplicity. Investors can take part in the gold market via the purchase of gold coins and gold ETF's. Gold coins and gold ETF's are discussed in subsections 1.2.1 and 1.2.2, respectively.

1.2.1 Gold coins

One of the simplest ways of investing in gold is by purchasing the gold bullion in the form of gold coins. A wide variety of merchants are available to S.A investors. The merchant sells gold coins to the general public and can also buy them back from the public. For example, Investgold offers investors, private or institutional, the option to purchase gold bullion by buying a range of coins. The price of the coins is linked to directly to the price of the gold, rand dollar exchange rate, time of trade and quantity of coins traded. The most common coin is the Krugerrand. According to Investgold (2012), Krugerrands are one of the most successful bullion coins with more than 50 million Krugerrands minted thus far. Rare gold coins may also be purchased from Investgold. The Rare gold coins include the Natura, Protea, Mandela and other coins. Rare coins are different from the normal Krugerrands since their value is not only linked to the price gold but also to the scarcity of the coin. The coins may be purchased using different payment options which makes investing in gold more accessible to a typical individual investor. For instance the golden mile plan offered by Investgold allows investors to purchase gold coins at a minimum fee of R300 per month. There are other companies which deals in gold coins such as The South African Gold Exchange.

1.2.2 Gold exchange traded funds

A number of gold ETF's have been developed in major world stock exchanges in the recent past. Examples of gold ETF's (apart from NewGold) include, AGOL which is U.S based and listed on the New York stock exchange, GOLD which is traded at Australian stock exchange and Gold Bullion Securities (GBS) which listed on multiple securities such as London stock exchange and Frankfurt Stock Exchange (Exchange Traded Gold securities, 2012). The ETF's are backed by physical gold and provide investors with a means of participating in the gold spot price. Gold ETF's seem to be the latest way of investing in gold and are becoming increasing popular. Nel (2009) studied how the recent development of gold ETF's on major stock markets around the world influenced analyst's recommendations for direct investment in gold in favour of SA gold stocks at a premium. Nel (2009) concluded that introduction of gold ETF's takes away the attractiveness of SA gold stocks. Moreover, he suggested that investing in gold ETF's is another way of participating in the gold price movement which is of lower risk in comparison to gold equities.

The price of gold is influenced mainly by market supply and demand forces. The supply of gold comes from mine production, recycled gold and gold issued by central banks. Demand for gold may be divided into the following broad categories: jewellery manufacturing, industrial applications and investment uses. The gold market involves a myriad of issues ranging from mining legislation in gold mining countries throughout the world to various gold related investment instruments which have been developed over time. For example, the ABSA NewGold Exchange Traded Fund (ETF) in South Africa offers the opportunity to invest directly in the gold bullion. The ETF offers investors a means of investing in gold via the JSE. This study aims to explore potential benefits that can be derived from investing in different gold investment vehicles, and the relationship between gold and major macroeconomic variables.

1.3 Research Problem

Mohamed (2008) noted that most households in S.A. do not invest directly when they have savings, instead most put their savings into banks or retirement funds and a few will buy stocks and bonds. Also, legislations such as Black Economic Empowerment (BEE) Act of (2003) highlight and promote ownership of shares in companies, making shares/stock appear to be more important than other forms of investment. The problem is, although a number of financial instruments relating to

gold have been developed in S.A., the emphasis on these instruments is relatively low and for some of them, the market tends to be small locally. For example, Gold in South Africa (2006) noted that the Absa Gold Exchange Traded Fund (ETF) formed in 2004 allowed South African investors to trade in shares representing gold on the stock exchange as easily as any other exchange-listed security but the local market is too small. Investors, especially individual investors, are not fully aware of the type of return they would yield from investing in gold, but most importantly they are not aware of what the effect of gold will be on their portfolios. The need for individual investors to become conversant with different ways of investing such as investing in gold has become necessary. The knowledge about gold investing and different gold investment vehicles can in turn be used as a tool against the plight of poverty as investing provides a means for long term wealth creation for S.A communities.

1.4 Research Objectives

Objectives of the study are to:

- Assess the abnormal return derived from investing in gold overtime.
- Compare the performance of gold investment instruments to the performance of other instruments such as shares for JSE listed companies.
- Assess whether the inclusion of gold in the portfolio increases or decreases portfolio risk.
- Investigate the correlation relationship between gold price and macroeconomic variables such as GPD, interest rates, exchange rate and inflation, and test for significance using S.A.
- Develop a model that will predict the macroeconomic variables that influence the price of gold.

1.5 Research Questions

- What are the different gold investment avenues accessible to South African investors and how do they perform in comparison to the domestic equities market?
- How does investment in gold affect portfolio risk?
- What is the relationship between gold price and South African macroeconomic variables (GDP, interest rates, exchange rates and inflation)?

1.6 Gap in the Literature

The relationship between gold and major world economies such the U.S. has been widely investigated and documented. Herbst (1983) studied the long-term performances of gold and the U.S. stock market and found that an investment strategy involving changing between gold and common stocks may be worth undertaking under certain conditions. Ratner and Klein (2008) assessed the value of holding gold to U.S. investors from 1975-2005 and concluded that there is no material benefit to investing in gold over the long term. Despite the role that gold has played in the development of South Africa, we are not aware of a study that comprehensively investigates the performance of gold overtime as well as the possible effect of gold in terms of portfolio risk and return and comparison of gold performance to South African stocks. This study investigates the performance of gold vehicles and correlation between gold and major South African economic indicators.

1.7 Significance of the Study

The study will benefit various parties. Investors will be aware of the different types of gold investments available out there, how these instruments have performed over time, what economic factors influence the performance of gold and how investing in gold will affect their portfolios.

Policy makers such as reserve/central banks normally keep gold as a reserve asset. The International Monetary Fund is the largest holder of gold globally and held 90.5 million ounces (2,814.1 metric tons) of gold at designated depositories at end February 2012 which amounted to $160.1 billion at market prices as at February 29, 2012 (International Monetary Fund, 2012). Locally the South African Reserve bank monitors the gold market. This research will help the bank to understand better the value of the gold they keep and the extent to which that value is affected by various macroeconomic factors, and thereby inform better their policy formula.

Companies that are based on gold such as gold mining companies will benefit from this study in different ways. For example, they can see how the performance of gold has and will affect company's financial performance and the creation of value for shareholders.

1.8 Structure of the Report

The remainder of the report is structured in the following manner. Chapter 2 presents the literature survey and examines previous research undertaken relating on the subject. Chapter 3 outlines the methodology followed for the study and describes data used to conduct the study. Performance assessment of gold is presented in Chapter 4. The role of gold on portfolio risk is assessed in Chapter 5. Regression model for investigating the relationship between gold and economic indicators is presented in Chapter 6. Chapter 7 presents conclusions from the study.

Chapter Summary

This chapter presented the context of the study and shows that gold played a major role in the economic development of South Africa. The gold price has been rising for most parts of the past decade including the period of the recent financial crisis. This makes gold a useful asset to include in a portfolio. Investors use gold for diversification, inflation and U.S dollar hedging purposes. There are many uses of gold. However, the study focuses on investment aspects of gold for South African based investors. Many studies have been conducted based on data from other countries but little emphasis has been placed on domestic data. The research objectives and questions were developed from the context. The next chapter presents the literature review related to the topic of the research.

CHAPER 2: LITERATURE REVIEW

2.1 Introduction

The broad objective of this study is to assess the role of gold as an investment asset for a typical S.A. based investor and to establish the viability thereof. The extant literature relating to the topic of gold as an investment asset is discussed in this literature review chapter. Emphasis is placed on: how gold has performed in comparison to other investment choices in other countries, the relationship between gold and macroeconomic variables as well as the influence of gold on portfolio risk.

This chapter is organised as follows. Section 2.2 presents the role of gold as an investment asset. Section 2.3 discusses gold and economic growth. Section 2.4 explores gold and inflation. Section 2.5 considers the relationship between gold and GDP. Section 2.6 examines the association between gold and exchange rate. Section 2.7 considers gold mutual funds. Section 2.8 takes a look at gold derivatives. Section 2.9 discusses forecasting of the gold price and chapter summary concludes the chapter.

2.2 The Role of Gold as an Investment Asset

2.2.1 Diversification benefits of gold

Correlation is the extent to which the returns on two assets move together (Jordan et. al., 2012). Positively correlated assets tend to move up or down together, negatively correlated assets tend to move in opposite directions and there is no obvious relationship between uncorrelated assets. The primary goal of portfolio diversification is to reduce risk. Diversification can only be achieved if assets held in a portfolio are not highly positively correlated. For investors to realise diversification benefits, it is vital to include assets which are not positively correlated with assets held in a typical portfolio of stocks and bonds.

Hiller et al. (2006) noted that diversification is most important to investors when equity markets are experiencing high volatility and poor performance. There is a slew of research on gold as an investment asset. For example, Chua et al. (1990) explored the possibility of diversifying a portfolio

with gold stocks and conclude that investors can rely on gold as a useful asset for portfolio diversification in the short and long term. Baur and Lucey (2010) studied hedging[1] and safe haven[2] properties of gold against stocks and bonds in United States, United Kingdom and Germany. The study found that gold acts as a hedge against stocks on average and a safe haven in extreme stock market conditions. The safe haven property was limited to around 15 trading days after the shock. They further found that gold does not serve as a safe haven for bonds. Ratner and Klein (2008) studied portfolio implications of gold and established that correlations between gold and U.S equities were mainly low or negative. Dempster and Artigas (2010) compared investment viability of gold against commodities, real estate and inflation linked bonds and found gold to be the most effective portfolio diversifier among these assets which are typically referred to as inflation hedges by U.S investors. Dempster and Artigas (2010) also noted that the strategic case for gold rests mainly on its effectiveness as a portfolio diversifier. Johnson and Soenen (1995) established that gold, due to its negative/low correlation with bonds and stocks presents a potential benefit for reducing risk through portfolio diversification. Conover et al. (2009) found that the benefits of precious metals derive from their diversification potential rather than their attractive returns. Hiller et al. (2006) analysed the roles of gold, silver and platinum in the capital markets and found that portfolios which contain precious metals perform better than standard equity portfolios.

The aforementioned authors have collectively established that gold can be considered a portfolio diversifier. Diversification potential of gold stems mainly from the metal's lack/low correlation with other assets. It is thus evident that gold has a role to play in modern portfolio management and adding gold to an investment portfolio has the potential of improving portfolio performance.

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[1] A hedge is an asset that is uncorrelated or negatively correlated with another asset or portfolio on average (Baur and Lucey, 2010).

[2] A safe haven is an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil (Baur and Lucey, 2010).

2.2.2 Performance of gold against other major assets

The role of gold in an investment portfolio as a diversifier has been addressed thoroughly, but how has gold performed in comparison to other major assets? A number of studies have been undertaken to check how returns on gold compares with returns on equities and bonds. Ratner and Klein (2008) evaluated the value of holding gold to U.S investors. Returns of gold were compared with U.S total stock market index returns. The study found that even though gold experienced notable appreciation in certain periods, the long-term return performance of the U.S total stock market index exceeded that of gold. As such gold was found to be an inferior investment. Dempster and Artigas (2010) evaluated performance of gold against typical inflation hedges (commodities, real estate and inflation linked bonds). Real returns of gold were found to be notably higher than those of other assets in the period between 1997 and 2009. Volatility of gold returns was inferior to the volatility inflation linked bond (Barclay's aggregate U.S. Treasury Inflation-Protected Securities Index) which produced the lowest volatility of all assets considered. The study also found that gold on average offered the best reward-to-risk and minimum variance portfolio.

Potential benefits of investing in gold from the U.S investor's perspective are well documented in the investment management literature. However, Johnson and Soenen (1997) studied whether investing in gold was beneficial for countries such as Canada, France, and others, during the period between 1978 and 1995. It was established that investing in gold from all countries underperformed stocks and bonds and emphasised that gold returns tend to be more time depended. The issue of time dependency on gold was further emphasised by Riley (2010) who noted that current market conditions should be taken in to account when evaluating the attractiveness of precious metals. Hoang (2010) studied the returns of investment in gold assets traded at Paris Stock exchange and reached a conclusion that gold presented lower levels of return at higher levels of risk compared to stocks and bonds.

It appears that gold as a stand-alone investment is an inferior choice in comparison to stocks and bonds in the long term when markets are performing well. Gold seems to be a profitable asset to hold during times of market distress when stocks and bonds are underperforming.

2.3 Gold and Economic Activity

Economies throughout the world go through cycles. Investors should be wary of times in which it is profitable to hold gold in order to avoid major losses and when to limit exposure to the metal in order to profit from rising equities. For example, Riley (2010) established that financial assets (such as shares and property) outperform commodities (such as gold and silver) in times of economic growth and that commodities outperform financial assets in times of economic contraction. Conover et al (2009) discovered that returns on precious metals (such as platinum, silver and gold) were notably higher during periods of restrictive policy than in periods of expansionary policy. Unlike metals such as platinum, which are used mainly for industrial usage and consumption, gold is less susceptible to demand shocks which may arise from reduced industrial consumption and offers investors a means of hedging during periods of poor economic performance. As a result gold price is not expected to drop significantly when the economy is in distress.

Constable and Wright (2011) propose that investors do not buy gold when the economy is robust, when the financial system is sound and when the world is not involved in major upheavals. As a result, the gold price can be used as measure of sentiment. The gold price is therefore regarded as a leading economic indicator. Constable and Wright (2011) also support the notion that gold acts as insurance against economic disasters and investors should hold a certain degree of gold in their portfolios especially when future economic outlook is not positive.

2.4 Gold and Inflation

Adrangi et al. (2003) explored the relationship between gold and silver returns and inflation in the U.S. They found that there was a positive relationship between expected inflation and gold price. The reason provided for the positive relationship is that the gold price increases due to a rise in demand of gold as a result of hoarding caused by inflationary fears. Jaffe (1989) also found a positive relationship between returns of gold and percentage change in CPI but cautions that gold cannot be used as a hedge against inflation due to low R-square (less that 2%). Tkacs (2007) assessed the leading indicator properties of gold prices using data from fourteen countries and concluded that gold prices lead inflation in many countries for up to two years in advance. However, Shafiree and Topal (2010) did not find a significant positive relationship between gold price and

inflation in the U.S. Dempster and Artigas (2010) asserted the role of gold as an inflation hedge and suggested that gold is likely to increase in value if the world economy experienced inflation.

There seems to be a general consensus about the positive relationship between gold and inflation. This implies that gold will tend to increase in value as inflation rises thereby maintaining its buying power over time.

2.5 Gold and GDP

The relationship between gold price and GDP was studied by Sharma and Aggarwal (2012). They studied the impact of GDP on gold price using data from leading gold-holding countries such as US, UK, France, Germany, Italy, Brazil, and others. The study established that, individually, Brazil's GDP and gold price were highly correlated and Italy's GDP and gold price were the least correlated of all countries studied. Collectively, it was also found that seven countries' GDPs were reliable in predicting gold price movement and that GDP for U.S and France were poor predictors of gold price movements.

2.6 Gold and Exchange Rate

Capie et al. (2005) assessed the possibility of using gold as a hedge against exchange rate. Specifically, they considered the degree to which gold acted as an exchange rate hedge using sterling-dollar and yen-dollar exchange rates. The broad conclusion of the study was that gold acted as a hedge against the dollar. They attributed the hedging property of gold to the ease of trade in the open market of gold and the inability of authorities to produce gold (in contrast to currencies).

Sjaastad and Scacciavillani (1996) investigated the relationship between the major exchange rate and prices of internationally-traded commodities. They concluded (among others) that the world gold market is influenced by appreciations or depreciations of European currencies.

Twite (2002) found the relationship between weekly rates of return for US dollar denominated gold price, Australian dollar denominated gold price and Australian dollar/US dollar exchange rate to be statistically significant.

2.7 Gold Mutual Funds

A gold mutual fund is a fund which typically invests in gold stocks and gold bullion. Gold mutual funds enable investors to own gold without taking possession of the physical gold. Blose (1996) examined the extent to which returns on gold bullion influenced returns on mutual funds which invest in gold and gold related stocks. He found that investors wishing to make use of gold returns to hedge a portfolio or to speculate in the price of gold can achieve the same objective by using gold mutual funds. He also found that returns on gold mutual funds are at least the same amount or greater than returns on the price of gold and established that gold mutual funds exhibited risk which is cannot be attributed to either gold price or market price.

2.8 Gold Derivatives

An investment asset is an asset held for investment purposes. Gold can be classified as an investment asset (Hull, 2012). Gold derivatives are traded in major stock exchanges around the world. For example, gold was one of the largest traded commodities by volume in India in the year 2006 (Bhattacharya, 2007). Cross (2000) noted that market participants with greatest influence in the gold derivatives market were central banks through lending and gold mining companies through hedging to manage price risk and to raise revenue. Gold derivatives are traded in many locations around world. London is the largest market for gold in the world for over-the-counter derivative transactions and New York is the main exchange-traded futures market for gold (Schofield, 2007). Schofield (2007) summarised some the gold derivative products such as forward agreements and options that are typically used by gold market participants.

2.9 Gold Price Forecasting

A vast number of econometric models with varying levels of complexity have been developed to forecast the price of gold over the years. Shafiree and Topal (2010) provided an account of some of the models. Mouls (1986) examined which models were used in S.A and which ones of those were most useful. Raftopulos (1981) investigated which economic variables influenced the price of gold with the aim of incorporating such variables into a model that could be used to predict the gold price. A multiple regression model was specified. The model comprised of the gold price as the depended variable and explanatory variables included U.S economic data such as inflation, prime overdraft

rate, money supply, dollar, oil price and dummy variables (to capture government's monetary and fiscal policies). Although the model yielded an R^2 of 0.9522, which is significant, it was found that the model over-reacted to historical trends. One of the reasons given for the poor performance of the model was that economic and political environments had changed. The study concluded that the gold price is influenced primarily by investor's inflation expectations. Baker and van Tassel (1984) examined the monthly change of the gold price in U.S dollars. The regression model revealed that changes in gold price can be described by changes in the price of other commodities, changes in the U.S prices and changes in the value of the dollar, and future rate of inflation. The analysis also found the influence of interest rate on the price of gold to be insignificant.

Chapter Summary

The role of gold in different countries (although most studies have been conducted from U.S investor's standpoint) has been investigated by a number of researchers. In general, it is established that gold has low correlation with other assets (i.e. stocks). This affirms the use of gold as a potential portfolio diversifier. Gold has been found to be a useful asset in times of poor stock market performance, but stocks perform better than gold in the long run once the market recovers. Investing in gold is becoming popular through the development gold ETF's which are easily accessible. The present chapter discusses previous research undertaken in the context of gold as an investment asset. The next chapter presents methodology used for the study.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter presents data requirements as well as methodology employed for the study to achieve the objectives and answer research questions. Data and data sources are discussed in Section 3.2, research design is presented in Section 3.3 and chapter summary concludes the chapter.

3.2 Data and Data Sources

The data used in the study comprises of monthly share price data of JSE listed gold mining companies, gold price, Krugerrand coin, NewGold ETF, FTSE/JSE all share index, gold mining index, unit trust index (gold & precious metals), GDP, rand/dollar exchange rate, repo rate and CPI. Closing prices of all variables on the last trading day of the month are used. The data is denominated in rands as the aim is to explore characteristics of gold for a South African based investor.

Gold price, FTSE/JSE all share index, gold mining index, the unit trust index, rand/dollar exchange rate, repo rate and CPI data was obtained from I-Net Bridge which is a financial and economic database. Data for NewGold EFT was obtained from ABSA. GDP and Krugerrand price data was obtained from JSE. Share price information was obtained from McGregor BFA.

In 2004, signatory banks announced the second gold agreement known as the Central Bank Gold Agreement two (CBGA2) which limited gold sales to 500 tons per annum over a five year period (European Central Bank, 2004). The agreement came into effect in September 2004. Since early 2000's, Gold ETF's became popular. For example, Gold Bullion Securities (GBS) was formed in March 2004 which consequently listed in various stock exchanges such the London Stock Exchange and the South African NewGold ETF was formed which came it effect in November 2004. Based on the aforementioned reasons, the sample in this study ranges from 1 November 2004 to 31 October 2012. The sample period is selected so that it coincides with the period of the introduction and popularization of gold ETF's.

3.3 Research Design

3.3.1 Performance assessment of gold as an investment asset

Performance of the gold bullion, NewGold ETF and Krugerrands is compared to the performance to the gold mining index, FTSE/JSE all share index, the unit trust index and JSE listed gold mining companies.

We began by calculating actual returns on each asset using monthly price data. The actual return on the gold bullion, NewGold ETF, Krugerrands, gold mining index, FTSE/JSE all share index, the unit trust index and gold mining companies was calculated using Eq. (1) as follows:

$$R_t = \frac{(P_t - P_{t-1})}{P_{t-1}} \tag{1}$$

Where: R_t is the return between period *t-1* and *t*

P_t is the price of the asset at the end of period *t*

P_{t-1} is the price of the asset at the beginning of period *t* or end of period *t-1*

When comparing returns on gold bullion to stocks, we consider only capital appreciation and ignore dividends paid by companies. We note that ignoring dividends paid by equities tend to understate returns yielded by equity investments.

Using results obtained from Eq. (1) together with the gold mining index as a benchmark, abnormal (excess) returns for gold assets were determined.

Abnormal returns for all gold assets were calculated using Eq. (2) as follows:

$$AR_t = R_t - R_m \tag{2}$$

Where: AR_t is the abnormal return on an asset for period *t*

R_t is return on an asset for period *t*

R_m is the return on the market for period *t*

The other performance measure used is the value added monthly index (VAMI). The advantage of using VAMI as a performance measure is that it tracks the growth of an investment in monetary terms (in this case rands) from the beginning to the end of the investment period. VAMI was calculated using Eq. (3) as follows:

$$VAMI_t = VAMI_{t-1}(1 - R_t) \tag{3}$$

Where: $VAMI_t$ is the VAMI for period *t*

$VAMI_{t-1}$ is the VAMI for period *t-1*

3.3.2 Determining beta for gold

Expected return on an asset depends on its systematic risk. Systematic risk is measured by means of the beta coefficient. Beta is a measure of how sensitive an asset's return is to the return on the market. Beta is estimated using Eq. (4) as follows:

$$R_g = \alpha + \beta R_m + \varepsilon \tag{4}$$

Where: R_g is the return on gold and calculated using Eq. (1)

R_m is the return on the market and is calculated using Eq. (1)

The FTSE/JSE all share index was used as the market benchmark (R_m) when estimating gold beta using Eq. (4).

3.3.3 Regression analysis

Regression analysis is used to investigate the relationship between gold price and South African macroeconomic variables, namely: GDP, CPI, rand/dollar exchange rate and repo rate. Gold returns are regressed on each variable separately using a simple regression model. A multiple regression model is then used where all variables are included in the model.

Time series regression techniques are employed to explore the relationship, if any, between the gold price and the macroeconomic variables. The gold price is the dependent variable and all four macroeconomic variables are used as explanatory variables. The aim is to develop a regression model which can test whether or not the change in gold price can be explained by the change in any of the macroeconomic variable(s) considered.

The purpose of the regression model is to measure the degree of association between the dependent variable (gold price) and explanatory variables. Koop (2006) noted that there are two issues that may arise with analysis of time series data, namely: one variable may influence another with a time lag and spurious regression may occur when variables are nonstationary (except when variables in the model are cointegrated). Nonstationary variables are variables which exhibit trend behaviour and contain a unit root. When spurious regression occurs, then regression results might be misleading. In order to avoid the problems often encountered when working with time series data, we test univariate properties and perform unit root test on all variables used in the regression model.

a) Univariate properties of gold and macroeconomic variables

It is possible that a variable may depend on lags of itself. Univariate properties of each series of data were analysed. Univariate properties refer to the relationship between a variable and lags of itself. The autoregressive (AR) model used to explore univariate properties and to test for the presence of a unit root is the AR (p) with a deterministic trend model. The model may be represented as follows:

$$\Delta Y_t = \alpha + \rho Y_{t-1} + \gamma_1 \Delta Y_{t-1} + ... + \gamma_{p-1} \Delta Y_{t-p+1} + \delta t + e_t \quad (5)$$

Where: $\Delta Y_t = Y_t - Y_{t-1}$, is the first difference of Y_t

Y_{t-1} is Y_t lagged one period

$\Delta Y_{t-p+1} = Y_{t-p+1} - Y_{t-p}$, is the first deference of lagged variables

α is the intercept

δt is the deterministic trend term

ρ, γ_1, γ_{p-1} are coefficients

e_t is the error term

Koop (2006) notes that this variant of the AR (p) model in Eq. (5) is easier to use when testing for a unit root and that the model avoids the multicollinearity problem. Multicollinearity occurs when variables are highly correlated with each other.

The procedure followed for testing for a unit root is as follows:

1. Select maximum lag length (p_{max}), lag length of four was initially chosen.
2. Create lagged variables and determine corresponding differences ($\Delta Y_t, \Delta Y_{t-1}, \Delta Y_{t-2}$ etc).
3. Estimate the AR (3) model.
4. Check if the p-value of coefficients (γ_1, γ_2 etc) is less than 0.05 (level of significance). Reduce the number of lags and re-estimate the AR (p) model until the coefficient for γ_{p-1} becomes statistically significant.

5. Test the significance of the deterministic trend model. i.e. check if δ =0.

6. Use Dickey-Fuller test to test for the presence of unit a unit root. If the final model includes a deterministic trend, then reject the unit root hypothesis if ρ is more negative than -3.45 and conclude that the series is stationary. If the final model does not include a deterministic trend, then reject the unit root hypothesis if ρ is more negative than -2.89 and conclude that the series is stationary.

ρ = 0 implies that the AR (p) model contains a unit root and $-2 < \rho < 0$ implies the series is stationary.

Koop (2006) notes that unit root test as described above should be used to test for the presence of a unit root for all variables used in the regression model. Unit root test was consequently carried out for all variables (gold price, GDP, CPI, rand dollar exchange rate and nominal interest rate).

b) Cointegration test

Koop (2006) notes that the only instance when non-stationary variables can be used directly in a regression model without being transformed is when the variables are cointegrated otherwise the results of the model can be misleading. The test for cointegration used is the Engle-Granger test described by Koop (2006). Koop (2006) outlined the steps for the cointegration test as follows:

1. Run the regression of *Y* on *X* and save the residuals.
2. Carry out unit root test on residuals (without including a deterministic trend)
3. If the unit root hypothesis is rejected then conclude that *Y* and *X* are cointegrated. If the unit root is accepted then conclude cointegration does not occur.

We followed the same procedure used for testing for a unit root (Dickey-Fuller test) as described before but we test for the presence of a unit root on residuals. The rationale is that, if cointegration occurs, the errors from the regression will be stationary and vice versa. The model used is as follows:

$$\Delta u_t = \alpha + \rho u_{t-1} + \gamma_1 \Delta u_{t-1} + ... + \gamma_{p-1} \Delta u_{t-p+1} + e_t \qquad (6)$$

Where the letter u implies a residual and all other symbols have the same meaning as in Eq. (5).

3.3.4 Hypothesis testing

The t-distribution is used to test for statistical significance. t-distribution is used since the population standard deviation is unknown and the number of observations exceeds thirty. A two-tail test is employed since the null hypothesis is non-directional. The formulation of the null and alternative hypotheses is as follows:

$$H_0 : \mu = 0 \text{ (null hypothesis)}$$

$$H_1 : \mu \neq 0 \text{ (alternative hypothesis)}$$

The hypothesis test was performed using Microsoft Excel following the p-value approach as follows. If the p-value is less than the specified significance level, then the null hypothesis is rejected in favour of the alternative hypothesis and conclude that the result of the test is statistically significant.

Chapter Summary

The chapter presented data required to investigate the investment performance of gold as well as macroeconomic data required for the regression model. Methodology for calculation of abnormal return was outlined. Steps followed for regression analysis and econometric tests carried out in the modelling process were detailed. The next chapter presents investment performance assessment of gold.

CHAPTER 4: INVESTMENT PERFORMANCE ASSESSMENT

4.1 Introduction

The previous chapter highlighted the methodology used for assessing investment performance of gold. This chapter presents the results obtained from evaluating the investment potential of gold. Gold has been regarded as an investment asset with the potential to reduce risk of a portfolio and create wealth for investors by enhancing diversification properties of a portfolio. Ratner and Klein (2008) assessed the value of holding gold to U.S. investors. We analyze the value of gold as an investment asset for South African investors and compare its performance to the gold mining index, FTSE/JSE all share index, unit trust index (gold & precious metals) and JSE listed gold mining companies.

This chapter is arranged as follows. Section 4.2 considers how the gold price evolved. Section 4.3 contains a discussion on descriptive statistics for all investments. Section 4.4 considers correlation between gold investments and equities. In Section 4.5 examines the historical performance of gold by abnormal returns and VAMI. Section 4.6 contains a summary of the chapter.

4.2 Trend Analysis

This section graphically examines the movement of gold price during the sample period and compares the movement of the gold price to the price movement of NewGold ETF, Krugerrand, gold mining index and FTSE/JSE all share index.

Figure 1 plots the gold price and NewGold ETF NAV (net asset value) per security. Both the gold and price and the NewGold ETF have been rising steadily over the sample period. The NewGold ETF has been following the gold price movement almost perfectly over the sample period. The close relationship between the NewGold ETF and the gold price is expected as each NewGold security is backed purely by gold.

A comparison of the gold price and Krugerrand price is shown on Figure 2. The price of the Krugerrand follows that of gold closely but to a lesser extent in comparison to the NewGold ETF. As expected, the Krugerrand price tends to fluctuate in accordance with the gold price.

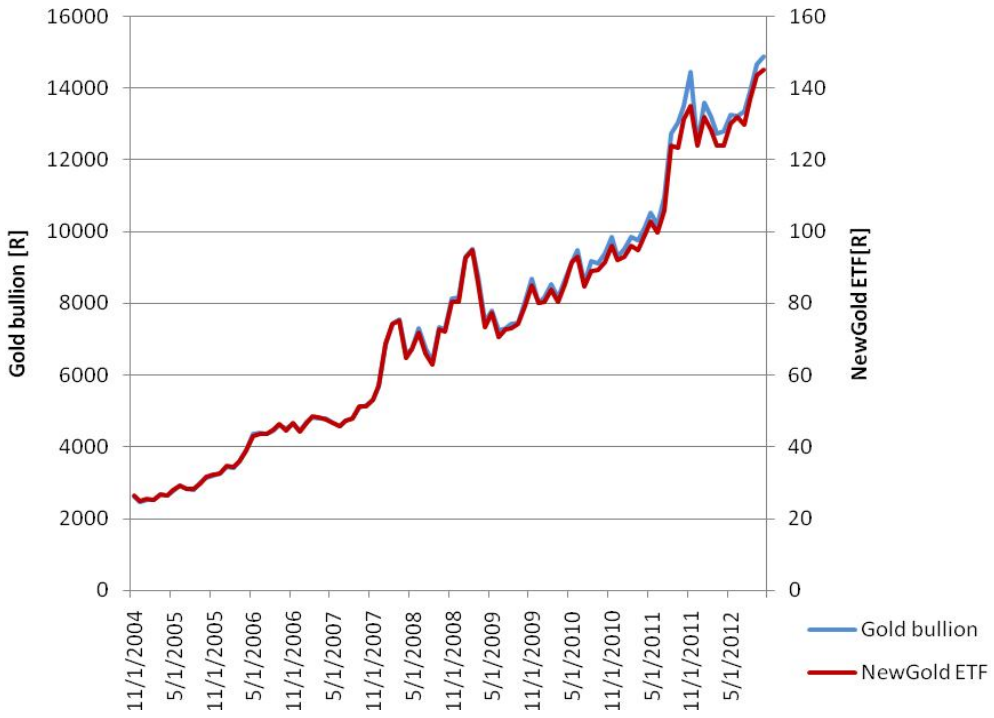

Figure 1: Gold bullion and NewGold ETF from 2004 to 2012

Figure 3 shows the movement of the gold price and the gold mining index. The figure indicates that the gold price has been rising steadily over the sample period. The gold mining index experienced a steep increase from May 2005 before starting to decline in May 2006 until the end of 2008 where it remained flat on average until 2011. Meanwhile the gold price continued to appreciate consistently. The gold mining index does not seem to be tracking the price of gold all the time but only during certain times. This result implies that the gold mining index is affected by other market variables which are not entirely related to the gold price.

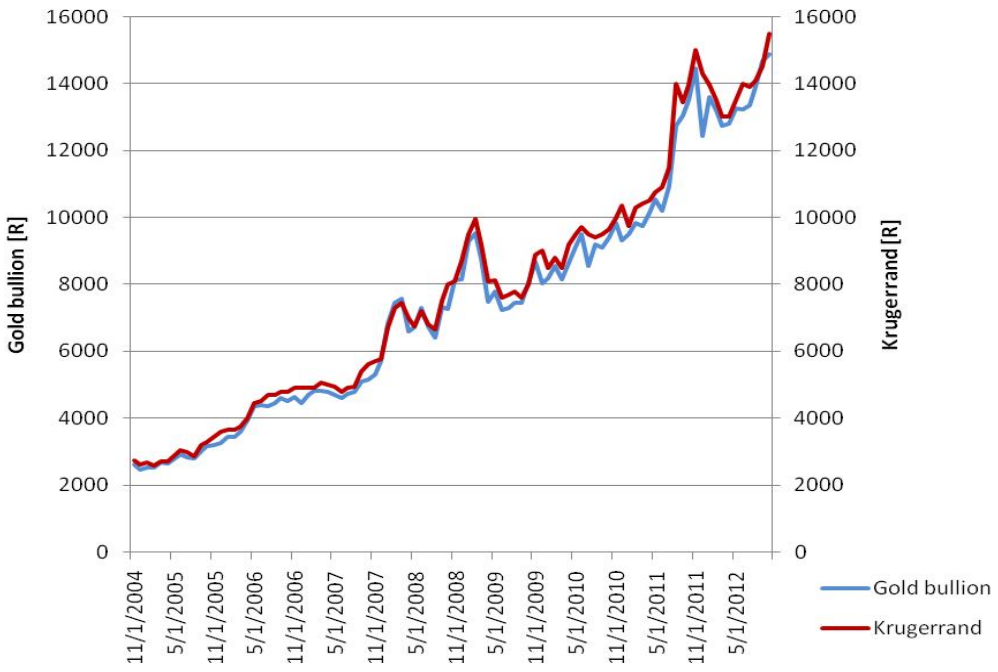

Figure 2: Gold bullion and Krugerrand from 2004 to 2012

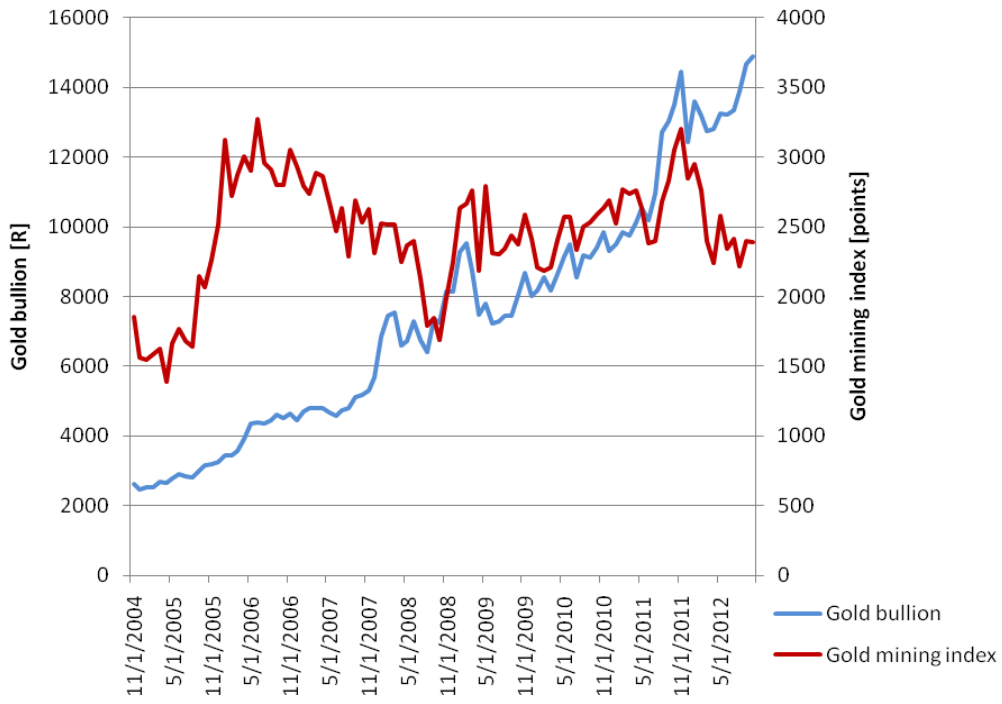

Figure 3: Gold bullion and gold mining index from 2004 to 2012

Figure 4 depicts the gold price and the FTSE/JSE all share index over the sample period. The gold price seems to be increasing together with the FTSE/JSE all share index for most part of the period considered. However, the FTSE/JSE all share index declined appreciably between 2008 and 2009 as equities globally experienced a drawdown in the wake of the recession. Gold price and FTSE/JSE all share index tend to follow the same trend together under normal market conditions.

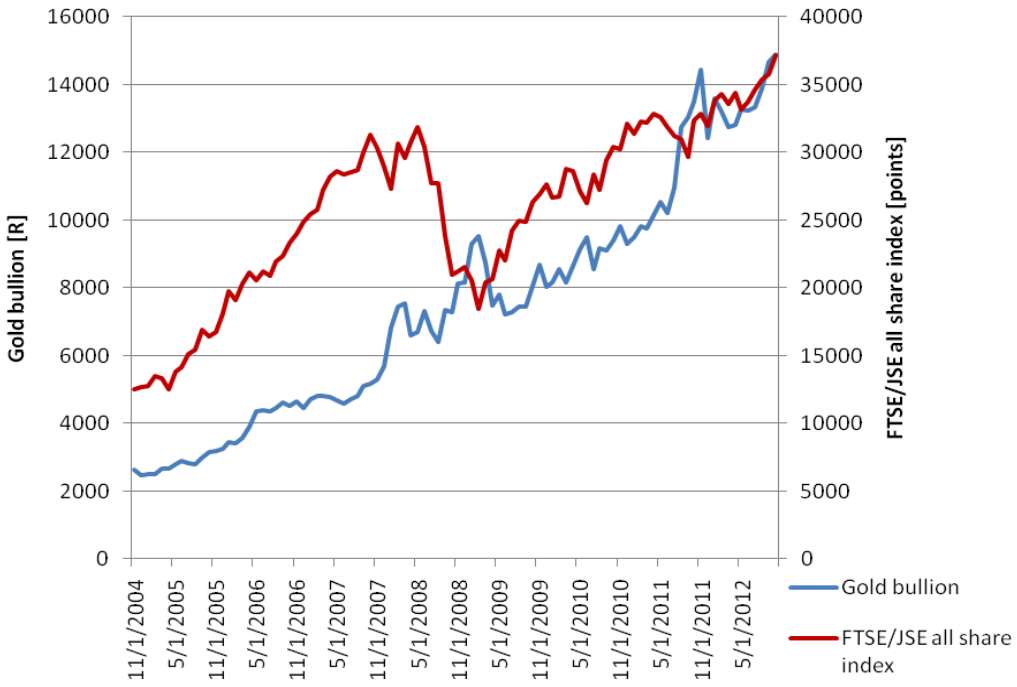

Figure 4: Gold bullion and FTSE/JSE all share index from 2004 to 2012

Figure 5 shows the gold price and unit trust index comprising gold and other precious metals. The unit trust index experienced a steep increase between 2005 and 2006 The gold price appears to be increasing with the unit trust index except for the period between 2008 and 2009 when the unit trust index experienced a drop of nearly 80 points. The deviation of the unit trust index from the movement of the gold price highlights the point that unit trusts tend to fall under adverse market conditions in a similar manner as equities tend to.

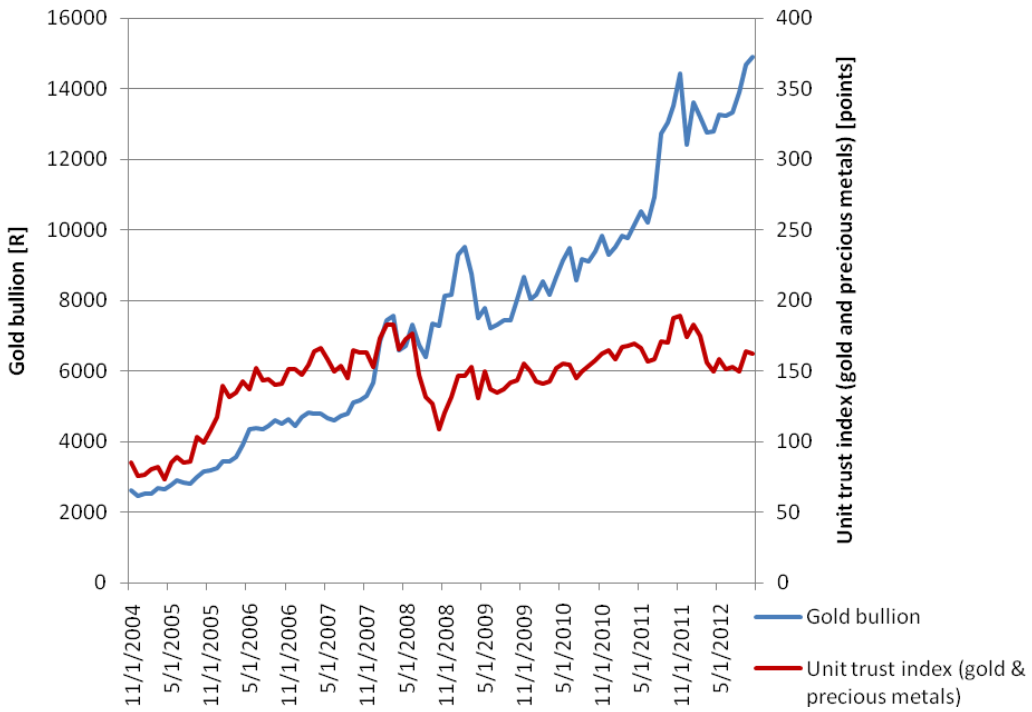

Figure 5: Gold bullion and unit trust index (gold and precious metals) from 2004 to 2012

4.3 Descriptive Statistics

This section presents summary statistics of all assets considered in the study. Table 1 contains mean return for gold bullion and compares it to other gold assets the overall JSE market. Table 1 shows that gold bullion produced returns superior against all assets. Gold produced an average monthly return of 2% while the FTSE/JSE all share index returns yielded a mean 1.27%. We find that mean returns of NewGold ETF and Krugerrand are close to the mean return of the gold bullion. This result is expected as the gold bullion is the underlying asset for both assets. The gold mining index was the worst performer with a mean of 0.73%. The unit trust index (gold & precious metals) came second producing mean return below the FTSE/JSE all share index. Kurtosis of all assets is below three indicating that all assets have a lower probability of extreme values compared to a standard normal distribution. Only gold bullion and FTSE/JSE all share index are negatively skewed. By looking at the minimum and maximum values, the FTSE/JSE all share index shows the least extreme values. The gold mining index shows the most extreme values followed by the unit trust index.

Table 1: Descriptive statistics for different assets

This table provides descriptive statistics for different gold assets as well as the JSE all share index over the period November 2004 to October 2012.

	Gold bullion	NewGold ETF	Krugerrand	Gold mining index	JSE all share index	Unit trust index (gold & precious metals)
Mean [%]	2.0191	1.9828	1.9696	0.7289	1.2746	0.9304
Median [%]	2.1768	2.1559	1.5957	0.7892	1.49	0.7805
Kurtosis	1.2297	1.292	1.8733	0.6407	0.5687	0.3049
Skewness	-0.1197	0.0277	0.6475	0.5095	-0.3216	0.1749
Minimum [%]	-14.4287	-14.2357	-11.9565	-20.7354	-13.956	-16.3385
Maximum [%]	20.2216	20.3218	21.7391	30.8897	12.2875	20.6275

Table 2 compares descriptive statistics of gold mining companies. Village and Main Reef produced superior returns followed by Simmer and Jack Mines. Village and Main Reef mean monthly returns are at least four times that of gold. Village and Main Reef, Simmer and Jack Mines, and Gold One International have a kurtosis greater than three indicating that they present a higher probability of extreme values than a normal distribution. None of the gold mining companies exhibited negative skewness. Village and Main Reef, and Simmer and Jack Mines produced most extreme values while Gold Fields produced the least.

Table 2: Descriptive statistics for gold mining companies

This table presents descriptive statistics for JSE listed gold mining companies over the period November 2004 to October 2012.

	Anglo-Gold Ashanti	DRD Gold	Gold Fields	Gold one interna-tional	Harmony Gold	Simmer and Jack	Village and Main Reef
Mean [%]	0.7076	0.8151	0.7644	2.6300	1.0389	3.5031	8.7407
Median [%]	-0.2334	-2.7273	-0.3774	0.0000	0.379	0.0000	0.0000
Kurtosis	0.0587	2.3939	0.1681	4.6224	1.3845	17.2088	51.307
Skewness	0.3514	1.1519	0.4815	1.1415	0.5546	3.0637	6.5357
Minimum [%]	-24.1159	-28.9697	-19.7468	-45.9459	-34.7583	-95.5882	-68.142
Maximum [%]	32.162	67.5926	29.3351	63.5135	51.1628	233.3333	566.6667

4.4 Correlation Coefficients

Low correlation of an asset with other assets makes the asset useful for diversification in a portfolio. Correlations of all assets are included in this section. The correlation matrix of different assets is included in Table 3 and Table 4 contains the correlation matrix for gold mining companies.

Table 3: Correlation coefficients for different assets

This table provides the correlation between monthly rates of return for different assets over the full sample period. The p-value for each correlation coefficient is indicated in brackets below each coefficient.

	Gold bullion	NewGold ETF	Krugerrand	Gold mining index	JSE all share index	Unit trust index (gold and precious metals)
Gold bullion	1					
NewGold ETF	0.9741***	1				
	(0.0000)					
Krugerrand	0.7508***	0.7695***	1			
	(0.0000)	(0.0000)				
Gold mining index	0.5611***	0.5730***	0.5053***	1		
	(0.0000)	(0.0000)	(0.0000)			
JSE all share index	-0.1503	-0.1385	-0.0956	0.3152***	1	
	(0.1460)	(0.1808)	(0.3566)	(0.0018)		
Unit trust index (gold and precious metals)	0.5701***	0.5844***	0.4943***	0.9343***	0.4427***	1
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	

***represent statistical significance at 1% level.

Table 3 shows that there is a strong positive relationship between gold bullion and the NewGold ETF. About 95% variation in the NewGold ETF can be explained by the variation in the gold price. This result is expected as the ETF is purely backed by gold bullion. There is also strong positive correlation between the Krugerrand and the gold bullion. Although the correlation coefficient is statistically significant at 1% level, only 56% of the variation in Krugerrand price can be explained by the price of gold. The result suggests that there are other factors which greatly influence the price and hence the return on the Krugerrand other than the price gold. The gold mining index is

moderately positively correlated with the gold bullion. Although the correlation coefficient is statistically significant, only 31% of the variation in gold mining index can be explained by the gold price. There is a negative correlation between the FTSE/JSE all share index and the gold bullion, however, we find that the result is not statistically significant at the 10% level. This result is plausible as a low or negative correlation suggests that there is a possible diversification benefit if gold is added to a portfolio comprising stocks of companies. In this instance, we find that the correlation between the FTSE/JSE all share index and the gold price to be negative but not statistically significant. The result is similar to the finding of Dempster and Artigas (2010) who established that the correlation between gold and other major assets was not statistically significant. The gold mining index tends to be positively correlated with the FTSE/JSE all share index although the correlation is weak. Notwithstanding the weak positive correlation between the two indices, the correlation coefficient is statistically significant at the 1% level. The unit trust index tends to be moderately positively correlated with all assets and has a strong positive relationship with the gold mining index.

Table 4 contrasts correlation between gold and gold mining companies. The figure indicates that gold is positively correlated with most gold mining companies except for Village and Main Reef. Gold Fields exhibit the largest positive correlation with gold followed by Harmony Gold. Simmer and Jack yielded the smallest correlation with the gold bullion. The largest positive correlation occurs between Gold Fields and AngloGold Ashanti. Village and Main Reef is mostly negatively correlated with other gold mining companies except for Simmer and Jack Mines. However, none of the correlations of Village and Main Reef with other gold mining companies are statistically significant. Table 4 shows that even though there is no meaningful correlation between gold and the FTSE/JSE all share index (as seen in Table 3), gold tends to be positively and significantly correlated with most gold mining companies when considered on an individual basis. It is expected for gold mining companies' stock returns to be correlated with the return on the gold bullion. Blose (1996) showed that stock return of gold mining companies is a function of the return on gold (including other factors).

Table 4: Correlation coefficients for listed gold mining companies

This table provides the correlation between monthly rates of return for different gold mining companies over the full sample period. Gold bullion is included for comparison. The p-value for each correlation coefficient is indicated in brackets below each coefficient.

	Gold bullion	AngloGold Ashanti	DRD Gold	Gold Fields	Gold one inter-national	Harmony Gold	Simmer and Jack Mines	Village and Main Reef
Gold bullion	1							
AngloGold Ashanti	0.4464*** (0.0000)	1						
DRD Gold	0.4752*** (0.0000)	0.4793*** (0.0000)	1					
Gold Fields	0.5839*** (0.0000)	0.8020*** (0.0000)	0.5222*** (0.0000)	1				
Gold one inter-national	0.2662*** (0.0092)	0.4276*** (0.0000)	0.3405*** (0.0008)	0.5313*** (0.0000)	1			
Harmony Gold	0.5041*** (0.0000)	0.6441*** (0.0000)	0.5363*** (0.0000)	0.7406*** (0.0000)	0.4455*** (0.0000)	1		
Simmer and Jack Mines	0.0769 (0.4586)	0.1894* (0.0660)	0.2353** (0.0216)	0.2203** (0.0320)	0.1469 (0.1554)	0.1694 (0.1008)	1	
Village and Main Reef	-0.1649 (0.1104)	-0.0560 (0.5898)	-0.1509 (0.1442)	-0.0329 (0.7512)	-0.1616 (0.1178)	-0.0589 (0.5710)	0.0334 (0.7482)	1

***represent statistical significance at 1% level, **represent significance at 5% level, *represent significance at 10% level.

4.5 Performance Evaluation

4.5.1 Abnormal returns

Results for t-test carried on abnormal returns are included in Table 5. Abnormal returns were determined using the JSE gold mining index as the benchmark. The t-tests were carried for three different periods. The purpose of dividing the sample period into pre- and post-2008 is to test whether results obtained from the full sample period are applicable in the period before 2008 and the

period after 2008. All tests were done at the 10% level of significance using a two tailed test. Table 5 indicates that none of the assets showed statistically significant results.

Table 5: t-test for abnormal returns for different gold assets

This table provides t-test results for all assets. The benchmark in panels 1, 3 and 5 is the JSE all share index and the benchmark for panels 2, 4 and 6 is the gold bullion.

Panel 1: Gold assets from 01 November 2004 to 31October 2008

	Gold bullion	New-Gold ETF	Krugerrand	JSE all share index	Unit trust index (gold & precious metals)
Mean [%]	2.0374	2.0179	2.1108	1.255	0.5394
t Stat	1.5368	1.5267	1.6187	1.5944	0.9419
P(T<=t) two-tail	0.1312	0.1336	0.1124	0.1176	0.3512
t Critical two-tail	1.6787	1.6787	1.6787	1.6787	1.6787

Panel 2: Gold mining companies from 01 November 2004 to 31October 2008

	Gold bullion	Anglo-Gold Ashanti	DRD Gold	Gold Fields	Gold One inter-national	Harmony Gold	Simmer and Jack Mines	Village and Main Reef
Mean [%]	2.0374	-0.3125	-0.528	-0.0991	1.7554	1.3034	9.0573	14.0003
t Stat	1.5368	-0.4538	-0.2228	-0.1630	0.8524	0.9999	1.4973	1.0245
P(T<=t) two-tail	0.1312	0.6522	0.8246	0.8712	0.3984	0.3226	0.1412	0.311
t Critical two-tail	1.6787	1.6787	1.6787	1.6787	1.6787	1.6787	1.6787	1.6787

Panel 3: Gold assets from 01 November 2008 to 31October 2012

	Gold bullion	New-Gold ETF	Krugerrand	JSE all share index	Unit trust index (gold & precious metals)
Mean [%]	0.5585	0.5059	0.3886	0.1503	-0.1295
t Stat	0.5508	0.5118	0.3403	0.1057	-0.2171
P(T<=t) two-tail	0.5844	0.6112	0.7352	0.9164	0.829
t Critical two-tail	1.6779	1.6779	1.6779	1.6779	1.6779

Panel 4: Gold mining companies from 01 November 2008 to 31October 2012

	Gold bullion	Anglo-Gold Ashanti	DRD Gold	Gold Fields	Gold One International	Harmony Gold	Simmer and Jack Mines	Village and Main Reef
Mean [%]	0.5585	0.2638	0.6876	0.1672	2.0436	-0.6628	-3.3779	2.1481
t Stat	0.5508	0.6733	0.4076	0.4625	1.289	-0.7346	-0.8308	0.526
P(T<=t) two-tail	0.5844	0.504	0.6854	0.6458	0.2038	0.4662	0.4104	0.6014
t Critical two-tail	1.6779	1.6779	1.6779	1.6779	1.6779	1.6779	1.6779	1.6779

Panel 5: Gold assets from 01 November 2004 to 31 October 2012

	Gold bullion	New-Gold ETF	Krugerrand	JSE all share index	Unit trust index (gold & precious metals)
Mean [%]	1.2901	1.2539	1.2406	0.5457	0.2014
t Stat	1.552	1.5253	1.4335	0.5626	0.4879
P(T<=t) two-tail	0.124	0.1306	0.155	0.575	0.6268
t Critical two-tail	1.6612	1.6612	1.6612	1.6612	1.6612

Panel 6: Gold mining companies from 01 November 2004 to 31 October 2012

	Gold bullion	Anglo-Gold Ashanti	DRD Gold	Gold Fields	Gold One international	Harmony Gold	Simmer and Jack Mines	Village and Main Reef
Mean	1.2901	-0.0213	0.0862	0.0355	1.9010	0.3100	2.7742	8.0118
t Stat	1.552	-0.0542	0.0597	0.1012	1.4746	0.3913	0.7565	1.1353
P(T<=t) two-tail	0.124	0.9568	0.9526	0.9196	0.1436	0.6964	0.4512	0.2592
t Critical two-tail	1.6612	1.6612	1.6612	1.6612	1.6612	1.6612	1.6612	1.6612

4.5.2 Value added monthly index (VAMI)

Figure 6 shows the value added monthly index (VAMI) for different gold assets considered. The benefit of using VAMI as a performance measure is that it shows the extent to which an investment grows to over time. Figure 6 illustrates that an initial investment of R1000 invested directly in the gold bullion at the end of November 2004 grows to R5668.06 by the end of October 2012. Gold bullion produced superior performance followed by the Krugerrand and NewGold ETF, respectively. The gold mining index, meanwhile, produced the least growth whereby an initial investment of R1000 ended at R1291.06. The unit trust index also produced inferior growth in comparison to gold. It is evident that while gold experienced growth other metals which form part of the index declined substantially thus causing the unit trust index to underperform gold. It appears that investing purely in gold (either by purchasing the bullion directly or via Krugerrands or via NewGold ETF) produced superior growth than investing in equity of companies (via the gold mining index or FTSE/JSE all share index) or investing unit trust index.

Figure 7 shows VAMI for gold mining companies. All gold mining companies did not outperform gold, NewGold ETF and Krugerrands. However, it should be noted the VAMI measure only considers capital appreciation and does not take dividends paid by gold mining companies into account. Hence, VAMI tends to be biased towards non-dividend paying assets and makes dividend paying stocks seem inferior. Figure 7 indicates that only Gold One International produced VAMI close to the gold bullion. An initial investment of R1000 invested directly in the Gold One International at the end of November 2004 grows to R4714.29 by the end of October 2012. An investor who invested in Simmer and Jack Mines and DRD gold would have experienced a loss of R928.57 and R398.02, respectively.

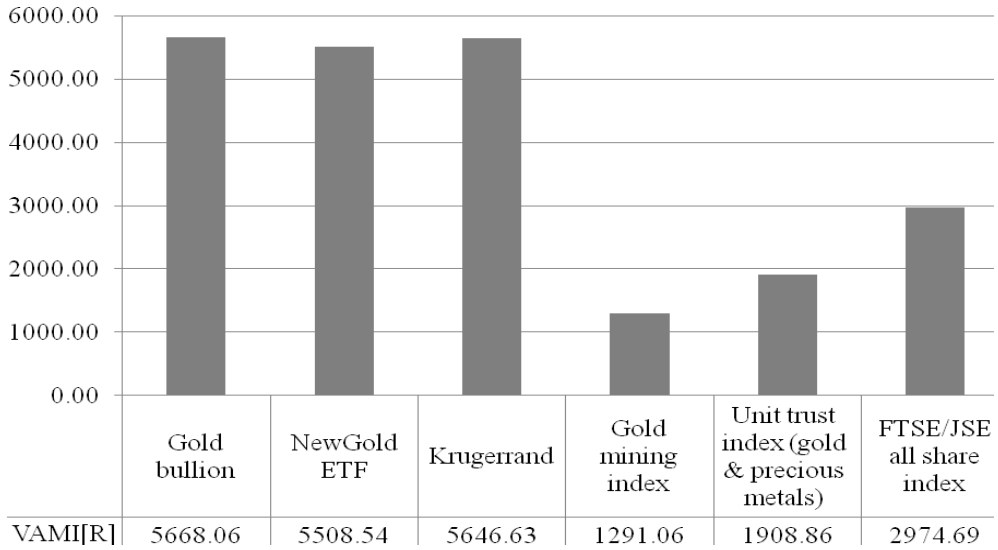

Figure 6: VAMI for different assets

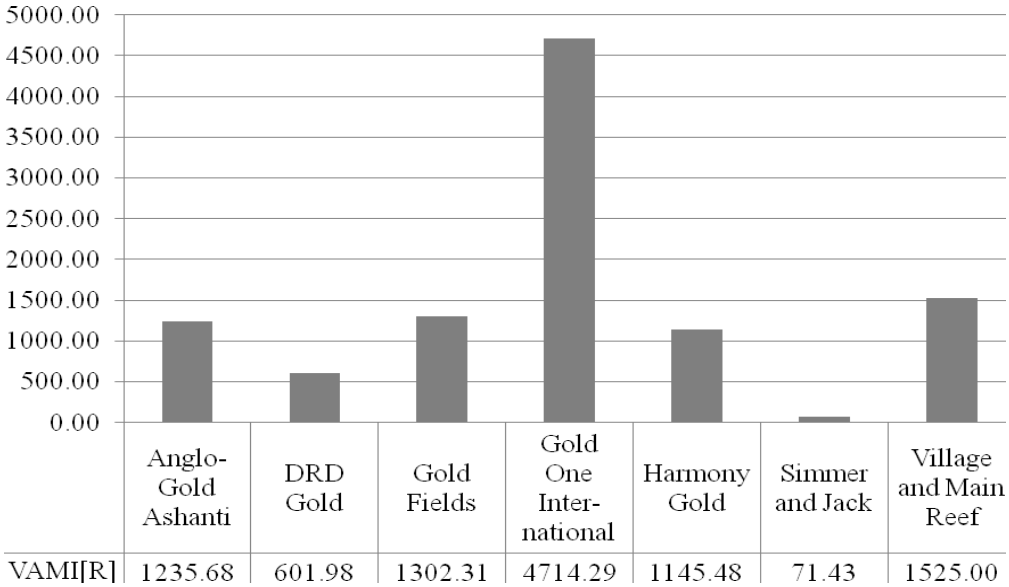

Figure 7: VAMI for gold mining companies

Chapter Summary

This chapter presented the historical performance of gold bullion. There was an upward trend in the gold price over the sample period even when stocks experienced a decline during 2008/2009. Gold bullion, NewGold ETF and Krugerrand offered superior returns compared to the gold mining index, FTSE/JSE all share index and unit trust index (gold & precious metals). Return on NewGold ETF and Krugerrand are comparable to the return on the gold bullion. Gold mining index yielded lowest return. The correlation between FTSE/JSE all share index and gold bullion is negative and not statistically significant. Gold bullion offered superior growth beyond that of all listed gold mining companies. The next chapter investigates the risk associated with gold investment assets.

CHAPTER 5: GOLD RISK

5.1 Introduction

The previous chapter considered returns of various gold assets and explored possible diversification benefits of investing in gold. Hillier et. al. (2006) mentioned that precious metals are possible substitutes for financial derivatives from risk management perspective. This chapter investigates the influence of gold on portfolio risk.

The rest of this chapter is arranged as follows. Section 5.2 contains volatility of different assets. Section 5.3 presents the impact of gold on a portfolio of stocks. Section 5.4 comprises of beta estimates for gold during different years. Chapter summary concludes this chapter.

5.2 Volatility Comparison

Figure 8 contrasts volatility of return on gold against other assets and Figure 9 shows volatility of listed gold mining companies. Figure 8 indicates that the FTSE/JSE all share index yielded the least volatility of all asset considered. The Krugerrand had a lower volatility than the gold price. NewGold ETF volatility is almost the same as that of gold. This finding is expected as the ETF is 100% backed by gold. The unit trust index had higher volatility than gold. This result suggests that other precious metals added to the index have a negative impact on volatility of the index. The gold mining index produced the highest volatility of all assets considered. This is a surprising result as the gold mining index had the least mean return as seen in Table 1. Modern portfolio theory suggests that riskier assets should be accompanied by higher returns. We observe a different outcome for the gold mining index. The strikingly high volatility of the gold mining index in comparison to the FTSE/JSE all share index indicates that gold mining companies exhibit added risk beyond the overall market and this risk be should be accompanied by higher levels of expected return.

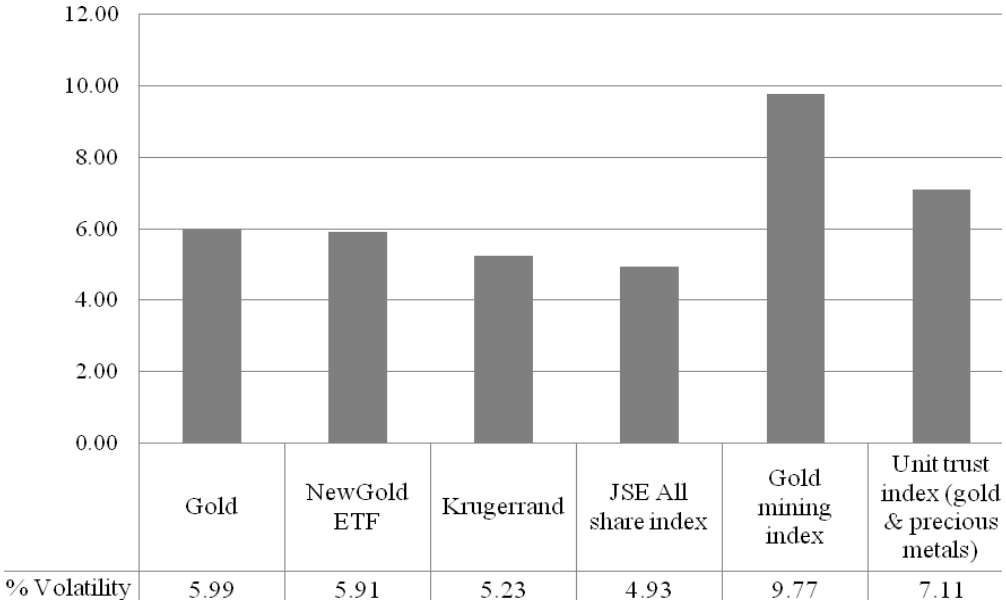

Figure 8: Monthly volatility (%)

Figure 9 shows that all gold mining companies produced more volatility than the actual gold they produce. More specifically, the smallest volatility observed on gold mining companies is nearly double that of gold bullion. AngloGold Ashanti produced the least volatility while Village and Main Reef produced the largest volatility. The observation that gold bullion volatility is less that the volatility of all listed gold mining companies suggests that it is more risky to invest in shares of gold mining companies as opposed to investing directly in the gold bullion. The difference in volatility between shares of gold mining companies and the actual physical gold suggest that equities of individual gold mining companies contains business risk that cannot be associated with market risk of the gold price.

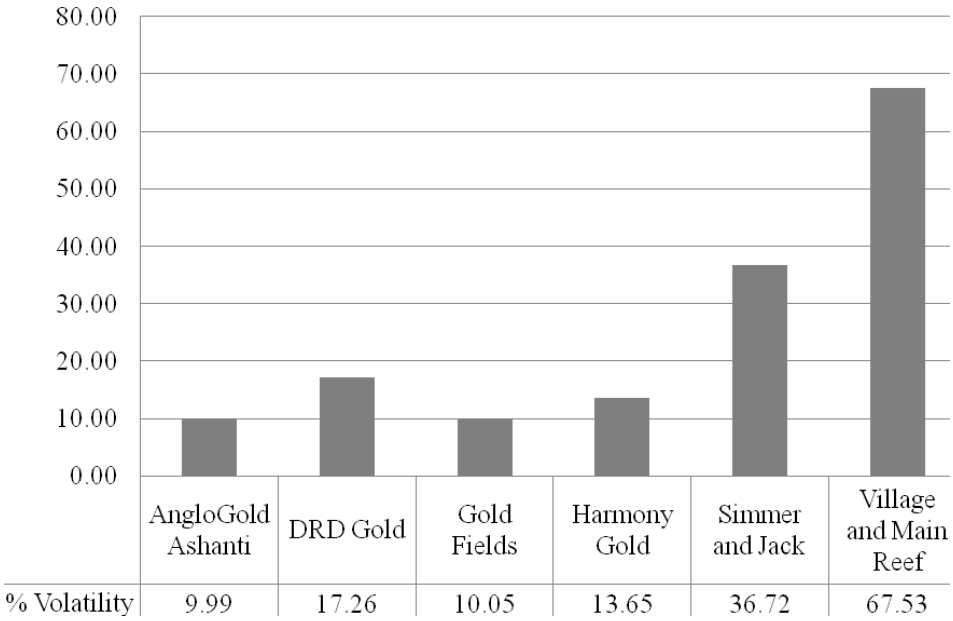

Figure 9: Monthly volatility of gold mining companies

5.3 Impact of Gold on a Portfolio

Table 6 contains results for three different allocations to gold. The first case considered represents 100% investment in South African stock index. This is an extreme case with aims to indicate possible returns and risks that could have realized by 100% investment of funds into stocks. The second case represents 5% allocation to gold and the third case mimics 10% investment in gold. Three sample periods were analyzed, namely: full sample range (November 2004 to October 2012), November 2004 to October 2008, November 2008 to October 2012.

Table 6 indicates that 100% investment if South African stock index consistently yielded the least return/risk ratio in all periods. Table 6 also shows that monthly portfolio returns tend improve with an increase in allocation to gold and portfolio standard deviation tends reduce with an increase in allocation to gold. This outcome leads to the conclusion that risk adjusted returns tend to improve when gold is added to a portfolio of stocks. The increase in return/risk ratio was observed in all three cases and three periods considered.

Table 6: Portfolio performance of gold

This table provides risk adjusted returns for three different allocations to gold. The analysis was done over the full sample period as well as pre and post 2008.

Period	Performance measure	Portfolio composition		
		% JSE all share index = 100 % Gold = 0	% JSE all share index = 95 % Gold = 5	% JSE all share index = 90 % Gold = 10
Nov 04 - Oct 12	Mean return	1.27	1.31	1.35
	Standard deviation	4.93	4.65	4.39
	Return/Risk ratio	0.26	0.28	0.31
Nov 04 - Oct08	Mean return	1.26	1.31	1.36
	Standard deviation	5.4	5.1	4.83
	Return/Risk ratio	0.23	0.26	0.28
Nov08 - Oct12	Mean return	1.29	1.31	1.33
	Standard deviation	4.49	4.22	3.97
	Return/Risk ratio	0.29	0.31	0.34

5.4 Gold Beta

Beta of an asset measures the amount of systematic risk relative to an average risky asset. Systematic risk of asset is an important aspect in asset selection as it is the risk that cannot be eliminated by diversification. Ideally, an asset's beta should be as low as possible. Herbst (1983) noted that assets with negative beta are particularly valuable within a portfolio because they can reduce systematic risk.

Table 7 Shows results for gold beta calculated yearly from November 2004 to October 2012. Gold exhibited lowest beta between November 2009 and October 2010. Gold started experiencing negative beta from November 2007. Beta remained negative for four consecutive years before becoming positive in the period between November 2011 and October 2012. The largest positive beta has been recorded for the last period considered. It is worth noting that negative beta's were observed during the 2008 economic recession. This result affirms that gold has a potential to be an effective risk management asset, especially when equities are underperforming. The results of Table 7 suggest that gold has the potential to reduce systematic risk if added to a portfolio. This finding is

similar to what Jaffe (1989) established. More specifically, Jaffe (1989) found beta for gold to be close to zero and noted that addition of gold is likely to reduce risk of a diversified portfolio.

Table 7: Beta for gold

This table presents estimated gold beta for gold. Gold beta was calculated using the JSE all share index as the market return.

Period	β
Nov'04-Oct'05	0.1268
Nov'05-Oct'06	0.0535
Nov'06-Oct'07	0.1075
Nov'07-Oct'08	-0.2466
Nov'08-Oct'09	-0.18
Nov'09-Oct'10	-0.8518**
Nov'10-Oct'11	-0.2911
Nov'11-Oct'12	1.2042*

** Indicates statistical significance at 5%, * Indicates statistical significance 10%

Chapter Summary

This chapter presented volatility of different assets. Gold bullion is more volatile that the FTSE/JSE all share index. Gold mining companies exhibit the largest volatility of all assets considered. Adding gold to a portfolio of shares improves risk adjusted returns. This chapter revealed that gold exhibits low or negative beta coefficient and thus gold has the potential to reduce systematic risk. The next chapter explores the relationship between gold and macroeconomic variables.

CHAPTER 6: THE REGRESSION MODEL

6. 1 Introduction

This chapter explores the relationship between gold price and South African macroeconomic variables, namely: rand/dollar exchange rate, repo rate, CPI and real GDP. The aim is test whether any of the variables can help to explain the gold price.

This chapter is organized as follows. Section 6.2 presents time-series plots of gold price with all macroeconomic variables. Section 6.3 provides an account of correlations between gold and macroeconomic variables. Section 6.4 contains results for unit root test. Section 6.5 contains results for cointegration test. Section 6.6 provides individual regression results of all variables with the gold returns. Section 6.7 presents combined regression results. Chapter summary ends this chapter.

6. 2 Qualitative Analysis of the Gold Price and Macroeconomic Variables

Examination of to time series plots involving the depended variable and explanatory variable can be useful in assessing the presence of cointegration between variables. If cointegration occurs, then regression results obtained from cointegrating variables are valid. The relationship between the gold price and each explanatory variable are analyzed in this section.

Figure 10 indicates that the gold price has been approximately co-trending with the rand dollar exchange rate until early 2009. The rand dollar exchange rate declined between May 2009 and May 2011 while the gold price continued to appreciate. The rand/dollar exchange rate started to increase in May 2011 following the same trend as the gold price. Since gold is quoted in U.S dollars in the market, it becomes more expensive for a South African based investor to buy gold as the rand/dollar exchange rate increases.

Figure 11 indicates that the repo rate has, in general, been increasing together with the gold price. The repo rate reached a peak in the second half of 2008 before declining from 2008 through to 2012. The repo rate reached lowest level towards the end of 2012. Since the repo is the benchmark interest rate in South Africa, a declining repo rate makes it more profitable for a South African based investor to hold gold as opposed to interest bearing investments.

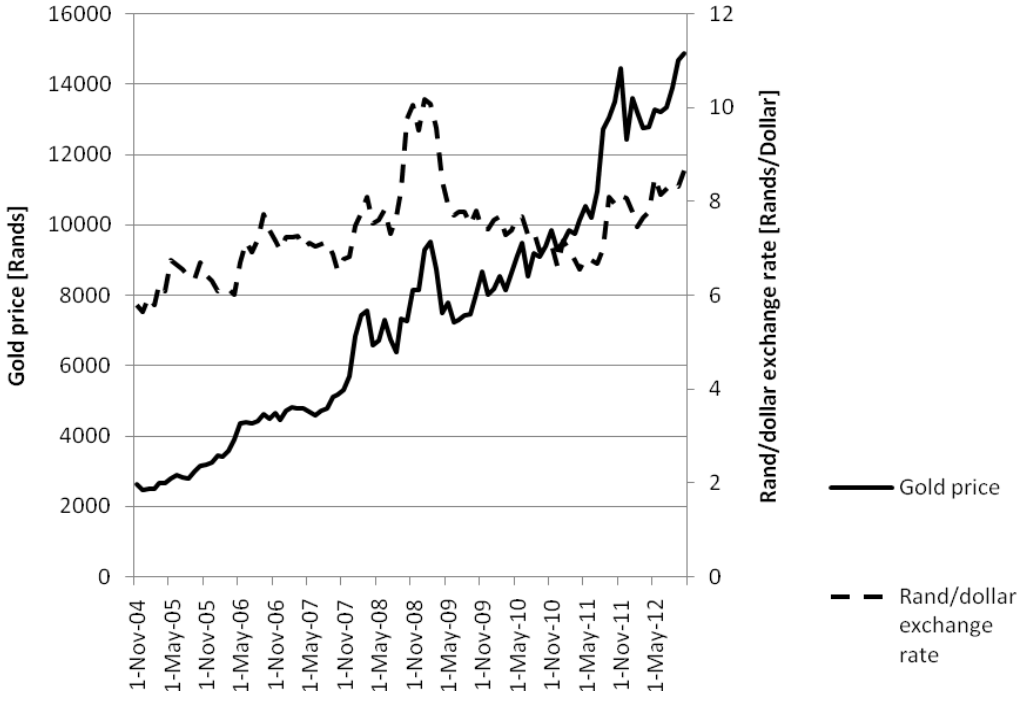

Figure 10: Gold price and rand/dollar exchange rate

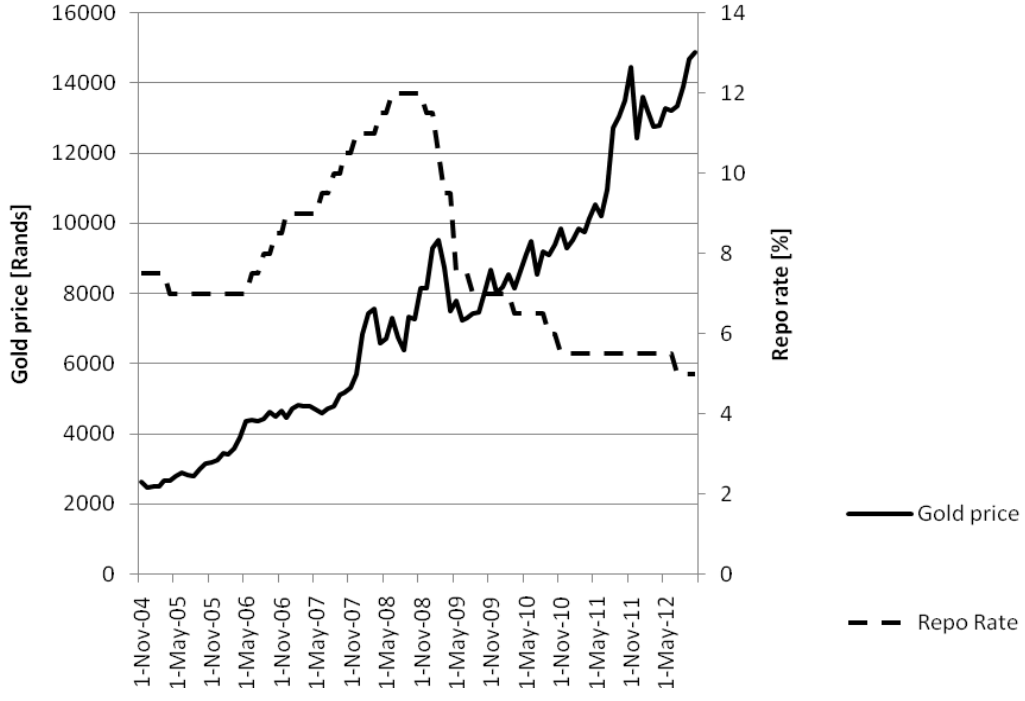

Figure 11: Gold price and repo rate

Figure 12 shows that the CPI has been increasing together with the gold price but only until the second half of 2008. CPI then declined until the end of 2010 while the gold price maintained an upward trend. It is evident that gold maintained a steady upward trend even during a period of rising inflation. This finding supports the hypothesis that gold can be used as a hedge against rising South African inflation. It is expected that the gold price will be highest during periods of high inflation. However, it can be observed in Figure 12 that the gold price continued to increase amid the decline in CPI.

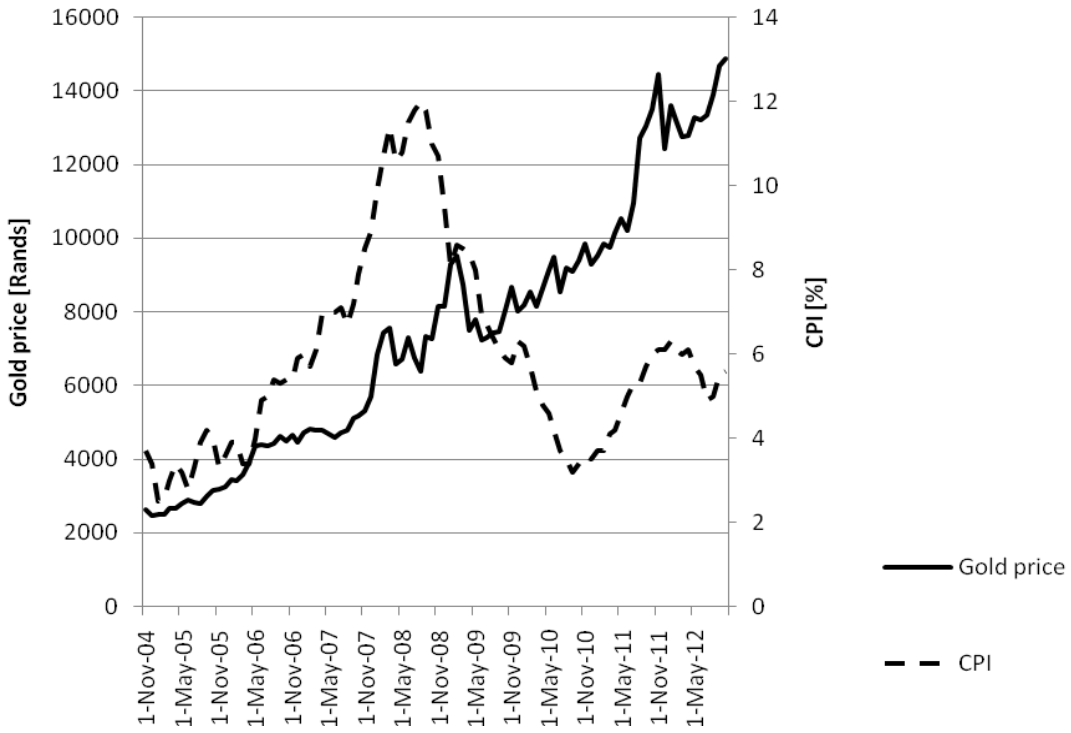

Figure 12: Gold price and CPI

Figure 12 shows movement of gold price and real GDP. Fluctuations in real GDP can be observed from time to time, but the overall trend has been upwards in line with the gold price.

It appears that the gold price and macroeconomic variables followed a similar trend prior to the 2008 economic crisis. All macroeconomic variables declined 2008 while the gold price maintained a continual increase in value.

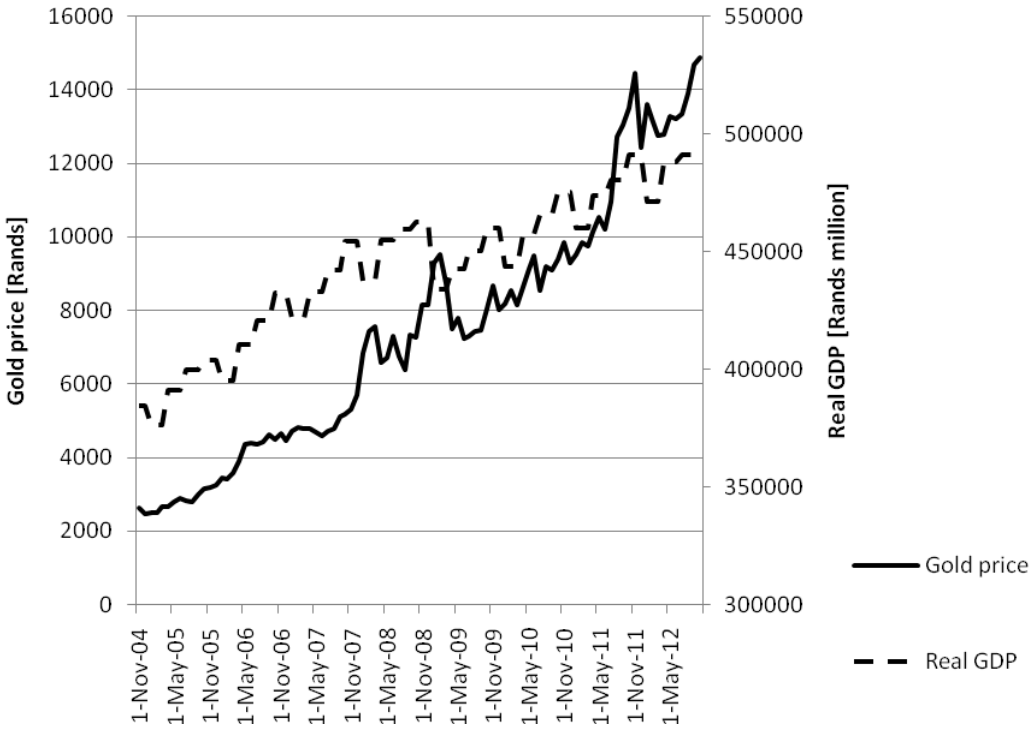

Figure 13: Gold price and real GDP

6. 3 Correlations

Table 8 shows the correlation matrix of all variables used in the regression model. There is a positive relationship between gold price and rand/dollar exchange rate. Gold price tends to increase with rand/dollar exchange rate. This result suggests that gold can be used to offset depreciation of the rand. Gold price is negatively correlated with the repo rate. As repo rate increases, gold price tends to fall. This result is expected since rising interest rate would imply higher returns for other interest rate linked investments. As a result, investors tend to sell gold when repo rate increases, causing a reduction in demand for gold and a drop in the price of gold. The correlation between gold and real GDP is positive. The least correlation is recorded between gold and CPI. However, the correlation coefficient is not statistically significant at 10% level. We find gold price to be highly correlated with real GDP followed by rand/dollar exchange rate.

Table 8: Correlation between gold and macroeconomic variables

This table provides correlation coefficients between macroeconomic variables. The p-value for each correlation coefficient is indicated below each coefficient.

	Gold price	Rand/dollar exchange rate	Repo Rate	CPI	Real GDP
Gold price	1				
Rand/dollar exchange rate	0.5431***	1			
	(0.0000)				
Repo Rate	-0.4107***	0.3174***	1		
	(0.0000)	(0.0018)			
CPI	0.1384	0.6038***	0.7979***	1	
	(0.1810)	(0.0000)	(0.0000)		
Real GDP	0.9016***	0.5198***	-0.2042**	0.3154***	1
	(0.0000)	(0.0000)	(0.0472)	(0.0018)	

***Indicates significance at 1% level, **indicates significance at 5% level.

6. 4 Unit Root Tests

The AR (p) model described in subsection 3.3.4 was used to investigate univariate properties of all variables included in the econometric model. The procedure followed to test for the presence of a unit root is as outlined in subsection 3.3.4. The process was to assume a number of lags (four lags we initially assumed), eliminate variables whose coefficients are not statistically significant (until the remaining coefficients are significant) and test the statistical significance of the deterministic trend. The significance level used is 5%. Final results of the autoregressive model for all variables are included in Table 9.

Panel 1 shows the autoregressive model (AR) for the gold price. It was found that the deterministic trend was statistically significant and could not be eliminated. Since the final model includes a deterministic trend, the Dickey-Fuller critical value is -3.45 and the t-stat is -2.8697 which is not more negative than -3.45 and thus we conclude that the gold price series is nonstationary and contain a unit root ($\rho = 0$).

Table 9: AR models for macroeconomic variables

This table provides autoregressive model results for each variable

Panel 1: Gold price

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	305.7832	147.5853	2.0719	0.0412	12.4415	599.125
Y_{t-1}	-0.1907	0.0665	-2.8697	0.0052	-0.3229	-0.0586
time	24.8132	8.3209	2.982	0.0037	8.2745	41.352

Panel 2 depicts the autoregressive model for the rand/dollar exchange rate. It was found that the deterministic trend is not statistically significant and does not form part of the autoregressive model. Since the final AR model does not include a deterministic trend, the Dickey-Fuller critical value is -2.89 and the t-stat is -2.1950 which is not more negative than -2.89 and thus we conclude that the rand/dollar exchange rate series is nonstationary and contain a unit root ($\rho = 0$).

Panel 2: Rand/dollar exchange rate

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.7557	0.3361	2.2484	0.027	0.0878	1.4236
Y_{t-1}	-0.0988	0.045	-2.195	0.0308	-0.1883	-0.0094

Panel 3 indicates the autoregressive model for the repo rate. It was found that the deterministic trend is not statistically significant and does not form part of the auto-regressive model. Since the final model does not include a deterministic trend, the Dickey-Fuller critical value is -2.89 and the t-stat for Y_{t-1} is -1.6665 which is not more negative than -2.89 and thus we conclude that the repo rate series is nonstationary and contain a unit root ($\rho = 0$). The first difference of repo rate lagged two and three periods were also found to statistically significant at 5% level.

Panel 3: Repo rate

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.1825	0.1193	1.5305	0.1296	-0.0546	0.4196
Y_{t-1}	-0.0245	0.0147	-1.6665	0.0993	-0.0537	0.0047
ΔY_{t-2}	0.4279	0.0913	4.6875	0.0000	0.2464	0.6094
ΔY_{t-3}	0.3376	0.0932	3.6227	0.0005	0.1523	0.5228

Panel 4 shows results for the autoregressive model for CPI. It was found that the deterministic trend is not statistically significant and does not form part of the autoregressive model. Since the final model does not include a deterministic trend, the Dickey-Fuller critical value is -2.89 and the t-stat for ρ is -1.6342 which is not more negative than -2.89 and thus we conclude that CPI series is nonstationary and contain a unit root ($\rho = 0$).

Panel 4: CPI

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.2019	0.1215	1.6614	0.1002	-0.0396	0.4435
Y_{t-1}	-0.0303	0.0185	-1.6342	0.1058	-0.0671	0.0065
ΔY_{t-1}	0.4040	0.0972	4.1556	0.0001	0.2108	0.5973

Panel 5 shows results for the autoregressive model for real GDP. It was found that the deterministic trend is statistically significant and forms part of the autoregressive model. Since the final model includes a deterministic trend, the Dickey-Fuller critical value is -3.45 and the t-stat for ρ is -3.8488 which is not more negative than -3.45 and thus we conclude that real GDP series is stationary and does not contain a unit root.

Panel 5: Real GDP

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	103870.7807	26460.8174	3.9255	0.0002	51277.042	156464.5193
Time	244.0831	73.5306	3.3195	0.0013	97.9331	390.2331
Y_{t-1}	-0.2579	0.067	-3.8488	0.0002	-0.3911	-0.1247

Gold price, rand/dollar exchange rate, repo rate and CPI series is nonstationary and contain a unit root. However, the real GDP series is stationary and does not contain a unit root. This result implies that gold price, rand/dollar exchange rate, repo rate and CPI series needs to be differenced before running a regression, except when each variable is cointegrated with the dependent variable. The real GDP series can be used in the regression model directly without differencing. The next section presents results of cointegration test done on all explanatory variables which are nonstationary.

6. 5 Cointegration Test

Results for cointegration test are presented in Table 10. Unit root test was carried out on residuals (u_t). More specifically, Δu_t was regressed on u_{t-1}. The procedure tests for the presence of a unit root on residuals in a similar as the procedure to the used to explore univariate properties of all variables and is outlined in subsection 3.3.4. Panel 1 shows that t-stat for the coefficient on u_{t-1} is -0.6829 which is not more negative than the critical value of -2.89. Since the former is not more negative than the latter we cannot reject the unit root hypothesis and we conclude that residuals contain a unit root. The gold price and exchange rate are not cointegrated.

Table 10: Cointegration tests for macroeconomic variables

This table presents autoregressive model results for each macroeconomic variable using residuals as explanatory variables.

Panel 1: Gold price and exchange rate cointegration

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	84.5575	79.7056	1.0609	0.2917	-73.8407	242.9557
u_{t-1}	-0.019	0.0278	-0.6829	0.4964	-0.0744	0.0363

Panel 2 indicates that t-stat for the coefficient on u_{t-1} is -0.8878 which is not more negative than the critical value of -2.89. Since the former is not more negative than the latter we cannot reject the unit root hypothesis and conclude residuals have a unit root. The gold price and repo rate are not cointegrated.

Panel 2: Gold price and repo rate cointegration

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	115.6787	61.3152	1.8866	0.0625	-6.1724	237.5298
u_{t-1}	-0.0184	0.0208	-0.8878	0.3771	-0.0597	0.0228

Panel 3 depicts that t-stat for the coefficient on u_{t-1} is 0.3003 which is not more negative than the critical value of -2.89. Since the former is not more negative than the latter we cannot reject the unit root hypothesis and conclude residuals have a unit root. The gold price and CPI are not cointegrated.

Panel 3: Gold price and CPI cointegration

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	127.9838	55.6647	2.2992	0.0239	17.3619	238.6057
u_{t-1}	0.0051	0.0171	0.3003	0.7647	-0.0289	0.0392

Neither of the explanatory variables is cointegrated with the gold price. Hence, none of the explanatory variables can be used directly in the regression model without being transformed by differencing. As a result, returns are used in the regression model in order to avoid spurious regression.

6. 6 Individual Regression Results

Regression results between gold and macroeconomic variables are presented in this section. More specifically, return on gold was regressed separately against return on rand/dollar exchange rate, repo rate, CPI and real GDP.

Table 11 shows the outcome of the regression between gold and each of the macroeconomic variables. Panel 1 (ΔY_t) and rand/dollar exchange rate returns (ΔX_t) over the sample period. There is a positive relationship between the return on gold and movement in the rand/dollar exchange rate. The result implies that the gold price tends to increase as the rand depreciates. In other words, gold can be used as a hedge against depreciation of the rand. The p-value of 0.0001 indicates significance at 5% level. The R^2 of 0.1707 is notably high suggesting that 17% of the variation in gold returns

can be attributed to the change in rand/dollar exchange rate. Lags of differenced rand/dollar exchange rate returns were not statistically significant and were not included in the final regression equation.

Table 11: Individual regression results

This table provides regression results for gold and each macroeconomic variable separately.

Panel 1: Gold and rand/dollar exchange rate

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	120.798	51.6361	2.3394	0.0216	18.1655	223.4304
ΔX_t (rand/dollar)	568.6423	134.1827	4.2378	0.0001	301.9396	835.3451
R^2=0.1711						

The regression equation describing the relationship between gold and rand/dollar exchange rate returns is as follows:

$$\Delta Y_t = 120.7980 + 568.6423 \Delta X_t$$

Panel 2 indicates results for the regression between gold **(ΔY_t)** and repo rate **(ΔX_t).** There is a positive relationship between gold returns and a change in repo rate. The results are not statistically significant. However, R^2 is also significantly small suggesting that changes in repo rate cannot solely be used to explain changes in the gold price.

Panel 2: Gold and repo rate returns

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	135.0445	56.7234	2.3808	0.0195	22.3006	247.7884
ΔX_t (repo rate)	0.7309	169.2221	0.0043	0.9966	-335.6164	337.0782
$R^{2=}$ 2.14E-07						

The regression equation describing the relationship between gold returns and change in repo rate is as follows:

$$\Delta Y_t = 135.0445 + 0.7309 \Delta X_t$$

Panel 3 shows regression results for gold (ΔY_t) and CPI returns (ΔX_t). There is a positive relationship between return on gold and change in CPI. The positive relationship suggests a possibility to hedge inflation using gold. The p-value of 0.2735 is greater than the significance level suggesting statistical insignificance. However, the t-stat of 1.1019 is close to the cut-off value of 2. An R^2 of 0.01382 is small suggesting that less that 1.4% of the variation in of gold returns can be explained by the change in CPI. These results are comparable to the findings by Jaffe (1989). More specifically, Jaffe (1989) found the t-stat and R^2 between gold returns and movement in price level (CPI) to be 1.941 and 0.0196, respectively. Lags of changes in CPI were found to be statistically significant and were not incorporated in the final model.

Panel 3: Gold and CPI returns

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	131.8535	56.2787	2.3429	0.0214	19.9936	243.7135
ΔX_t (CPI)	134.5406	122.0937	1.1019	0.2735	-108.1338	377.2151
R^2=0.0138						

Panel 4 shows regression results for gold returns (ΔY_t) and change in real GDP (ΔX_t). There is a negative relationship between return on gold and change in real GDP. The negative relationship suggests gold price decreased as South African real GDP increased and vice versa. This is result is in contrast to the findings of Sharma and Aggarwal (2012). Sharma and Aggarwal (2012) found that a positive relationship existed between gold price and GDPs of countries such as Italy, Japan, U.S. and others when regressed separately. In the South Africa case, we find that gold price and real GDP did not move in the same direction. The results are significant at the 5% level. An R^2 of 0.0895 suggests that about 9% of the variation in gold returns can be explained by the change in real GDP.

Panel 4: Gold and real GDP returns

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	159.9937	54.6761	2.9262	0.0044	51.3191	268.6683
ΔX_t (real GDP)	-0.0222	0.0076	-2.9236	0.0044	-0.0372	-0.0071
R^2= 0.0895						

The regression equation describing the relationship between gold returns and change in real GDP is as follows:

$$\Delta Y_t = 159.9937 - 0.0222\Delta X_t$$

6. 7 Combined Regression

Table 12 shows regression results for gold returns regressed against change in rand/dollar exchange rate, repo rate, CPI and GDP, respectively. The model used to obtain results shown in Table 12 is as follows:

$$\Delta Y_t = \alpha + \beta_1 \Delta X1_t + \beta_2 \Delta X2_t + \beta_3 \Delta X3_t + \beta_4 \Delta X4_t + \delta t + \varepsilon$$

Where $\Delta X1_t$ is change in rand/dollar exchange rate

$\Delta X2_t$ is change in repo rate

$\Delta X3_t$ is change in CPI

$\Delta X4_t$ is change in real GDP

The model included a deterministic trend term which proved to be statistically insignificant. Table 12 shows that only changes in rand/dollar exchange rate and real GDP are statistically significant at 10% level. The result implies that only changes in rand/dollar exchange rate and real GDP can be used to explain return on gold. The final regression result showing the effect of rand/dollar exchange and real GDP are shown in Table 13. There is positive relationship between gold returns and rand/dollar exchange rate as observed in Table 11, panel 1. There is a negative relationship between gold return and change in real GDP as seen in Table 11, panel 4. The rand/dollar exchange rate

coefficient has a bigger magnitude indicating that rand/dollar exchange rate has a more superior influence on gold returns than real GDP. R^2 of 0.2003 shows that change in rand/dollar exchange rate combined with change in real GDP accounts for 20.03% variation in gold returns. The final regression equation linking gold returns to rand dollar exchange rate and real GDP is as follows:

$$\Delta Y_t = 130.2128 + 484.7516\Delta X1_t - 0.0132\Delta X4_t$$

Table 12: Regression of gold and macroeconomic variables

	Coefficients	Standard Error	t Stat	P-value	Lower 90.0%	Upper 90.0%
Intercept	27.9638	100.3946	0.2785	0.7813	-138.9275	194.8552
$\Delta X1_t$ (rand/dollar)	488.1814	136.9726	3.5641	0.0006	260.4843	715.8784
$\Delta X2_t$ (repo rate)	-90.109	154.2826	-0.5841	0.5607	-346.5812	166.3633
$\Delta X3_t$ (CPI)	154.2658	107.4068	1.4363	0.1545	-24.2823	332.8138
$\Delta X4_t$ (GDP)	-0.0137	0.0072	-1.904	0.0602	-0.0256	-0.0017
Time	2.0077	1.8081	1.1104	0.2699	-0.998	5.0135
$R^2 = 0.2295$						

Table 13: Regression of gold, rand/dollar exchange rate and real GDP

	Coefficients	Standard Error	t Stat	P-value	Lower 90.0%	Upper 90.0%
Intercept	130.2128	49.2585	2.6435	0.0097	48.3564	212.0691
$\Delta X1_t$ (rand/dollar)	484.7516	133.9318	3.6194	0.0005	262.1876	707.3156
$\Delta X4_t$ (GDP)	-0.0132	0.0071	-1.8574	0.0665	-0.025	-0.0014
$R^2 = 0.2003$						

Chapter Summary

This chapter explored autoregressive properties of the gold, rand/dollar exchange rate, repo rate, CPI and real GDP. Variables tend to be nonstationary except for the real GPD series. Gold tends to be highly correlated with real GDP and rand/dollar exchange rate. Individual regression of macroeconomic variables with gold was computed. The final regression model incorporates rand/dollar exchange and real GDP as explanatory variables for gold. The next chapter presents discussion and conclusion for the study.

CHAPTER 7: DISCUSSION AND CONCLUSION

7.1 Introduction

The previous chapter presented the regression model which relates gold price to South African macroeconomic variables. This chapter discusses the findings of this study and relates the findings to the extant literature. Section 7.2 presents discussion. Section 7.3 presents conclusion to the study.

7.2 Discussion

We found that gold bullion produced superior abnormal returns surpassing the JSE all share index as well as the unit trust index. The NewGold ETF and the Krugerrand abnormal returns resemble gold bullion abnormal returns as expected. Only two out of the seven sampled gold mining companies yielded abnormal returns greater than gold bullion. This finding does not support the finding by Johnson and Soenen (1995) who concluded that gold is dominated by stocks and bonds. Our finding is also in contrast to the finding by Ratner and Klein (2008) who found gold to be a poor investment in comparison to the U.S. stock market.

Gold bullion VAMI exceeded VAMI for all assets considered including all gold mining companies. Ratner and Klein (2008) found VAMI for U.S. stocks to be larger than VAMI for gold and concluded that gold does not offer substantial returns in the long run. However, Ratner and Klein (2008) noted that short-term profitability is possible from gold. Our findings suggest that direct investment in gold offered superior growth over the sample period compared to investment in gold mining companies and the JSE all share index. Our finding is not in agreement with the finding by Conover et al. (2009) who concluded that indirect investment in precious metals via equities of precious metals firms dominates direct investment in precious metal commodities. Our finding does not support the finding by Barr and Affleck-Graves (1985) who concluded that gold shares should be chosen above gold bullion.

The correlation between gold bullion returns and the JSE all share index is negative and not statistically significant. This finding is in accord with the finding by Jaffe (1989) who established that there is no meaningful relationship between gold and common stocks. The low or negative correlation between gold and stocks suggest that gold has the potential to enhance diversification in

a portfolio of stocks. We found gold bullion to be strongly positively correlated with other gold investment vehicles (NewGold ETF and Krugerrands). We found the correlation between gold and five of sampled gold mining companies to be positive and statistically significant except for two companies (Simmer and Jack Mines, and Village and Main Reef). It is expected for gold mining companies to be correlated with the gold price as profits (and hence share price) of gold mining companies are directly influenced by the market price of gold.

We found that gold bullion returns are more volatile than the JSE all share index. The gold mining index as well as the unit trust index volatility exceeds that of gold. Gold bullion volatility is lower than the volatility of all gold mining companies. It is concluded that gold mining companies exhibit added risk which cannot be attributed to the gold bullion.

Addition of gold to a diversified portfolio of stocks improves the return/risk ratio. This result is in agreement with the finding by Dempster and Artigas (2010) who concluded that gold enhances investor's risk adjusted returns in a low and medium inflation environment. Conover et al. (2009) concluded that smaller allocations to gold improve portfolio returns and risk even though the benefits are less prominent.

Beta coefficient for gold was calculated and was found to be mostly close to zero if not negative for various years. This result is in accord with the finding by Herbst (1983) who established that gold exhibited negative beta over a span of years. Gold has the potential to reduce systematic risk when added to a portfolio.

Gold bullion is positively correlated with rand/dollar exchange and real GDP. There is a negative correlation between gold bullion and repo rate. The correlation between gold bullion and CPI is positive but not statistically significant. Shafiee and Topal (2010) did not find any significant relationship between gold price and inflation.

Autoregressive techniques where used to investigate univariate properties of gold price, rand/dollar exchange rate, repo rate, CPI and real GDP. Unit root tests revealed that gold price, rand/dollar exchange rate, repo rate and CPI are nonstantionary while real GDP is stationary. Cointegration test revealed that rand/dollar exchange rate, repo rate and CPI are not conitegrated with gold bullion and hence cannot be used directly in the regression model without being differenced.

A multiple regression model was estimated using rand/dollar exchange rate, repo rate, CPI and real GDP as explanatory variables for gold price. It was found that only changes in rand/dollar exchange rate and changes in real GDP have explanatory power on the gold price. All else equal, an increase in rand/dollar exchange rate tends to lead to a rise in the gold price, while gold price tends to fall with an increase in real GDP. The multiple regression model also shows that rand/dollar exchange rate influences the gold price more than real GDP. Our finding is different from the finding by Baker and van Tassel (1984) who found that changes in gold price are explained by changes in commodity prices, U.S. prices, value of the dollar, and future inflation.

7.3 Conclusion

This study explores potential benefits of investing in various gold investment vehicles in terms of risk and return. In addition, the study investigates the relationship between gold and South African macroeconomic variables. There are various gold investment vehicles such as NewGold ETF, Krugerrands and stocks of gold mining companies which are available to South African investors. Abnormal returns and value added monthly index were determined to assess the return on various gold instruments over a period of time. Risk adjusted returns for gold were determined together with the beta coefficient to assess the impact of gold on portfolio risk. Regression analysis techniques were used to investigate the relationship between gold and South African macroeconomic variables.

It was found that gold assets (gold bullion, NewGold ETF and Krugerrands) produced superior abnormal returns compared to the JSE all share index and the unit trust index in all periods considered. Gold bullion tends to yield higher returns compared to some gold mining stocks but not all the time. Gold bullion returns tend to be uncorrelated with the JSE all share index. The JSE all share index exhibits the least volatility of all assets considered. Adding gold to a portfolio of stocks tends to increase return/risk ratio. Gold is a useful asset to include in a portfolio of stocks from a risk management perspective as it reduces systematic risk. Gold tends to be highly correlated with real GDP followed by the rand/dollar exchange rate. A regression model was estimated which relates the gold price to real GDP and rand/dollar exchange rate.

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