GOLD AND RISK: A COMPARISON OF THE RISK-ADJUSTED PERFORMANCE OF DIFFERENT GOLD INVESTMENTS

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ABSTRACT

Gold and risk: A comparison of the risk-adjusted performance of different gold investments

Michael Armstrong

Prior studies have shown that investing in gold can, to varying degrees, provide a hedge against inflation and some of the negative effects of economic recessions. Investors wishing to invest in gold have a number of choices available to them, which for even the most sophisticated investors can be a daunting task. The purpose of this thesis was to assess whether there are differences in the performance of three investments in gold in order to help individual investors choose the best way to gain exposure to appreciation in the price of gold.

We used a single-factor ANOVA model to compare the Sharpe ratio, excess return on value at risk, the conditional Sharpe ratio, and the modified Sharpe ratio in order to assess the difference in mean risk-adjusted performance across three samples of gold exchange-traded funds, mutual funds and stocks. We cannot be certain that investors have a preference for the higher moments, such as skewness and kurtosis, of return distributions; but to the extent that they do, the modified Sharpe ratio, as a measure of risk-adjusted performance, captures these moments, and for the selection of gold investments studied, reveals differences in performance that would be missed by the other measures. In particular, we found that mutual funds outperformed both exchange-traded funds and stocks on a risk-adjusted basis. Investors wishing to gain exposure to appreciation in the price of gold should therefore favour gold mutual funds over both gold ETFs and gold stocks.

DEDICATION

To Liam

Every day you inspire me with your courage

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Chapter 1

Introduction

1.1 Statement of the problem and significance

Gold is attractive as an investment primarily because prior studies have shown that investing in gold can, to varying degrees, provide a hedge against inflation and some of the negative effects of economic recessions. For example, since the onset of the 2008-2009 Global Financial Crisis and the subsequent recessions in the United States and Canada, the price of gold has appreciated significantly from approximately $ 808.50 (USD) per ounce on September 5th, 2008 to a peak of $ 1,895.00 (USD) per ounce on September 5th, 2011. This represents an extraordinary rate of return of 134% over the holding period, which translates to an annual return of 32%. Baur and McDermott (2010) demonstrate the effectiveness of gold as a hedge and safe haven against the risk of decreases in stock prices and argue that gold can stabilize the financial system by reducing losses when negative market shocks occur. The benefits to the average investor of holding gold are clear.

There are a number of methods by which an investor can obtain exposure to gold prices. One method is to purchase gold bullion itself, usually in the form of gold bars or gold coins. Alternatively, an investor can purchase gold certificates to avoid the storage costs and other risks associated with holding physical bullion. Another way to invest in gold is to purchase shares in a gold mining company.

Investors can also choose to buy gold derivatives (futures and options). There are also many mutual funds that specialize in providing exposure to gold. Finally, exchange-traded products such as exchange-traded funds are increasingly popular and highly liquid vehicles that give investors an exposure to gold prices at a relatively low cost. With a multitude of options available to them, modern investors wishing to buy gold face a daunting task: choosing the most attractive investment or combination of investments in gold. Consequently, the main purpose of this study is to determine the best way for an average investor to invest in gold. The best investment will be the one that provides the investor with the best risk-adjusted performance.

Risk-adjusted performance measures help investors evaluate assets with different risk profiles. Two investments with the same expected return, for example, are not necessarily equivalent after one considers the riskiness of each investment. It is therefore necessary to calculate risk-adjusted performance as a way of standardizing performance in order to facilitate the comparison of different investment alternatives. This is achieved by scaling an investment's excess return by an appropriate risk measure. These risk measures include the standard deviation, value at risk (VaR), conditional value at risk (CVaR), and modified value at risk (MVaR). Each of these measures has advantages and disadvantages, but there is an ongoing debate in the finance literature about the appropriateness of using risk measures that do not account for return distributions that exhibit characteristics that depart from those of the normal distribution. The standard deviation, for instance, is a measure of central tendency that by definition is more appropriate for return distributions that are approximately normal. The Sharpe ratio has been widely criticized because it uses the standard deviation to scale returns when a number of prior studies have shown that returns on many financial assets are seldom normally distributed. The authors of a number of prior studies on the matter have argued that risk measures that consider the entire shape of the return distribution (such as MVaR) are superior to the other measures and that using performance

ratios that do not consider the skewness and kurtosis of the distribution lead to erroneous evaluations of risk-adjusted performance. Others have argued in favour of the Sharpe ratio and have shown that conclusions about risk-adjusted performance are the same regardless of the risk measure chosen.

We used a single-factor ANOVA model to compare the Sharpe ratio, excess return on value at risk, the conditional Sharpe ratio, and the modified Sharpe ratio in order to assess the difference in mean risk-adjusted performance across three samples of gold exchange-traded funds, mutual funds and stocks. We cannot be certain that investors have a preference for the higher moments, such as skewness and kurtosis, of return distributions; but to the extent that they do, the modified Sharpe ratio, as a measure of risk-adjusted performance, captures these moments, and for the selection of gold investments studied, reveals differences in performance that would be missed by the other measures. In particular, we found that mutual funds outperformed both exchange-traded funds and stocks on a risk-adjusted basis. Investors wishing to gain exposure to appreciation in the price of gold should therefore favour gold mutual funds over both gold ETFs and gold stocks.

Chapter 2

Literature Review

2.1 On the relationship between inflation and stock returns

The negative relationship between inflation and asset returns is well established in the literature. This is in direct contradiction to the well known Fisher hypothesis (1930), which postulates that the nominal interest rate or return (such as the return on stocks) should reflect all information about future inflation. As such, according to the Fisher hypothesis, in practice we would expect to see a positive relationship between nominal stock returns and inflation. A number of papers have examined this issue in the past, with many of the earlier papers finding initial evidence of a negative relation between nominal stock returns and inflation (Lintner, 1975; Bodie, 1976; Jaffe and Mandelker, 1976; Nelson, 1976; Fama and Schwert, 1977; Gultekin, 1983).

A second branch of research has emerged in response to the fact that most of the earlier papers on the relation between stock returns and inflation tended to focus exclusively on short time horizons (time horizons of one year or less). Consequently, many papers have emerged in recent years which examine the nature of the long-run relationship between stock returns and inflation. (Boudoukh and Richardson, 1993; Solnik and Solnik, 1997; Engsted and Tanggaard, 2002; Schot-

man and Schweitzer, 2000; Kim and In, 2005). In general, these papers find support for the Fisher hypothesis over long horizons. In other words, they find evidence of a positive relationship between stock returns and inflation over the long term.

While the empirical evidence on the effectiveness of stocks to hedge against inflation is currently mixed, an investment in gold might do better at providing a reliable hedge against inflation. I examine the papers that have dealt with this issue in the following section.

2.2 On the advantages of investing in gold

Three main themes emerge from the current literature when we examine the reasons why individual investors would want to make an investment in gold. The main reasons that make gold an attractive investment are that it acts as a hedge against inflation, it provides a safe haven when market shocks occur, and it provides diversification benefits when combined in individual investment portfolios. Each of these advantages and the prior literature that addresses them will be discussed in successive paragraphs below.

2.2.1 Gold as a hedge against inflation

A plethora of papers discuss the benefits of holding gold to counteract the negative effects of inflation. These papers have led to the widespread acceptance of gold as an effective hedge against inflation in a number of different countries around the world (Kolluri, 1981; Moore, 1990; Laurent, 1994; Harmston, 1998; Ghosh et al., 2004); Ranson, 2005; Levin and Wright, 2006; Worthington and Pahlavani, 2007). While the view that investing in gold provides an effective means to protect one's assets from the threat of inflation currently enjoys widespread acceptance, a number of papers also dispute this view. In their early study of six major industrial countries, Chua and Woodward (1982) confirm that gold is an effective way to

beat inflation, but only in the United States. In contrast, Herbst (1983) finds that gold is inferior to U.S. stocks as an inflation hedge over the long term. Mahdavi and Zhou (1997) test the performance of commodity and gold prices as leading indicators of inflation and find that the strength of the relationship between gold and inflation is time-varying. As such, they fail to conclude that gold is an effective hedge against inflation over the long term.

Recent studies also cast some doubt regarding the appropriateness of the methodology used in the earlier research on the relation between the return on gold and the rate of inflation. For example, Kyrtsou and Labys (2006) use a noisy chaotic multivariate model to describe the relationship between commodity prices and inflation and find a bi-directional non-linear relationship between U.S. inflation and commodity prices. In addition, Wang et al. (2011) argue that the relationship between inflation and the return on gold is not linear due to fluctuations in the business cycle and that empirical results from models that fail to account for the asymmetry in the relationship are biased. They use a non-linear model to examine the relationship in both the short and long term and find that time selection and market selection are essential factors in determining the effectiveness of gold as an inflation hedge.

2.2.2 Gold as a safe haven

There is an extensive literature on the concept of flight-to-quality which examines how investors flee from stocks into bonds when market volatility increases. A couple of recent papers related to the flight-to-quality literature discuss the benefits of holding gold to protect against downturns in the stock market, and in particular to protect against extreme market shocks. Baur and Lucey (2010), for example, examine whether gold is a hedge or a safe haven. They define a hedge to be a security that is uncorrelated with stocks or bonds on average, while they view a safe haven to be an asset that is uncorrelated with stocks or bonds during a market crash. Their results show that on average gold provides an effective hedge

against stocks while providing a safe haven in times of market turmoil in the United States, the United Kingdom, and Germany. In a subsequent paper, Baur and McDermott (2010) extend the analysis to several other international markets and find additional evidence that gold acts as a safe haven during financial crises in a number of markets around the world, including most of the major developed European markets (Germany, France, and Italy), Switzerland, the United States, and the United Kingdom.

2.2.3 Gold as a means of diversification

A number of studies examine the role of gold investments from a portfolio management perspective. Sherman (1982) used simulation techniques to examine the effect of holding varying proportions of gold in balanced portfolios and found that in almost all scenarios, an investment in gold helped to reduce portfolio volatility and improve returns. Jaffe (1989) also wrote an earlier paper that outlines the benefits of holding gold in institutional portfolios. In particular, the paper discusses how gold stocks can improve a portfolios return and how the increase in the portfolios mean return more than compensates for the additional portfolio risk. Chua et al. (1990) also find that investments in gold bullion were effective in reducing portfolio risk during the 1970's and 1980's. Interestingly, they also find that an investment in gold stocks does not provide the same diversification benefit as does an investment in bullion over the same period. Hillier et al. (2006) examine the role of three precious metals (gold, platinum, and silver) in the financial markets and find that gold has the lowest correlation with both the S&P 500 and EAFE equity index returns and thus provides diversification benefits when included in investment portfolios. They also confirm the hedging effectiveness of gold during times of abnormal market volatility, which reinforces the safe haven property of the precious metal discussed in the previous section. Conover et al. (2009) extend the analysis further by comparing and contrasting the advantages of direct versus indirect investment in each of the metals. The authors find further

evidence of the superior diversification benefits of holding gold relative to silver and platinum. Interestingly, the authors also found that indirect investments in gold (via an investment in equities of gold-producing firms) provided better diversification than direct investments such as gold bullion. This is in contrast to the results of Chua et al. (1990) discussed above.

While the view that gold provides significant diversification benefits and inflation hedging capability when it is included in equity portfolios is generally widely accepted, it is not without its detractors. Johnson and Soenen (1997), for example, dispute the efficiency of gold as a portfolio component. They examine this issue across seven major industrialized countries from 1978 to 1995 and find that the benefits of holding gold in a portfolio are negligible. They find that gold provides some diversification benefits but that when performance was measured in terms of a risk-return trade-off, gold does not provide any increase in risk-adjusted return over the entire sample period.

2.3 On performance measurement

The Sharpe ratio (Sharpe, 1966) is arguably the most well-known and widely used risk-adjusted performance measure. It measures the relationship between an asset's excess return and risk (standard deviation) and provides a convenient, standardized measure by which assets with differing risk characteristics can be compared and evaluated. It is used extensively by practitioners in the financial marketplace (for example, in mutual fund performance evaluation) and it has also been the subject of extensive research by academics. Since its appearance in 1966, the Sharpe ratio has been the subject of scrutiny by researchers who have questioned its appropriateness as a measure of risk-adjusted performance, and this debate continues to this day. The Sharpe ratio has been criticized because it uses the standard deviation of an asset's returns to measure risk, which by definition is only appropriate if the asset's returns are Gaussian distributed. This section of

my thesis will review the research on performance measurement that has emerged in response to the Sharpe ratio and will provide a summary of the papers that have proposed other risk-adjusted performance measures.

A vast literature exists which documents the non-normality of security returns. Early research examining this issue began to appear prior to the publication of Sharpe's seminal paper in 1966. Mandelbrot (1963), for example, provided one of the first papers to question the assumption of normality in security price distributions. Fama (1965) extended Mandelbrot's work on cotton prices and found that the Gaussian hypothesis does not hold for stock prices. Both of these early papers attempted to explain the leptokurtosis observed in empirical distributions of security prices at that time, and confirmed that security prices are not normally distributed. These early papers motivated additional work that tried to explain the distribution of stock returns. A number of subsequent empirical studies (Press, 1967; Praetz, 1972; Kon, 1984; Gray and French, 1990; and Peiro, 1994) all confirm that the distribution of stock prices departs significantly from the normal distribution. In general, all of these papers point to the fact that the observed distributions have fatter tails and a higher concentration of values in the center of the distribution (leptokurtosis) relative to that of the normal distribution.

Having established that security prices are not normally distributed, researchers began examining alternatives to the Sharpe ratio. This led to the development of a plethora of financial ratios which are intended to quantify risk and performance in different ways. These measures include the Sortino ratio (Sortino and Van der Meer, 1991), the Calmar ratio (Young, 1991), the Burke ratio (Burke, 1994), the Sterling ratio (Kestner, 1996), the upside potential ratio (Sortino, Van der Meer, and Plantinga, 1999), the Omega ratio (Keating and Shadwick, 2002), and the Kappa 3 ratio (Kaplan and Knowles, 2004). The development of these new and innovative attempts at quantifying risk has in turn fueled an ongoing debate over the merits of each measure. For the sake of brevity, the following sections will review the prior research that incorporates only the performance measures that

I will examine in this paper namely, the Sharpe ratio, excess return on value at risk, the conditional Sharpe ratio, and the modified Sharpe ratio.

2.3.1 The Sharpe ratio

As I mention in the introduction to this section, a number of studies question the usefulness of the Sharpe ratio as a performance measure when returns are not normally distributed. By definition, the Sharpe ratio uses the standard deviation of returns as its risk measure. As such, risk is defined relative to a measure of central tendency, in this case, the mean return. While this is appropriate for return distributions that are approximately normal, it may not be appropriate for asymmetrical distributions where there is a greater probability of extreme gains and/or losses. These distributions would exhibit fatter tails, and the use of the standard deviation in such a situation could result in risk being underestimated and risk-adjusted performance being overestimated. In addition, the standard deviation incorporates both positive and negative deviations of return around the mean, while it has been shown in the past that investors' risk aversion is not constant across both gains and losses (Kahneman and Tversky, 1979). Many would argue, therefore, that assigning equal weights to both positive and negative deviations around the expected value is inconsistent with investors' preferences, and contrary to the general perception of risk. These criticisms have led to the development of new ratios such as excess return on value at risk, the conditional Sharpe ratio, and the modified Sharpe ratio. These modifications to the Sharpe ratio use alternative risk measures (value at risk, conditional value at risk, and modified value at risk, respectively) that focus on downside risk.

In general, the literature that examines the effectiveness of the Sharpe ratio as a performance measure in situations where returns are not normally distributed is divided. A large number of prior studies have focused on the performance measurement of hedge funds due to the nature of their return distributions. Hedge funds often have very large gains and/or losses due to their use of derivatives,

short selling, and leverage, causing the distribution of their returns to depart significantly from that of the normal distribution. Many of the earlier papers that examined the issue have concluded that hedge funds cannot be evaluated using the Sharpe ratio (Brooks and Kat, 2002; Mahdavi, 2004; Sharma, 2004; and Sharpe, 2007).

In contrast, Eling and Schuhmacher (2007) examine 2,763 hedge funds and find that even though hedge fund returns are not normally distributed, the first two moments (mean and variance) are adequate to describe the return distribution. They used a rank correlation analysis and concluded that the Sharpe ratio is an adequate performance measure since there was virtually no difference between the rank ordering of hedge funds using the Sharpe ratio and the ranking using 12 of the other performance measures that have been proposed in the earlier literature. The papers on hedge funds subsequently led to the development of another branch of research which extended the analysis to other assets. A large number of papers have examined the nature of mutual fund return distributions, and the appropriateness of the Sharpe ratio in describing mutual fund returns. One such paper in support of the Sharpe ratio as a performance measure is by Eling (2008), in which he extended the hedge fund analysis in Eling and Schumacher (2007) to 38,954 mutual funds that invested in seven asset classes (stocks, bonds, real estate, hedge funds, funds of hedge funds, commodity trading advisers, and commodity pool operators). He concluded that the Sharpe ratio is adequate as a performance ratio since it resulted in almost identical rank ordering as that produced by the newer performance measures.

Farinelli et al. (2008) also compared the Sharpe ratio with other asymmetrical parameter-dependent performance ratios. They set up a wealth-maximization and portfolio optimization system to aid in the selection of the best performance ratio and subsequently tested it on 5 total return stock indices (the S&P 500, the Dow Jones Industrial Average, the FTSE, and the NIKKEI). Their main finding was that the asymmetrical ratios were all superior as they consistently outperformed

the Sharpe ratio.

2.3.2 Excess return on value at risk

Dowd (2000) introduced the first of the three variations of the Sharpe ratio that will be examined in this study. Excess return on value at risk modifies the Sharpe ratio by substituting value at risk (VaR) for the standard deviation in the calculation of risk-adjusted performance. The author developed the theoretical framework and showed how his modified ratio is superior to the traditional Sharpe ratio since it leads to valid investment decisions regardless of the correlations of the investments under consideration. This is an improvement on the traditional Sharpe framework, which can lead to incorrect rankings among investment alternatives when the assets involved are correlated with the rest of the portfolio (Sharpe, 1994).

2.3.3 Condtitional Sharpe ratio

The conditional Sharpe ratio is the second variation of the Sharpe ratio that will be examined in this paper. It is similar to excess return on value at risk but instead uses conditional value at risk (CVaR) as the risk measure. Agarwal and Naik (2004) examined the risk exposures of hedge funds and showed that many equity-based hedge fund strategies had significant left-tail risks. They then compared risk estimates using the traditional mean-variance framework with those using a CVaR approach to account for the greater probability of large losses and found that the mean-variance framework significantly underestimated tail risk. As such, the CVaR framework was superior at explaining the risk inherent in a non-normal return distribution.

2.3.4 Modified Sharpe ratio

The third and final variation of the Sharpe ratio that will be examined in this study is the modified Sharpe ratio. It is similar to the previous two ratios but

uses modified value at risk (MVaR) as the risk measure. Gregoriou and Gueyie (2003) examined 30 funds of hedge funds and compared risk estimates using both the traditional Sharpe ratio and the modified Sharpe ratio. The main result of their analysis was that MVaR did better at capturing the skewness and kurtosis in the return distributions, whereas the traditional Sharpe ratio and VaR measures did not, since they only consider the first two moments of the return distributions. As such, they argue that the modified Sharpe ratio is the superior risk-adjusted performance measure for non-normal return distributions.

Chapter 3

Description of securities

The next section of this thesis will provide an in-depth description of the characteristics of the investment vehicles that I will analyze in this study. For each security examined, I will provide a general description of the investment, describe how the asset is structured and traded, and most importantly, discuss its advantages and disadvantages.

3.1 Exchange-traded funds

3.1.1 General information

An exchange-traded fund (ETF), like a mutual fund, is an investment company that offers investors the benefit of purchasing shares in a diversified pool of securities. Unlike mutual funds, however, exchange-traded funds can be bought and sold throughout the trading day on a stock exchange. Another major difference between mutual funds and ETFs lies in their general investment philosophy. Whereas mutual funds are *actively* managed investments designed to provide investors with returns that are superior to the mutual fund's designated performance benchmark, ETFs are *passively* managed portfolios of securities that are designed to replicate the performance of various benchmarks. There are a multitude of ETFs that track various stock and bond indices, not only from North America, but also around

the world. Broad-based ETFs, for example, can track large capitalization indices such as the Standard & Poor's 500 or the Dow Jones Industrial Average, as well as the smaller and medium-sized capitalizations found on the Russell 2000 and the Russell Midcap indices. In addition, there are specialized ETFs that have been designed to mirror the performance of distinct sectors or industries such as technology, real estate, health care, financial services, and precious metals, for example. Other global ETFs focus on replicating the performance of stock indices or sectors in different countries or regions. For example, investors can easily gain exposure to price appreciation in the shares of Japanese companies listed on the Nikkei 225 or the shares of Australian companies trading on the All Ordinaries Index. In addition, investors can choose from a large variety of ETFs that track North American and international bond indices. In short, ETFs offer investors endless possibilities for portfolio customization and diversification. The market for exchange-traded funds has exploded since they were first issued in 1993. Since 2000, ETF assets have grown from $ 65.6 billion to over $ 1.048 trillion at the end of 2011.

3.1.2 ETF structure and market regulation

The way exchange-traded funds are structured and issued to the public differs markedly from the way mutual fund units are issued. ETF sponsors usually seek the assistance of large institutional investors due to the costs of purchasing the large number of securities that make up the underlying index the ETF attempts to track. The fund sponsor will issue a "creation unit" to the institutional investor in exchange for a basket of securities that represents the underlying index. The creation unit that is issued usually represents 50,000 to 100,000 ETF shares, which individually represent ownership of every company in the underlying index. The institutional investor then makes a market for the ETF shares by selling them on the open market and listing them on a stock exchange. Individual investors are then able to buy and sell the shares on the stock exchange throughout the trading

day, making ETFs more like the equity securities of individual companies rather than like mutual funds, which can only be bought or sold at the close of each trading day. The ETF sponsor and institutional investor make changes to the basket of securities whenever the composition of the underlying index changes. As such, investors can rest assured that the ETF accurately reflects the composition of the index as stocks are added to or removed from the index.

The majority of ETFs must be registered with the Securities and Exchange Commission and are governed by the provisions of the Investment Company Act of 1940. A very small percentage of ETFs (approximately 3 percent) are not registered with the SEC and as such, are not governed by the regulations set forth in the Investment Company Act. Most of these ETFs are commodity-based, and make investments in commodity futures. The Commodity Futures Trading Commission (CFTC) regulates these ETFs, while other ETFs that invest directly in physical commodities are not governed by either the SEC or the CFTC, since they invest in commodities, not securities. Investors should be aware of this before making investments in certain commodity-based ETFs.

3.1.3 Advantages

1. Lower costs: ETFs, by design, are passively managed investments. As such, they have lower fees and expenses relative to mutual funds. Unlike mutual funds, ETFs do not have to buy and sell securities in order to account for client purchases and redemptions. In addition, ETFs will generally have much lower administrative expenses. ETFs do not incur 12b-1 fees to cover marketing and distribution expenses like mutual funds, for example. In most cases, the total expense ratio for an ETF is between 0.15% and 0.70% and will vary depending on the ETF's focus and objective. ETFs that track bond indices, for example, will have lower expenses relative to those that track equity or sector-specific indices.

2. Trading flexibility: A major advantage of investing in ETFs is that they

are listed on stock exchanges and trade like common shares. ETFs can be bought and sold at different prices any time during the trading day. Investors in mutual funds, on the other hand, all get the same price regardless of the time their order was placed, since all purchases and redemptions occur at the close of business on the day the order was submitted. In addition, mutual funds are priced at their NAV. ETFs, on the other hand, can trade at a premium or discount to their NAVs, depending on the supply and demand for the shares on the exchange. ETFs can also be bought on margin, sold short, and it is also possible to write options on many ETFs. There is a greater flexibility in the types of orders that can be used with ETFs as well, because they trade like stocks (investors can use stop and limit orders, for example) which are important features for speculative investors who want to take advantage of intraday price fluctuations in the underlying index. For example, a trader who would like to speculate on the intraday movement in the NASDAQ Composite Index can easily do so by buying and selling the PowerShares QQQ Trust ETF which tracks the Nasdaq Composite. This cannot be done with a mutual fund.

3. Tax efficiency: ETFs also offer the benefit of greater tax efficiency relative to mutual funds. Mutual funds must sell securities to cover client redemptions, which can trigger taxable capital gains and must distribute any realized capital gains to all shareholders. These capital gains are taxable at the individual level even when a shareholder chooses to reinvest them in the fund. In contrast, ETFs are more tax efficient since a shareholder will only realize a capital gain at the time they actually sell their shares on the exchange. As such, investors in ETFs have greater control over the timing of the recognition of capital gains (or losses) on their investment.

4. Customized diversification: ETFs offer almost endless possibilities to achieve portfolio diversification. Investors can often have a fully diversified portfolio of equity securities simply by purchasing one ETF. For example, an investor

can choose to purchase the Standard & Poor's Depositary Receipt (SPDR) ETF that tracks the Standard & Poor's 500 Index and obtain an ownership stake in each of the 500 companies that make up the index. In addition, ETFs offer investors the opportunity to customize the general asset allocation of their portfolio, as well as the composition of the portfolio within asset classes. For example, investors who want a balanced portfolio can choose to split their investment between two ETFs: an equity index ETF and a fixed income index ETF. In addition, investors can customize the composition of their portfolio even further by varying the exposures within each asset class. This can be achieved by choosing more specialized ETFs that invest in specific industries or sectors. For example, an investor can select ETFs that represent companies in the real estate or financial sectors for the equity portion of the portfolio, and an ETF that invests in corporate bonds for the fixed income portion.

5. Increased market exposure: ETFs offer investors exposure to a very large variety of markets. These include broad-based equity indices of small, medium and large capitalization companies; sector or industry-specific indices such as real estate, financial services, energy, health care, technology, industrial goods, transportation, and consumer goods, for example; and bond indices of Treasury and corporate bond issues. In addition, a plethora of global or international ETFs track different international indices and/or focus on replicating stock market returns in specific regions. There are also a large number of commodity ETFs designed to track the performance of different commodities, such as the spot prices of oil, natural gas, silver, gold, and copper. There are ETFs that specialize in capturing the returns from speculation in the foreign exchange market. In short, the growth of the market for ETFs has provided investors with access to an extremely large number of markets that were previously the exclusive domain of large institutional investors.

6. Transparency: ETFs are extremely transparent investments since they are priced at regular intervals throughout the day. It is very easy for investors to obtain an ETF's current NAV at any time during the trading day. A number of third party providers as well as some stock exchanges calculate and publish the intraday indicative value (IIV), which is a real-time estimate of an ETF's NAV. These figures are usually updated every 15 seconds, making ETFs much more transparent than mutual funds.

7. Lower cash drag: Cash drag is defined as a decrease in investment performance arising from having to maintain a certain percentage of a portfolio in cash. Mutual funds suffer from cash drag because they must keep a portion of their investable assets in cash in order to fund ongoing client redemptions. Rather than liquidate the fund's stock holdings, managers use the cash on hand to fund redemptions. This has an adverse effect on portfolio performance. In contrast, ETFs are traded on the secondary market and have no need to keep cash on hand to cover redemptions. Kostovetsky (2003) states that the effect of cash drag on the performance of index funds is estimated at 2%. Lower cash drag is therefore a significant advantage of ETFs relative to mutual funds.

3.1.4 Disadvantages

1. Tracking error: One of the major disadvantages of investing in ETFs is that there is often a significant difference between an ETF's return and the return on the index or benchmark the ETF is designed to track. Studies by Elton et al. (2002) and DeFusco et al. (2011) have examined this tracking error and have found that the pricing deviations between the most liquid ETFs and their underlying indices are predictable and statistically different from zero. For example, DeFusco et al. (2011) found an average pricing deviation of $ 0.29 between the Spider (SPDR, or Standard & Poor's Depositary Receipt) and the Standard and Poor's 500 Index it tracks. Consequently, an ETF's

tracking error can be an important source of added costs to investors.

2. Trading fees: ETFs have the advantage of being highly liquid instruments that trade like stocks. However, it is important for investors who are more active traders and/or speculators to consider the transaction costs associated with buying and selling ETFs on a regular basis, as these costs can become significant.

3. Higher volatility: Broad-based ETFs that track indices composed of large capitalization stocks provide investors with quick and easy diversification across different industries. However, an important disadvantage of certain sector-specific ETFs is that they do not offer the same benefit of greater diversification. These ETFs tend to be more volatile than their broad-based counterparts since they only provide investors with diversification within each particular sector. While they are well-suited for investors who want more exposure to price appreciation within a specific sector, they may not be appropriate for more risk-averse investors who seek a greater level of portfolio diversification.

4. Liquidity: The more popular ETFs such as the Spiders, Diamonds, and Cubes, which track the S&P 500, Dow Jones Industrial Average, and NASDAQ Composite indexes, respectively, are highly liquid instruments that can be bought and sold quickly with little to no adverse price impact to the investor. There are many ETFs for which the market is much thinner, in that higher spreads between the bid and offering prices can be a significant cost to investors. As such, it is important for investors to consider these costs before investing in certain ETFs.

5. Dividend drag: Due to SEC regulations, ETFs are not allowed to reinvest the dividends paid by the securities that make up the underlying index. This is an important disadvantage relative to open-ended mutual funds, which benefit from being able to reinvest dividends in the fund and capturing

additional returns during bull markets. The ability to reinvest dividends also provides the benefit of dollar cost averaging during market downturns since units are purchased at lower prices, thereby reducing an investor's average unit cost. ETFs must pay out dividends to shareholders at the end of each quarter, which can have a negative effect on performance because an investor that chooses to reinvest the dividend must purchase new units on the open market and incur additional transaction costs. This dividend drag is an important consideration for longer term investors as its negative effects on an investor's portfolio are compounded over many years.

3.2 Mutual funds

3.2.1 General information

A mutual fund, as its name suggests, is a professionally managed portfolio of securities that is collectively held by a group of investors. While there is a great diversity in the types of securities that are held by different mutual funds, the general idea remains the same: investors pool their funds together by purchasing units of the fund and the fund manager invests the proceeds on their behalf, according to the fund's investment objectives. Different funds have different objectives, and will invest different proportions of their total assets in each of the major asset classes depending on the fund's objectives. Funds that are predominantly focused on lower-risk strategies for more conservative investors, for example, will invest primarily in money market and fixed-income securities such as bonds. At the other end of the spectrum, there are highly specialized funds that invest only in certain sectors of the equity markets (such as the shares of gold mining companies). These funds have very different objectives and are intended for investors with a higher risk tolerance that are seeking exposure to price appreciation in a very specific market. In the middle of the spectrum, there are other hybrid or balanced funds that invest relatively equal proportions of their total assets between fixed-income

and equity securities. This brief description does little to cover all the different types of mutual funds available to investors, and to do so here would be an extremely lengthy process. According to the Investment Company Institute (ICI), the national trade association of the mutual fund industry in the United States, there were 7,628 active mutual funds as of November 2011 with a combined value of $ 11.608 trillion.

3.2.2 Fund structure and market regulation

All mutual funds in the United States are strictly regulated by the Securities and Exchange Commission (SEC) and fall under one of three categories: closed-end funds, open-end funds, and unit investment trusts.

The most common type of mutual fund structure is the open-end fund, which allows investors to purchase and sell units in the fund on a daily basis. The fund must calculate the total value of its net assets (assets less liabilities) on a per-unit basis at the close of trading every day. This price, known as the fund's net asset value (or NAV) represents the price at which an investor can redeem or purchase an ownership interest in the fund. Thus, open-end funds, as their name suggests, allow investors to purchase and redeem units on an ongoing basis.

Closed-end funds, on the other hand, only sell units in the fund when a fund is first issued to the public via an initial public offering. In contrast to open-end funds, closed-end funds issue a fixed number of common shares which trade on stock exchanges. As such, investors do not directly buy or redeem units from the fund at its net asset value. The price of a closed-end fund fluctuates like that of other publicly traded securities and is determined by market forces. As such, units in these types of funds generally trade at either a premium or discount to their net asset value.

Unit investment trusts differ from both open and closed-end funds in that the portfolio that is held by a unit investment trust is not actively managed by an investment professional as it is intended to be bought and held until the trust is

terminated, sometimes for as long as 30 years. The termination date associated with each trust will vary depending on the composition of the trust's underlying portfolio. Unit investment trusts issue units only once, when they are created. Unit holders are then entitled to a share of principal and income or dividends. Most unit investment trusts are designed to pay out a steady stream of monthly income (either regular fixed or dividend income) to unit holders depending on whether the trust invests predominantly in fixed income or equity securities. Investors in unit investment trusts who choose to redeem their units prior to maturity may do so as the trusts are required to redeem units at the trust's net asset value, much like an open-end fund. In addition, a secondary market may sometimes exist for certain trusts.

Although the generic term "mutual fund" can be used to refer to any of the three types of securities described in the preceding paragraphs, from this point on I will unambiguously use it in reference to the most common of the three types of mutual funds: the open-end fund. The paragraphs that follow will provide a detailed examination of the advantages and disadvantages of investing in open-end mutual funds.

3.2.3 Advantages

1. Diversification: Mutual funds typically invest in a large number of different securities in order to create a well diversified portfolio that minimizes risk. Mutual funds allow smaller investors with as little as $ 1,000 to have access to diversified portfolios that they would otherwise not be able to construct on their own. Investors with larger sums to invest also benefit from mutual funds as they provide a more economical way of achieving a desired level of diversification since they avoid the transaction costs associated with consecutively adding individual positions to a portfolio.

2. Liquidity: Mutual funds are required to calculate and report their net asset values (NAV) on a daily basis. Investors may purchase or redeem units in

the fund at the fund's NAV at any time. As such, even though there is no secondary market for mutual funds, they are highly liquid instruments since the fund company or sponsor is legally required to redeem an investor's units when he or she chooses.

3. Professional management: Mutual funds provide investors with the benefit of having a professional money manager making investment decisions on their behalf. Fund managers generally have many years of experience and make investment decisions based on extensive research. In addition, investors that own mutual funds are freed from the burden of monitoring and adjusting their portfolios as economic conditions change. Mutual fund managers keep abreast of important developments in the financial markets that could be likely to impact the value of the fund over both the short and long term and will make investment decisions accordingly.

4. Variety: Investors have a large selection of mutual funds to choose from, as there are over 7,000 mutual funds available in the United States. There are a multitude of possibilities available both within and across the three general categories of funds (money market, bond, and stock). In addition, many fund companies offer funds of funds which offer additional possibilities for customization according to the investor's preferences and risk tolerance.

5. Access to a larger universe of investments: Mutual funds sometimes use more sophisticated investment vehicles that the average investor would otherwise not be able to purchase. For example, funds on the riskier side of the investment spectrum (such as global equity or specialty funds) may use derivatives to hedge certain risks such as currency risks. Average investors do not have access to such investments and therefore benefit from the fact that mutual fund managers can use sophisticated instruments to hedge certain portfolio risks.

6. Shareholder services and convenience: Mutual funds offer a large number of

services to their investors. Fund companies often have large client service departments that are always available to answer any questions that investors might have. Mutual fund companies offer detailed and extensive client documentation, including account summaries and tax statements. Another advantage of investing in mutual funds is the ability to switch between funds in the same family. Mutual fund companies also facilitate saving by allowing investors to sign up for pre-authorized purchase plans. In such a plan, fund units are automatically purchased at regular time intervals (for example, once a month) with money that is withdrawn from the investor's bank account. Investors requiring a steady stream of income from their mutual fund investments can also enroll in systematic withdrawal plans that function in the opposite manner. Fund units are sold at regular intervals and the money is deposited to the client's bank account. Finally, most mutual fund companies offer extensive investor education and financial planning tools to their clients.

7. Government regulation: Mutual funds in the United States are regulated by the Security and Exchange Commission (SEC). The SEC is the federal government agency that regulates the securities industry. Its mission is to protect investors, maintain fair, orderly, and efficient markets, and facilitate capital formation. The SEC accomplishes this mission by enforcing the laws that govern all the participants in the securities industry. The laws that govern mutual funds are the Investment Company Act of 1940, which requires all funds to submit to SEC regulation and meet the agency's stringent operating standards; the Securities Act of 1933, which mandates specific disclosures of information related to securities being offered for sale to the public; the Securities Exchange Act of 1934, which established the SEC and is designed to prevent fraudulent activity related to the purchase and sale of mutual fund shares; and finally, the Investment Advisers Act of 1940, which regulates mutual fund advisors. The main goal of these extensive

regulations is that investors receive all the information they need in order to fully evaluate an investment in a particular mutual fund. As such, fund companies are required to provide their investors with a prospectus which provides extremely detailed information about the fund. A prospectus contains information such as the fund's objectives and how it plans on achieving them, details about its risk profile, and information about the fund manager. In short, anything that is expected to affect the value of the fund will be included in the prospectus and potential investors will be able to carefully consider every detail of the investment prior to purchase.

8. Accessibility: Mutual funds are available to all investors, and can be purchased either directly from the fund company, or through a registered investment advisor. Registered advisors, however, will usually charge a sales fee for their services, which include retirement planning and other general advisory services. It is therefore beneficial for investors who do their own research and make their own investment decisions to purchase funds directly from the fund company, as the sales charges involved are often much lower. The different expenses and fees associated with purchasing mutual funds will be discussed in extensive detail in the following section.

3.2.4 Disadvantages

1. Fees: All mutual funds have expenses that must be paid as part of their normal business operations. These expenses are important for the individual investor to consider as they can have a significant effect on the return one can expect to earn from their investment. In general, mutual fund expenses fall into one of two categories: shareholder fees, and annual fund operating expenses. Shareholder fees are costs that are borne directly by the investor, whereas a fund's annual operating expenses represent indirect costs that are paid by the fund itself. Although these expenses are not paid directly by shareholders, they reduce the fund's net asset value and are therefore impor-

tant to consider. Shareholder fees include "sales charges" or "loads" which are commissions that are paid to investment advisors for making a purchase or sale on an individual's behalf. U.S. securities law restricts these fees to a maximum of 8.5% of the initial investment. Commissions can be paid at the time of purchase, in which case they are called "front-end loads," or when a fund is sold, in which case they are called "back-end loads" or "deferred sales charges." Deferred sales charges are calculated on a yearly basis as a percentage of total assets and decrease over a set number of years until they reach zero. There are also "no-load" funds which do not charge sales fees. Investors that purchase mutual funds directly from the fund company or that have a fee-based account with an investment advisor would purchase these types of funds. Other types of shareholder fees include redemption fees, which are similar to deferred sales charges but are paid to the fund when an investor redeems shares; exchange fees, which are paid when an investor transfers units between funds in the same family; and an annual account maintenance fee, which is only charged to cover the costs associated with low balance accounts. In contrast to shareholder fees, which are paid directly by investors, a mutual fund's "annual fund operating expenses" represent the ongoing costs of running the fund. These costs include an annual management fee paid to the fund manager for managing the fund, and a distribution fee, which is also known as the 12b-1 fee. Under the Investment Company Act of 1940, rule 12b-1 allows mutual funds to pay marketing and distribution expenses (including sales commissions to advisors) out of the fund's assets. As such, this rule provides investors with an alternative way of paying for their investment advisory services because it allows them to spread out their commission costs over time instead of paying a lump sum at the time of purchase. Funds can use an annual maximum of 0.75% of their average net assets to pay marketing and distribution expenses under rule 12b-1. In addition, a fund can pay an annual maximum of 0.25% of

average net assets as a service fee to investment advisors as compensation for their services. Mutual funds publish expense ratios (a fund's total operating expenses as a percentage of its total assets) as a convenient summary of the costs associated with owning a particular fund. Expense ratios vary depending on the fund's objectives but nevertheless provide investors with a meaningful figure by which they can compare the costs of owing different funds. Another important point for investors to consider in relation to mutual fund fees is that a large number of empirical studies (Jensen, 1968; Malkiel, 1995; and Carhart, 1997, for example) have shown that equity funds generally underperform their passive benchmarks.

2. Income tax issues: Another disadvantage of investing in mutual funds is that shareholders have less control over the timing of the recognition of capital gains on their mutual fund investments. For individual shareholders, income from a mutual fund consists of interest and dividend income as well as capital gains from the sale of securities held by the fund. The income and gains generated by the fund in the prior year get passed on to shareholders who then report it on their tax returns. Dividend income is reported by the fund and investors declare it as regular dividend income. The major disadvantage for individual investors occurs because capital gains realized by the fund are distributed to shareholders who then pay income tax on the gains regardless of whether they actually sold their investment. Consequently, investors could pay capital gains taxes every year they own a mutual fund without ever having sold any units and actually realizing a gain.

3. Less predictable income: Mutual funds, unlike bonds, do not provide investors with a reliable and steady income stream. While many funds distribute the dividends and interest generated by the securities in the portfolio to shareholders, this income can fluctuate because mutual funds that invest part of their assets in fixed income securities often use a laddering strategy to minimize interest rate risk. While interest rate risk reduction is bene-

ficial from an overall portfolio management standpoint, it also means that the investor's income stream is subject to change. Consequently, mutual funds may not be appropriate for investors that prefer a steady source of investment income.

4. No opportunity for customization: Mutual funds, by design, enable investors to delegate the investment decision-making process to the mutual fund manager, who makes decisions based on the fund's investment objectives. Consequently, all shareholders of a particular mutual fund will own the same portfolio of securities. The only difference lies in the amount invested. As such, mutual funds do not offer an opportunity for investors to customize their investments in the fund. Should an individual disagree with any purchase or sale that is made in the fund, the investor's only recourse would be to sell his or her entire holdings.

3.3 Publicly-traded common shares

3.3.1 General information

Common shares are equity securities representing an ownership stake in a public corporation. Unlike mutual funds and ETFs, common share ownership represents an equity investment in one company, not a portfolio of securities. Common shares are highly liquid investments that are traded on stock exchanges around the world, with the New York Stock Exchange (NYSE) eclipsing other international exchanges in terms of both the market capitalization of its listed companies and total trading volume. The market capitalization of all the companies listed on the NYSE was approximately $ 14.24 trillion USD for the year ended December 31st 2011. Total trading volume was $ 20.16 trillion USD. The next largest stock exchange outside the United States is the Tokyo Stock Exchange, with a total market capitalization of $ 3.32 trillion USD and total trading volume of $ 3.97 trillion USD. The universe of publicly-traded companies in the United States is

made up of a very diverse group of companies of different sizes in a multitude of industries. Companies with a capitalization that is less than $ 2 billion USD are generally considered small capitalization companies (or "small cap" stocks), while those with a capitalization between $ 2 and $ 10 billion USD are considered medium capitalizations (or "mid cap" stocks). Companies with capitalizations in excess of $ 10 billion USD are considered large capitalizations (or "large cap" stocks).

Many market observers categorize common stocks according to their price volatility. While the prices of equity securities are more volatile than those of fixed income securities such as bonds, there is a great deal of diversity within the universe of common stocks as an asset class. The stock of a newly public technology company or a junior gold exploration company, for example, would exhibit much greater price volatility than a more mature, dividend-paying financial services firm due to differences in the risks inherent in each company's business. As such, common stocks can be classified on a general risk spectrum with speculative stocks such as the shares of exploration companies on the riskier side of the spectrum, and more conservative, dividend-paying stocks such as the shares of large banks on the less risky side of the spectrum.

3.3.2 Market regulation

The stock market and its participants are regulated by the SEC. The specific laws that govern the market for common shares are the Securities Act of 1933, the Securities Exchange Act of 1934, the Sarbanes-Oxley Act of 2002, and the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. The overall theme that arises from an examination of the purpose of the laws is one of maximum disclosure. The main purpose of these laws is to provide the investing public with a maximum level of transparency to facilitate the investment decision-making process. The purpose of each of these laws will be discussed briefly in the paragraphs that follow, but their main objective remains the same: to protect

investors by ensuring they have all the information they need to make informed investment decisions.

1. The Securities Act of 1933: The purpose of this law is twofold. The first objective is to "require that investors receive financial and other significant information concerning securities being offered for public sale." The second is to "prohibit deceit, misrepresentations, and other fraud in the sale of securities." These objectives are accomplished by requiring firms that plan on offering their securities for sale to the public to register with the SEC and provide detailed information about the company and the nature of its business, the securities being offered for sale, the company's management, and its financial position (by providing audited financial statements).

2. The Securities Exchange Act of 1934: This law led to the establishment of the Securities and Exchange Commission and empowers it with authority over essentially every aspect of the securities industry. The SEC has the authority to register and otherwise regulate the activities of brokerage firms, transfer agents, clearing agencies and stock exchanges. This law also enables the SEC to require the ongoing disclosure of information about a company's publicly-traded securities. Such information includes periodic financial reports, proxy solicitations, information about any tender offers for 5% or more of a company's shares, and the details of any insider trading activities.

3. The Sarbanes-Oxley Act of 2002: This law established the Public Company Accounting Oversight Board (PCAOB) and enacted major reforms designed "to enhance corporate responsibility, enhance financial disclosures and combat corporate and accounting fraud."

4. The Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010: This act is one of the most recent additions to the laws governing the securities industry. Its general purpose is "to reshape the U.S. regulatory system in a number of areas including but not limited to consumer protection, trad-

ing restrictions, credit ratings, regulation of financial products, corporate governance and disclosure, and transparency."

3.3.3 Advantages

1. Customization and control: Investing in publicly-traded common shares facilitates the portfolio formation process. Investors can put together fully customized portfolios composed exclusively of the shares of the companies that they find the most attractive. This is in direct contrast to investing in a mutual fund, for example, where investment decisions are controlled by the fund manager. Similarly, purchasing a broad-based ETF means holding a proportional interest in every company that is included in the underlying index. Common stocks allow investors to pick and choose the stocks they want to include in their portfolio, which is not possible with either mutual funds or ETFs.

2. Liquidity: Common shares are very liquid investments. In general, shares can be bought and sold at any time during the day with little to no adverse effect on price. This is an advantage relative to mutual funds, which are only priced at the close of trading. For example, an investor who submits a market order to sell 100 shares of stock at 10:00 AM will generally have his order filled at the bid that was in effect at that time. An investor who submits an order to sell units in a mutual fund at 10:00 AM will not get the value of all shares held by the fund at that precise time. Mutual funds are priced using the *closing* prices of the shares held in the fund, and these prices can vary greatly during the course of a trading day. As such, investors in common shares benefit from greater daily liquidity relative to mutual funds. It is important to note, however, that there are still varying degrees of liquidity within the universe of common stocks. For example, shares in larger companies are generally more liquid than smaller companies, and there can be a difference in the liquidity of an issue based on the exchange

on which it is listed.

3. Control over tax issues: Investors in common stocks have full control over their decisions to purchase or sell the shares they hold in their portfolios, and consequently, have full control over when they realize capital gains or losses on their investments. For example, investors can choose to offset a large capital gain realized on the sale of certain shares by selling their underperforming stocks on which there are unrealized losses. Doing so can reduce or eliminate an investor's tax liability, depending on the situation. This is an important advantage relative to mutual funds. Investors in mutual funds often have to pay taxes on capital gains that are distributed to shareholders when the fund must sell securities to cover redemptions, even though the shareholders never actually sold their units. As such, mutual funds do not offer the same level of control over taxation issues relative to common shares.

4. More predictable income: Common shares that pay dividends, unlike mutual funds, offer investors a relatively steady source of income. While the dividends on common shares are by no means guaranteed, the shares of many "blue chip" companies have been paying quarterly dividends over a number of decades. Large financial institutions, for example, often maintain an uninterrupted dividend payment record. The income generated by the securities held in certain mutual funds, on the other hand, can sometimes vary due to the fund manager's investment strategy. This is the case if the manager uses a laddering strategy on the fixed income portion of the portfolio, for instance. Consequently, many common shares offer the advantage of more stable income relative to certain mutual funds.

5. Absence of fees: Another major advantage of common shares over mutual funds is the absence of fees. While there are transaction costs to purchasing and selling shares, they are usually not as significant as the fees that investors incur by investing in mutual funds. Mutual fund sales fees can be as high

as 8.5%, and there are additional management fees that must be paid while the investor holds the fund. Investors that manage their own portfolios of common shares will only incur transaction costs when they make a purchase or sale. These transaction costs will be discussed in the next section.

3.3.4 Disadvantages

1. Transaction costs: Purchases and sales of common stock must be made through a registered broker-dealer. Investors can choose to employ the services of an investment advisor or registered representative working at a financial institution or they can forgo the personalized services offered by investment advisors and instead use a discount brokerage. Both types of broker-dealers charge commissions to buy and sell stock, but as their name implies, discount brokers usually charge less. The commission on a purchase or sale of stock is usually based on the size of the order, with larger orders having a proportionately lower commission rate. Discount brokers often charge a fixed commission regardless of the size of the order. The transaction costs incurred when an investor manages his or her own portfolio can become significant if the investor makes relatively frequent trades. In addition, small investors are at a significant disadvantage because they are charged a much larger commission (as a percentage of the value of the order). Consequently, transaction costs can be an important disadvantage, especially for investors with smaller amounts to invest.

2. Inadequate diversification: Adequate diversification is harder to achieve with common shares. While investors enjoy the flexibility of choosing which shares to purchase, the costs involved in forming a properly diversified portfolio with common shares are almost prohibitive. The formation of a portfolio of 30 stocks, for example, can be quite expensive and perhaps even impossible for certain investors depending on the price per share of the chosen companies. Investors can achieve a greater level of diversification by replicating the per-

formance of an index such as the S&P 500, but this can best be achieved by purchasing an ETF at a much lower cost. As such, ETFs and mutual funds have an advantage over common shares since they make it much easier (and more economical) for the majority of investors to achieve an adequate level of diversification.

3. Higher volatility: Higher volatility is a consequence of the difficulty of achieving adequate diversification with common shares. A portfolio that is not properly diversified is subject to greater price volatility as it is more sensitive to any shocks that can change the valuation of the individual companies that make up the portfolio. In contrast, the value of mutual funds and ETFs that are well diversified are not expected to be as significantly affected by any change in the fortunes of the individual companies that make up their portfolio of assets.

Chapter 4

Data

4.1 Data sources

All stock, mutual fund, and exchange-traded fund data were collected from the Center for Research in Security Prices (CRSP). The CRSP U.S. Stock Database contains a vast amount of data on security prices, returns, and volume for a number of American stock markets. Mutual fund and ETF returns were obtained from the CRSP Survivor-Bias-Free U.S. Mutual Fund Database, which is the only complete database of both active and inactive mutual funds.

Interest rates were collected from the Federal Reserve Bank Reports via Wharton Research Data Services (WRDS). Specifically, The WRDS Rates database is based upon the Federal Reserve Boards H.15 release that contains selected interest rates for U.S. Treasuries and private money market and capital market instruments.

4.2 Data collection - gold exchange-traded funds

The first step in the collection of gold ETF returns was to compile a list of gold ETFs. A list of all exchange traded funds available on CRSP was compiled from the CRSP mutual fund database for the period from January 1995 to December 2011. ETFs were isolated by using the "et_flag" variable in CRSP, which identifies whether a fund is an exchange-traded fund (if et_flag=F) or an exchange-traded

note (if et_flag=N). Only funds that were flagged as ETFs (where et_flag=F) were kept. There were 2021 ETFs. Once the list was compiled it was filtered again to include only gold ETFs. This was achieved by only including funds where the fund name included the word "gold" in the title. This list included a number of ETFs which had returns linked to a decrease in the price of gold. These "short" or "inverse" funds were also eliminated by removing all funds with the words "short" or "bear" in the fund name. As such, only ETFs that took a long position in gold were kept. This resulted in a list of 17 ETFs. Upon visual inspection, it was noted that there were some duplicates in the sample due to name changes of certain ETFs. These duplicates were then filtered out using the unique 8-digit fund CUSIP. This resulted in a final sample of 11 gold ETFs.

The second step was to collect the returns for each of the gold ETFs. Daily returns were obtained from the CRSP Mutual Fund return database for the period from September 1st, 1998 (the earliest date available) to September 30th, 2012. Returns were obtained using the 8-digit fund CUSIP for each ETF. Table 4.1 contains the final sample of gold exchange-traded funds.

Table 4.1: Final sample of gold exchange-traded funds

ID	COMPANY	ETF NAME
1	Direxion Funds	Direxion Daily Gold Miners Bull 2X Shares
2	ETF Securities	ETFS Physical Swiss Gold Shares
3	Global X Funds	Global X Gold Explorers ETF
4	Global X Funds	Global X Pure Gold Miners ETF
5	BlackRock	iShares Gold Trust
6	Van Eck Funds	Market Vectors–Gold Miners ETF
7	Van Eck Funds	Market Vectors–Junior Gold Miners ETF
8	Invesco PowerShares Capital Management	PowerShares DB Gold Fund
9	Invesco PowerShares Capital Management	PowerShares Global Gold and Precious Metals Portfolio
10	ProShares Advisors	ProShares Ultra Gold
11	State Street Global Markets	SPDR Gold Shares

4.3 Data collection - gold mutual funds

The first step in the collection of gold mutual fund returns was to compile a list of gold mutual funds. A list of all mutual funds available on CRSP was compiled from the CRSP mutual fund database for the period from January 1995 to December 2011. There were 97,961 mutual funds. Gold mutual funds were isolated by only keeping funds where the fund name included the word "gold" in the title. Closed-end funds and institutional funds were also eliminated from the list by filtering using the "open_to_inv" and "retail_fund" variables in CRSP, respectively. The variable "open_to_inv" identifies if a fund is open to investors (open_to_inv=Y) or not (open_to_inv=N). The variable "retail_fund" identifies if a fund is a retail fund (where retail_fund=Y) or not (where retail_fund=N). Only open-ended gold funds that are available to retail investors were included in the list (where both open_to_inv=Y and retail_fund=Y). This resulted in a sample of 41 gold mutual funds. Upon visual inspection of the data, it was noted that many of the funds were in fact different classes of the same fund, with identical returns. As such, the sample was filtered again to eliminate duplicates. Where there was a discrepancy in the length of the time series of different classes of the same fund, the class with the longest time series was kept. The final sample consisted of 14 gold mutual funds.

The second step was to collect the returns for each of the gold mutual funds. Daily returns were obtained from the CRSP Mutual Fund return database for the period from September 1st, 1998 (the earliest date available) to September 30th, 2012. Returns were obtained using the 8-digit fund CUSIP for each fund. Table 4.2 contains the final sample of gold mutual funds.

Table 4.2: Final sample of gold mutual funds

ID	COMPANY	FUND NAME
1	Fidelity Investments	Fidelity Select Gold Portfolio
2	First Eagle SoGen Funds	First Eagle SoGen Gold Fund
3	Franklin Templeton Investments	Franklin Gold & Precious Metals Fund, Class A Shares
4	Gold Bank Funds	Gold Bank Equity Fund
5	Lexington Management	Lexington Goldfund
6	Mercury Asset Management	Mercury Gold and Mining Fund, Class C Shares
7	Oppenheimer & Co.	Oppenheimer Gold & Special Minerals Fund, Class A Shares
8	Orrell Capital Management	OCM Gold Fund
9	Tocqueville Asset Management	Tocqueville Gold Fund
10	U.S. Global Investors Funds	U.S. World Gold Fund
11	U.S. Global Investors Funds	U.S. Gold Shares Fund
12	Van Eck Funds	International Investors Gold Fund, Class A Shares
13	The Vanguard Group	Vanguard Gold and Precious Metals Fund
14	Scudder Mutual Funds	Scudder Gold Fund

4.4 Data collection - gold mining company shares

I collected daily return data for all active gold mining companies from the CRSP Daily Stock File database. Gold miners were identified using the 4-digit SIC code 1041 (gold ores). The United States Department of Labor describes companies in this category as follows: "Establishments primarily engaged in mining gold ores from lode deposits or in the recovery of gold from placer deposits by any method. In addition to ore dressing methods such as crushing, grinding, gravity concentration, and froth flotation, this industry includes amalgamation, cyanidation, and the production of bullion at the mine, mill, or dredge site." Defunct companies were eliminated using the "Trading Status" field in CRSP. "Trading Status" is a one-character field containing the trading status (A=Active, H=Halted, S=Suspended, and X=Unknown) of securities. Only companies that had a trading status equal to "A" (Active) were included in the sample. The sample period is from January 1st, 1995 to December 31st, 2011.

The sample was then filtered to only include common shares. ADRs and other classes of shares other than common were eliminated using the share code variable included in CRSP. "Share Code" is a two-digit code describing the type of shares traded. The first digit describes the type of security traded. The second digit provides additional information about the type of security. The CRSP definitions for each digit are defined in Table 4.3.

The sample was filtered to only include companies with share codes equal to 10, 11, or 12. As per the definitions in Table 4.3, this restricts the sample to common shares. Therefore, the sample can include companies incorporated outside of the U.S. that trade on U.S. exchanges, but not the shares of closed-end funds and REITs, for example. This filtering resulted in the reduction of the original sample from 148 to 132 companies. The data was filtered again to eliminate duplicates in the sample due to name changes. This was done using the CRSP PERMNO which is a unique permanent security identification number assigned to each security. Unlike the CUSIP, the PERMNO doesn't change during an issue's trading

Table 4.3: CRSP share code definitions

First digit	
Code	Definition
1	Ordinary common shares
2	Certificates
3	ADRs (American Depository Receipts
4	SBIs (Shares of Beneficial Interest)
7	Units (Depository Units, Units of Beneficial Interest, etc.)
Second digit	
Code	Definition
0	Securities which have not been further defined
1	Securities which need not be further defined
2	Companies incorporated outside the U.S.
3	Americus Trust Components (Primes and Scores)
4	Closed-end funds
5	Closed-end fund companies incorporated outside the U.S.
8	REITs (Real Estate Investment Trusts)

history. The elimination of duplicates from the data set reduced the sample size from 132 to 117 firms. Upon visual inspection of the data, the sample was found to contain certain companies that had nothing to do with the gold mining industry. These 10 firms were removed, further reducing the sample size from 117 to 107 firms. Upon further inspection, it was found that certain companies with different PERMNOs were in fact the same company. In such cases, only the longer time series was kept in the data set. This reduced the number of firms in the sample to 103 firms. Finally, in order to ensure that the time series for each firm was long enough, only firms with a minimum of 4 years of daily data were retained. Table 4.4 contains the final sample of 64 gold mining firms.

Table 4.4: Final sample of gold mining firms

ID	COMPANY NAME	TICKER
1	AGNICO EAGLE MINES LTD	AEM
2	ALEXCO RESOURCE CORP	AXU
3	ALLIED NEVADA GOLD CORP	ANV
4	ALMADEN MINERALS LTD	AAU
5	AUGUSTA RESOURCE CORP	AZC
6	AURICO GOLD INC	AUQ
7	AURIZON MINES LTD	AZK
8	BANRO CORP	BAA
9	BARRICK GOLD CORP	ABX
10	BATTLE MOUNTAIN GOLD CO	BMG
11	BEMA GOLD CORP	BGO
12	BENGUET CORP	BE
13	BRIGUS GOLD CORP	BRD
14	CAMBIOR INC	CBJ
15	CANYON RESOURCES CORP	CAU
16	CARDERO RESOURCE CORP	CDY
17	CLAUDE RESOURCES INC	CGR
18	COEUR D ALENE MINES CORP ID	CDE
19	CORRIENTE RESOURCES INC	ETQ
20	CRYSTALLEX INTERNATIONAL CORP	KRY
21	DAYTON MINING CORP	DAY
22	ELDORADO GOLD CORP NEW	EGO
23	ENTREE GOLD INC	EGI
24	EXETER RESOURCES CORP	XRA
25	FREEPORT MCMORAN COPPER & GOLD	FCX

Continued on next page

Table 4.4 – *Continued from previous page*

ID	COMPANY NAME	TICKER
26	GLAMIS GOLD LTD	GLG
27	GOLD RESERVE INC	GRZ
28	GOLDCORP INC NEW	GDL
29	GOLDEN STAR RESOURCES LTD	GSR
30	GREAT BASIN GOLD LTD	GBN
31	H S RESOURCES INC	HSE
32	HECLA MINING CO	HL
33	HOMESTAKE MINING CO	HM
34	IAMGOLD CORP	IAG
35	INTERNATIONAL TOWER HILL MINES	THM
36	IVANHOE MINES LTD	IVN
37	JAGUAR MINING INC	JAG
38	KEEGAN RESOURCES INC	KGN
39	KINROSS GOLD CORP	KGC
40	MERIDIAN GOLD INC	MDG
41	MINCO GOLD CORP	MGH
42	MINEFINDERS CORP LTD	MFN
43	MIRAMAR MINING CORP	MNG
44	NEVSUN RESOURCES LTD	NSU
45	NEW GOLD INC	NGD
46	NEWMONT MINING CORP	NEM
47	NORTHERN DYNASTY MINERALS LTD	NAK
48	NORTHGATE MINERALS CORP	NXG
49	NOVAGOLD RESOURCES INC	NG
50	OREZONE RESOURCES INC	OZN
51	PACIFIC RIM MINING CORP	PMU

Continued on next page

Table 4.4 – *Continued from previous page*

ID	COMPANY NAME	TICKER
52	PLACER DOME INC	PDG
53	RICHMONT MINES INC	RIC
54	ROYAL OAK MINES INC	RYO
55	RUBICON MINERALS CORP	RBY
56	SEABRIDGE GOLD INC	SA
57	SOLITARIO EXPLOR & ROYALTY CORP	XPL
58	T V X GOLD INC	TVX
59	TANZANIAN ROYALTY EXPL CORP	TRX
60	TASEKO MINES LTD	TGB
61	TECK RESOURCES LTD	TCK
62	U S GOLD CORP	UXG
63	VISTA GOLD CORP	VGZ
64	YAMANA GOLD INC	AUY

4.5 Data collection - the risk-free rate

I used the daily 3-month U.S. Treasury bill rate as the risk-free interest rate in my analysis. This rate was obtained from the Federal Reserve Bank Reports database in WRDS. Annualized rates were converted to daily rates in order to calculate daily excess returns.

4.6 Descriptive statistics

Table 4.5 contains descriptive statistics for each of the three samples. There were 11,689 daily observations in the ETF sample. The average daily excess return for the ETFs was 0.06%, the lowest of the three groups. The standard deviation of the ETF sample was 2.2, and the median excess return was 0.06%, and equal to

the average. The minimum and maximum daily excess returns for the ETF sample were -15.93% and 27.31%, respectively. The skewness and kurtosis measures for the ETFs were 0.33 and 10.84, respectively, indicating that the excess returns for the ETF sample are clustered around the average. In addition, the distribution of ETF returns has fatter tails relative to the normal distribution, and the positive skewness indicates that most of the returns lie to the left of the mean, while the right tail of the distribution is longer than the left.

The mutual fund sample contained 43,754 observations of daily excess returns. The average daily excess return for the mutual funds was slightly higher than that of the ETFs, at 0.08%. It is interesting to note that while the average excess return for the funds was higher relative to the ETF sample, the standard deviation of the mutual fund returns was slightly lower than that of the ETFs, at 2.1. The median excess return for the mutual funds was 0, and the minimum and maximum daily excess returns were -16.2% and 24%, respectively. It is also interesting to note that the range of excess returns for the mutual funds was slightly smaller than the range of the ETF sample. The mutual fund excess return distribution also exhibited positive skewness and kurtosis of 0.25 and 6.78, respectively, but both of these measures were lower relative to the ETFs.

The sample of gold company shares contained 128,763 observations of daily excess returns. The average daily excess return for this sample was 0.11%, the highest of the three groups. However, the standard deviation of the stock returns was 4.84, also the highest of the three groups. The median excess return was -0.01%, and this group had the largest range of the three groups, with the minimum and maximum daily excess returns equal to -81.26% and 100%, respectively. The sample of stock returns was also the most asymmetrical of the three, with skewness and kurtosis measures of 1.51 and 24.81, respectively. This is consistent with the speculative nature and riskiness of gold exploration, where significant finds can lead to very large returns, and where the opposite can lead to very large losses. As such, the descriptive statistics for the stock sample accurately reflect the mix of junior and

senior gold mining companies contained in the sample.

Table 4.6 contains results from the Jarque-Bera normality test for each of the samples. We use the Jarque-Bera test to determine if each of the excess return distributions has skewness and kurtosis values that match those of the normal distribution (excess kurtosis=0 and skewness=0). From Table 4.6, we see that in all three cases the p-value of the test is 0, leading to the rejection of the null hypothesis that each of the samples has excess kurtosis and skewness equal to zero. This finding is also evident when we examine Figures 4.1 to 4.3, which show the normal Q-Q plots of excess returns for each group. In all three cases, the excess return distributions clearly depart from normality as we approach the extreme quantiles. The upward bend on the right of each plot and the downward bend to the left of each plot show that extremely high and low excess returns are more common in each of our samples than in the normal distribution. In addition, the upward bend is sharper than the downward bend in each of the three cases, indicating that the returns in the right tail of each of the distributions tend to be higher than those in the left tail.

Table 4.5: Descriptive statistics - summary of excess returns by group

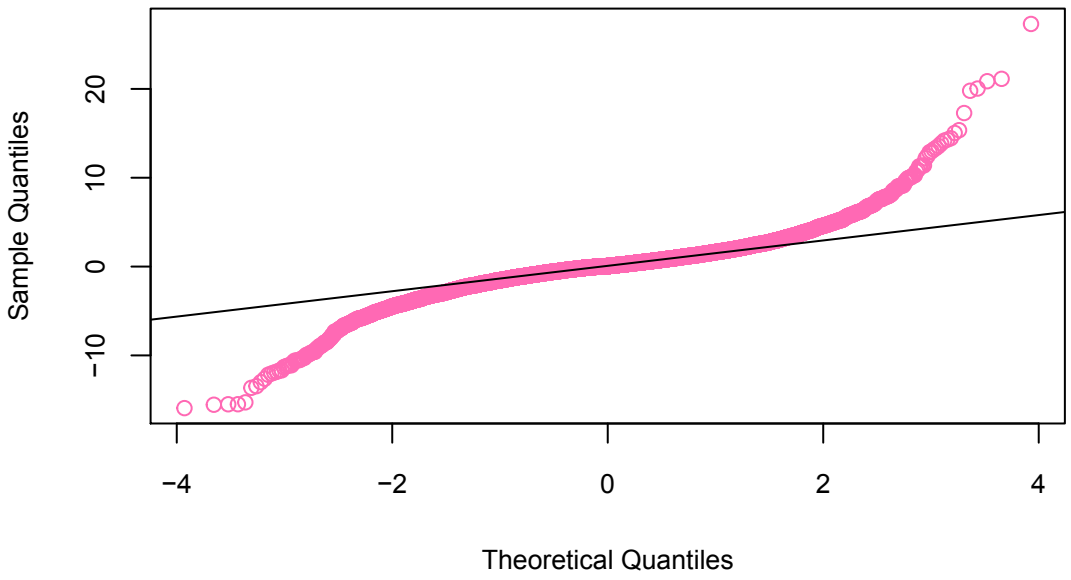
Table 4.5 below provides summary statistics for each sample, where: n=the number of daily observations; $\bar{E}$=the mean daily excess return; σ=the standard deviation of daily excess returns; $\bar{E}_t$=the trimmed mean daily excess return; MAD=the mean absolute deviation; S=skewness; K=kurtosis; $SE_{\bar{E}}$=the standard error of the mean daily excess return.

GROUP	**n**	$\bar{E}$	σ	**Median**	$\bar{E}_t$	**MAD**	**Min**	**Max**	**Range**	**S**	**K**	$\mathbf{SE}_{\bar{E}}$
ETFs	11689	0.06	2.2	0.06	0.07	1.44	-15.93	27.31	43.25	0.33	10.84	0.02
Mutual funds	43754	0.08	2.1	0	0.06	1.66	-16.2	24	40.2	0.25	6.78	0.01
Stocks	128763	0.11	4.84	-0.01	-0.03	3.06	-81.26	100	181.26	1.51	24.81	0.01

Table 4.6: Jarque-Bera normality test of the distribution of daily excess returns by group

GROUP	df	JB	p-value
ETFs	2	57,468.94	0.00
Mutual funds	2	84,179.17	0.00
Stocks	2	3,351,657	0.00

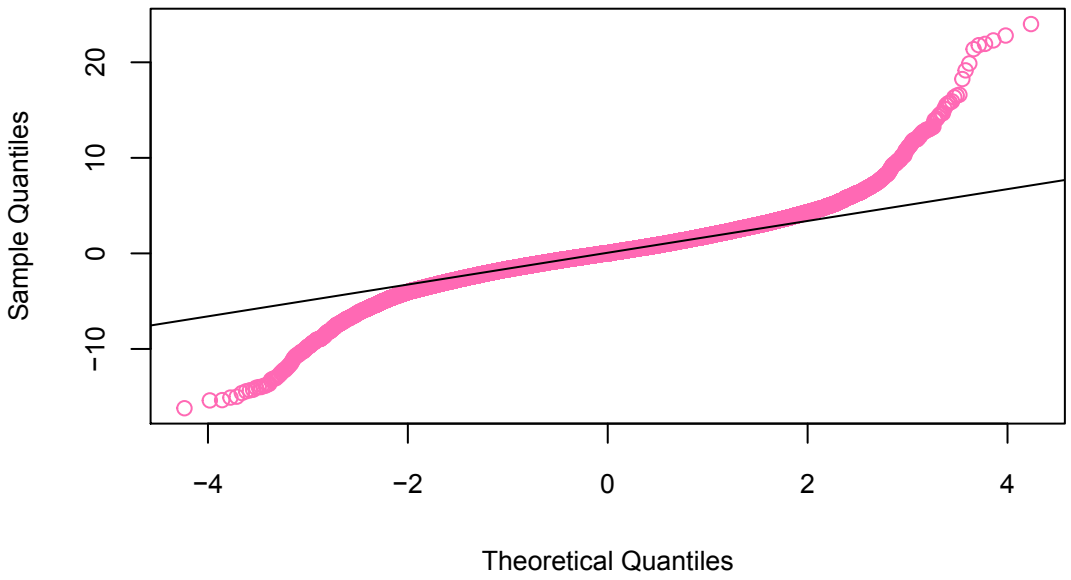
Figure 4.1: Normal Q-Q plot of gold ETF excess returns



4.6.1 Gold exchange-traded funds

Table 4.7 contains descriptive statistics for each of the 11 exchange-traded funds in the sample. The majority of ETFs (8/11, or 73%) had a positive average daily excess return. The ProShares Ultra Gold ETF had the highest average return (0.16%), which was twice as large as that of the ETFs with the next highest average excess returns (0.08% for both the iShares Gold Trust and SPDR Gold

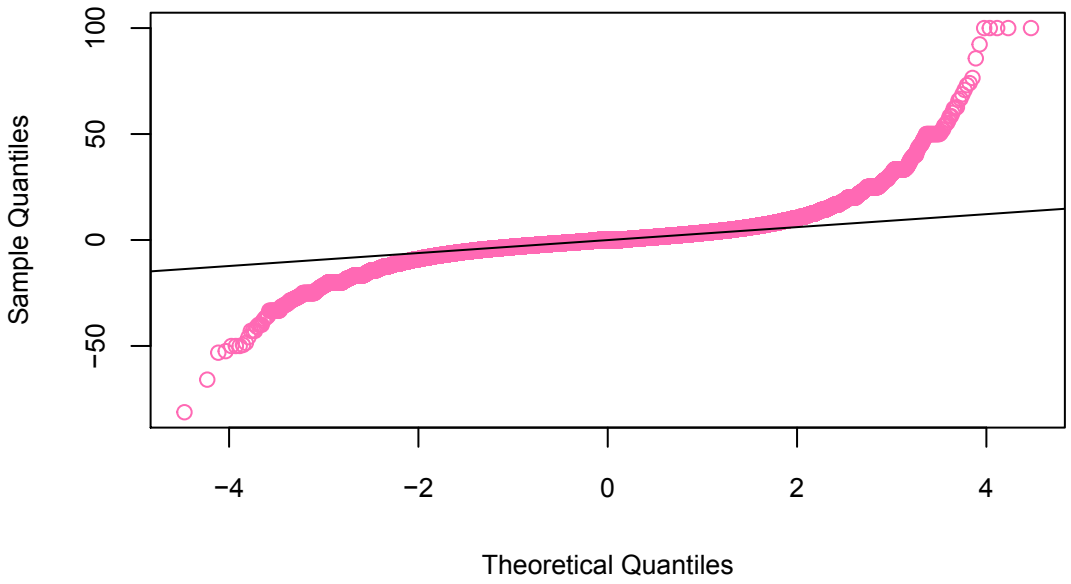
Figure 4.2: Normal Q-Q plot of gold mutual fund excess returns



Shares). This is logical since the ProShares ETF uses leverage to capture twice the return of the underlying benchmark. The Market Vectors Junior Gold Miners ETF was the ETF with the smallest positive average excess return (0.04%). A small proportion of the sample (3/11, or 27%) had negative average daily excess returns. The Global X Gold Explorers ETF had the lowest average daily excess return (-0.08%), and the Direxion Daily Gold Miners Bull 2X Shares had the second lowest average daily excess return (-0.07%), the latter being somewhat surprising, given its investment objective of providing a return that is double that of the benchmark.

The ETF with the largest standard deviation (5.04) was the Direxion Daily Gold Miners Bull 2X ETF. Its standard deviation was considerably larger than that of the ETF with the second largest standard deviation (2.86), namely the Market Vectors Gold Miners ETF. The ETF with the lowest standard deviation was the ETFS Physical Swiss Gold Shares (1.17). The Market Vectors Gold Miners ETF was the one with the largest range, with a minimum daily excess return of

Figure 4.3: Normal Q-Q plot of gold stock excess returns



-15.93% and a maximum of 27.31%. The ETFS Physical Swiss Gold Shares had the smallest range, with a minimum daily excess return of -5.65% and a maximum of 4.67%.

A small majority (6/11, or 55%) of the ETFs exhibited negative skewness, indicating that most excess returns were concentrated to the right of the mean, while the remainder of the ETFs (5/11, or 45%) had return distributions that were either not skewed or exhibited positive skewness (a larger concentration of values to the left of the mean). All of the ETFs had distributions that could be classified as leptokurtic (kurtosis > 0). As such, all of the ETFs had excess return distributions that had a narrower peak and higher probability of extreme values than the normal distribution. The PowerShares DB Gold Fund and ProShares Ultra Gold ETFs had excess return distributions that most closely resembled the normal distribution.

Table 4.7: Descriptive statistics - daily ETF excess returns

Table 4.7 below provides summary statistics for each ETF, where: n=the number of daily observations; $\bar{E}$=the mean daily excess return; σ=the standard deviation of daily excess returns; $\bar{E}_t$=the trimmed mean daily excess return; MAD=the mean absolute deviation; S=skewness; K=kurtosis; $SE_{\bar{E}}$=the standard error of the mean daily excess return.

ETF	**n**	$\bar{E}$	σ	**Median**	$\bar{E}_t$	**MAD**	**Min**	**Max**	**Range**	**S**	**K**	$\mathbf{SE}_{\bar{E}}$
Direxion Daily Gold Miners Bull 2X Shares	454	-0.07	5.04	-0.09	-0.12	4.52	-15.50	20.04	35.54	0.24	1.16	0.24
ETFS Physical Swiss Gold Shares	766	0.07	1.17	0.08	0.10	0.98	-5.65	4.67	10.32	-0.37	2.19	0.04
Global X Gold Explorers ETF	477	-0.08	2.37	0.00	-0.08	2.40	-9.63	7.87	17.50	-0.08	0.65	0.11
Global X Pure Gold Miners ETF	389	-0.04	1.95	0.00	-0.01	1.87	-7.00	5.90	12.90	-0.15	0.41	0.10
iShares Gold Trust	1923	0.08	1.32	0.09	0.10	0.99	-7.32	9.03	16.35	-0.06	3.84	0.03
Market Vectors Gold Miners ETF	1595	0.06	2.86	0.00	0.04	2.19	-15.93	27.31	43.25	0.57	9.04	0.07
Market Vectors Junior Gold Miners ETF	722	0.04	2.39	0.00	0.08	2.16	-11.83	6.98	18.81	-0.28	1.07	0.09
PowerShares DB Gold Fund	1435	0.07	1.33	0.11	0.11	0.98	-5.88	8.79	14.68	-0.00	3.79	0.04
PowerShares Global Gold & Precious Metals Portfolio	1008	0.07	2.69	0.07	0.07	1.83	-15.28	21.13	36.42	0.71	11.52	0.08
ProShares Ultra Gold	954	0.16	2.51	0.11	0.16	2.01	-11.22	14.17	25.39	0.05	2.66	0.08
SPDR Gold Shares	1966	0.08	1.30	0.06	0.09	0.98	-6.06	7.08	13.14	-0.12	2.98	0.03

4.6.2 Gold mutual funds

Table 4.8 contains descriptive statistics for each of the 14 gold mutual funds in the sample. The vast majority of funds (13/14, or 93%) had a positive average daily excess return. The Oppenheimer Gold & Special Minerals Fund, OCM Gold Fund, Tocqueville Gold Fund, and Van Eck International Investors Gold Fund each had the highest average daily excess return (0.09%). The Gold Bank Equity Fund had the smallest positive average daily excess return (0.04%). The fund with the lowest average excess return (and also the only fund with a negative average excess return) was the Mercury Gold and Mining Fund (-0.01%).

Two of the funds with the highest average excess returns (the OCM Gold Fund and Van Eck International Investors Gold Fund) also had the highest standard deviations (2.38 and 2.35, respectively). The fund with the lowest average excess return (the Mercury Gold and Mining Fund) also had the lowest standard deviation (1.67). The Fidelity Select Gold Portfolio had the largest range, with a minimum daily excess return of -15.35% and a maximum of 24%. The Gold Bank Equity Fund had the smallest range, with a minimum daily excess return of -3.36% and a maximum of 3.77%.

A majority of the funds (12/14, or 86%) exhibited positive skewness, and all of the funds had leptokurtic distributions (kurtosis > 0).

Table 4.8: Descriptive statistics - daily mutual fund excess returns

Table 4.8 below provides summary statistics for each fund, where: n=the number of daily observations; $\bar{E}$=the mean daily excess return; σ=the standard deviation of daily excess returns; $\bar{E}_t$=the trimmed mean daily excess return; MAD=the mean absolute deviation; S=skewness; K=kurtosis; $SE_{\bar{E}}$=the standard error of the mean daily excess return.

FUND	**n**	$\bar{E}$	σ	**Median**	$\bar{E}_t$	**MAD**	**Min**	**Max**	**Range**	**S**	**K**	$\mathbf{SE}_{\bar{E}}$
Fidelity Select Gold Portfolio	3518	0.08	2.16	0.01	0.06	1.69	-15.35	24.00	39.35	0.53	9.54	0.04
First Eagle SoGen Gold Fund	3518	0.08	1.81	0.00	0.06	1.48	-10.72	16.34	27.06	0.36	5.12	0.03
Franklin Gold & Precious Metals Fund	3518	0.08	2.03	0.05	0.08	1.64	-14.99	21.92	36.92	0.24	8.66	0.03
Gold Bank Equity Fund	1030	0.04	0.81	0.07	0.04	0.70	-3.36	3.77	7.13	0.06	1.45	0.03
Lexington Goldfund	3518	0.06	2.00	0.00	0.07	1.59	-14.27	14.00	28.27	-0.16	4.66	0.03
Mercury Gold and Mining Fund	508	-0.01	1.67	-0.15	-0.13	1.10	-6.13	15.69	21.83	2.31	17.42	0.07
OCM Gold Fund	3518	0.09	2.38	-0.01	0.05	1.95	-14.61	22.80	37.41	0.52	6.35	0.04
Oppenheimer Gold & Special Minerals Fund	3518	0.09	2.22	0.07	0.10	1.77	-16.20	21.79	37.99	0.12	7.42	0.04
Scudder Gold Fund	3518	0.08	2.14	0.00	0.07	1.74	-13.99	22.29	36.28	0.30	7.35	0.04
Tocqueville Gold Fund	3518	0.09	2.05	0.04	0.08	1.69	-13.07	15.79	28.87	0.17	5.07	0.03
U.S. Gold Shares Fund	3518	0.08	2.25	-0.01	0.05	1.95	-12.69	19.88	32.57	0.34	4.29	0.04
U.S. World Gold Fund	3518	0.07	2.16	0.00	0.06	1.80	-13.98	19.15	33.14	0.15	5.12	0.04
Van Eck International Investors Gold Fund	3518	0.09	2.35	0.00	0.07	1.90	-15.09	21.38	36.46	0.20	5.68	0.04
Vanguard Gold and Precious Metals Fund	3518	0.07	1.86	0.09	0.10	1.39	-15.39	12.94	28.32	-0.33	6.10	0.03

4.6.3 Gold mining company shares

Table 4.9 contains descriptive statistics for each of the 64 gold mining companies in the sample. An overwhelming majority of firms (60/64, or 94%) had positive average daily excess returns. The firm wit h the highest average daily excess return (0.28%) was Allied Nevada Gold Corp. Two other miners (Vista Gold Corp. and Benguet Corp.) came close with average excess returns of 0.27%. Only 4 firms (6% of the total) had negative average daily excess returns. Royal Oak Mines Inc. had the lowest average excess return (-0.09%), followed by Hecla Mining Co. (-0.03%), Battle Mountain Gold Co. (-0.03%), and Homestake Mining Co. (-0.01%).

It is not surprising to see that in general, the firms with the largest average excess returns also exhibit greater excess return variability. The company with the largest standard deviation (9.98) was Dayton Mining Corp., followed by Benguet Corp. (8.97) and Vista Gold Corp. (8.63). The firms with the smallest standard deviations were Newmont Mining Corp. (2.56), Barrick Gold Corp. (2.70), H.S. Resources Inc. (2.96) and Placer Dome Inc. (3.00). We would expect to see larger, senior gold miners such as Newmont, Barrick, and Placer Dome among the firms with the least variable excess returns. Vista Gold Corp. was the firm with the largest range, with a minimum daily excess return of -81.26% and a maximum of 100%. Homestake Mining Co. had the smallest range, with a minimum excess return of -11.83% and a maximum of 21.04%.

Almost all of the companies in the sample (62/64, or 97%) had excess return distributions that exhibited varying degrees of positive skewness. In addition, each of the gold miners had return distributions that were leptokurtic (with kurtosis > 0), indicating a larger probability of extreme values in the tails of the distribution. The firms that had skewness and kurtosis values that most closely resembled those of the normal distribution were Benguet Corp., Taseko Mines Ltd., Freeport-McMoRan Copper & Gold Inc., AuRico Gold Inc., and International Tower Hill Mines Ltd. These miners had skewness and kurtosis values that ranged from 0 to 0.7 and from 3.17 to 3.78, respectively.

Table 4.9 - Descriptive statistics - daily common share excess returns

Table 4.9: This table provides summary statistics for each stock, where: n=the number of daily observations; $\bar{E}$=the mean daily excess return; σ=the standard deviation of daily excess returns; $\bar{E}_t$=the trimmed mean daily excess return; MAD=the mean absolute deviation; S=skewness; K=kurtosis; $SE_{\bar{E}}$=the standard error of the mean daily excess return.

COMPANY	**n**	$\bar{E}$	σ	**Median**	$\bar{E}_t$	**MAD**	**Min**	**Max**	**Range**	**S**	**K**	$\mathbf{SE}_{\bar{E}}$
AGNICO EAGLE MINES LTD	4248	0.08	3.32	-0.01	0.01	2.57	-25.18	24.99	50.17	0.30	5.67	0.05
ALEXCO RESOURCE CORP	1070	0.13	4.79	0.00	0.00	3.61	-19.61	30.23	49.85	0.83	5.20	0.15
ALLIED NEVADA GOLD CORP	1156	0.28	5.11	0.12	0.18	3.20	-27.02	58.50	85.52	1.82	22.29	0.15
ALMADEN MINERALS LTD	1509	0.16	5.13	-0.01	-0.15	3.57	-19.77	38.52	58.29	1.51	7.92	0.13
AUGUSTA RESOURCE CORP	1271	0.14	5.46	0.00	-0.08	3.46	-25.46	56.63	82.08	2.31	20.42	0.15
AURICO GOLD INC	1376	0.05	4.01	-0.11	0.00	3.29	-19.30	24.53	43.83	0.23	3.58	0.11
AURIZON MINES LTD	2035	0.13	4.03	-0.01	0.00	3.21	-20.10	33.80	53.90	0.79	6.16	0.09
BANRO CORP	1693	0.12	5.15	-0.09	-0.12	3.04	-30.56	54.34	84.90	1.65	16.73	0.13
BARRICK GOLD CORP	3701	0.06	2.70	-0.01	0.00	2.19	-14.65	31.31	45.96	0.70	8.19	0.04
BATTLE MOUNTAIN GOLD CO	1510	-0.03	4.55	-0.01	-0.22	3.57	-23.45	59.99	83.44	2.21	23.65	0.12
BEMA GOLD CORP	3037	0.18	5.54	-0.01	-0.01	3.62	-25.02	62.34	87.36	1.42	12.07	0.10
BENGUET CORP	1362	0.27	8.97	-0.01	0.09	10.59	-42.87	66.65	109.52	0.43	3.17	0.24

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Table 4.9 – *Continued from previous page*

COMPANY	**n**	$\bar{E}$	σ	**Median**	$\bar{E}_t$	**MAD**	**Min**	**Max**	**Range**	**S**	**K**	$\mathbf{SE}_{\bar{E}}$
BRIGUS GOLD CORP	2087	0.02	5.17	-0.01	-0.16	3.62	-30.78	92.31	123.08	3.03	51.18	0.11
CAMBIOR INC	2964	0.09	5.06	-0.01	-0.07	2.91	-37.27	39.98	77.25	0.77	9.22	0.09
CANYON RESOURCES CORP	1778	0.08	4.94	-0.01	-0.06	3.79	-52.44	31.99	84.43	-0.22	11.11	0.12
CARDERO RESOURCE CORP	1376	0.05	4.75	-0.01	-0.16	3.24	-26.05	34.31	60.36	1.12	7.60	0.13
CLAUDE RESOURCES INC	2012	0.10	4.49	-0.01	-0.06	3.33	-25.00	35.14	60.14	0.81	6.77	0.10
COEUR D ALENE MINES CORP ID	4248	0.05	4.74	-0.01	-0.07	3.45	-33.35	40.18	73.53	0.57	7.71	0.07
CORRIENTE RESOURCES INC	993	0.14	3.89	0.00	0.06	2.57	-20.60	20.09	40.69	0.45	5.29	0.12
CRYSTALLEX INTERNATIONAL CORP	2442	0.08	6.63	-0.01	-0.32	3.66	-50.00	100.00	150.00	3.27	45.44	0.13
DAYTON MINING CORP	1680	0.19	9.98	-0.01	-0.23	3.35	-42.87	49.99	92.86	0.91	5.81	0.24
ELDORADO GOLD CORP NEW	2236	0.16	3.79	0.00	0.09	3.10	-26.95	30.77	57.72	0.39	6.82	0.08
ENTREE GOLD INC	1615	0.09	5.01	-0.08	-0.11	4.00	-26.23	47.17	73.40	1.03	8.34	0.12
EXETER RESOURCES CORP	1285	0.13	4.78	-0.01	0.01	3.58	-23.42	34.13	57.55	0.59	5.97	0.13
FREEPORT MCMORAN COPPER & GOLD	4104	0.07	3.16	-0.01	0.08	2.43	-19.13	19.11	38.23	-0.00	3.78	0.05
GLAMIS GOLD LTD	2962	0.11	3.56	-0.01	-0.02	2.70	-13.17	24.99	38.16	0.75	4.08	0.07

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Table 4.9 – *Continued from previous page*

COMPANY	**n**	$\bar{E}$	σ	**Median**	$\bar{E}_t$	**MAD**	**Min**	**Max**	**Range**	**S**	**K**	$\mathbf{SE}_{\bar{E}}$
GOLD RESERVE INC	2060	0.12	5.34	-0.01	-0.05	3.33	-31.15	49.99	81.13	1.36	14.59	0.12
GOLDCORP INC NEW	4248	0.13	3.15	-0.01	0.05	2.43	-17.49	27.27	44.76	0.59	5.25	0.05
GOLDEN STAR RESOURCES LTD	3903	0.07	5.66	-0.01	-0.09	3.70	-49.52	66.02	115.54	1.08	12.37	0.09
GREAT BASIN GOLD LTD	2118	0.09	4.62	-0.01	-0.02	3.38	-36.51	68.75	105.26	1.82	29.25	0.10
H S RESOURCES INC	1650	0.11	2.96	-0.01	-0.03	2.16	-12.51	20.92	33.43	0.81	4.50	0.07
HECLA MINING CO	1665	-0.03	5.02	-0.01	-0.26	3.22	-22.09	37.25	59.34	1.11	6.57	0.12
HOMESTAKE MINING CO	1739	-0.01	3.06	-0.01	-0.14	2.43	-11.83	21.04	32.87	0.81	3.79	0.07
IAMGOLD CORP	2271	0.13	3.34	0.00	0.10	2.62	-21.24	30.63	51.88	0.39	6.99	0.07
INTERNATIONAL TOWER HILL MINES	1103	0.13	4.54	-0.01	-0.05	3.56	-15.74	28.96	44.70	0.70	3.21	0.14
IVANHOE MINES LTD	1240	0.21	4.79	0.15	0.09	3.16	-27.92	43.69	71.61	1.11	12.23	0.14
JAGUAR MINING INC	1112	0.11	4.87	-0.19	-0.02	3.63	-22.10	44.71	66.81	1.01	9.45	0.15
KEEGAN RESOURCES INC	1001	0.11	5.45	-0.18	-0.04	3.20	-27.95	55.00	82.95	1.40	15.23	0.17
KINROSS GOLD CORP	2229	0.07	3.34	0.00	0.03	2.78	-16.93	29.05	45.98	0.53	5.89	0.07
MERIDIAN GOLD INC	3248	0.13	3.67	-0.01	0.02	3.16	-15.08	38.76	53.84	0.89	7.02	0.06

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Table 4.9 – *Continued from previous page*

COMPANY	**n**	$\bar{E}$	σ	**Median**	$\bar{E}_t$	**MAD**	**Min**	**Max**	**Range**	**S**	**K**	$\mathbf{SE}_{\bar{E}}$
MINCO GOLD CORP	1527	0.11	5.92	-0.01	-0.22	4.44	-31.59	62.64	94.23	1.66	13.87	0.15
MINEFINDERS CORP LTD	2238	0.10	3.77	-0.12	-0.02	2.83	-21.43	25.91	47.34	0.83	6.26	0.08
MIRAMAR MINING CORP	1071	0.19	3.94	0.00	0.00	2.93	-22.81	23.87	46.68	0.68	4.22	0.12
NEVSUN RESOURCES LTD	1376	0.18	5.23	0.00	-0.02	3.61	-20.31	51.04	71.35	1.99	16.57	0.14
NEW GOLD INC	1376	0.15	5.55	-0.01	0.03	3.24	-38.09	100.00	138.09	4.35	81.50	0.15
NEWMONT MINING CORP	2583	0.07	2.56	0.03	0.05	2.13	-14.10	25.17	39.27	0.59	8.28	0.05
NORTHERN DYNASTY MINERALS LTD	1789	0.07	4.09	-0.01	-0.04	3.14	-18.55	32.67	51.22	0.86	6.72	0.10
NORTHGATE MINERALS CORP	2075	0.13	3.99	0.00	0.06	2.84	-27.34	58.41	85.75	1.57	26.45	0.09
NOVAGOLD RESOURCES INC	2021	0.16	5.35	0.00	0.03	2.93	-65.88	74.03	139.91	1.45	54.24	0.12
OREZONE RESOURCES INC	1235	0.07	6.05	-0.01	-0.09	3.43	-35.71	100.00	135.71	4.18	66.74	0.17
PACIFIC RIM MINING CORP	2088	0.08	5.51	-0.01	-0.12	3.85	-31.65	52.00	83.65	1.08	11.52	0.12
PLACER DOME INC	2794	0.04	3.00	-0.02	-0.04	2.60	-15.61	30.68	46.29	0.82	7.06	0.06
RICHMONT MINES INC	2520	0.16	3.76	0.00	0.07	2.77	-22.23	28.46	50.68	0.55	5.36	0.07
ROYAL OAK MINES INC	1031	-0.09	5.76	-0.01	-0.18	2.85	-33.35	46.14	79.49	0.91	9.93	0.18

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Table 4.9 – *Continued from previous page*

COMPANY	**n**	$\bar{E}$	σ	**Median**	$\bar{E}_t$	**MAD**	**Min**	**Max**	**Range**	**S**	**K**	$\mathbf{SE}_{\bar{E}}$
RUBICON MINERALS CORP	1829	0.18	4.64	-0.01	-0.09	3.46	-23.11	55.39	78.50	1.92	16.23	0.11
SEABRIDGE GOLD INC	1926	0.17	4.12	-0.01	0.04	3.28	-26.16	36.21	62.36	0.58	5.81	0.09
SOLITARIO EXPLOR & ROYALTY CORP	1347	0.01	4.06	0.00	-0.07	2.87	-14.96	32.82	47.77	0.75	5.68	0.11
T V X GOLD INC	1000	0.02	6.28	-0.01	-0.15	4.67	-30.54	53.83	84.37	0.67	7.77	0.20
TANZANIAN ROYALTY EXPL CORP	1660	0.12	4.30	-0.01	0.02	3.04	-33.04	36.03	69.07	0.64	10.51	0.11
TASEKO MINES LTD	1811	0.12	4.44	-0.01	0.00	3.42	-24.23	27.63	51.86	0.36	3.64	0.10
TECK RESOURCES LTD	1241	0.14	4.56	0.23	0.16	3.14	-27.77	34.55	62.32	-0.04	7.04	0.13
U S GOLD CORP	1264	0.06	4.89	0.00	-0.10	3.97	-23.56	39.13	62.69	0.80	5.76	0.14
VISTA GOLD CORP	4248	0.27	8.63	-0.01	-0.10	3.61	-81.26	100.00	181.26	1.49	17.10	0.13
YAMANA GOLD INC	1376	0.10	3.60	0.08	0.05	3.01	-19.48	22.50	41.98	0.23	4.25	0.10

Chapter 5

Methodology

Risk-adjusted performance measures help investors evaluate assets with different risk profiles. Two investments with the same expected return, for example, are not necessarily equivalent after one considers the riskiness of each investment. It is therefore necessary to calculate risk-adjusted performance as a way of standardizing performance in order to facilitate the comparison of different investment alternatives. This is achieved by scaling an investment's excess return by an appropriate risk measure.

The following sections of this thesis will provide a detailed explanation of the four risk-adjusted performance measures that will be analyzed: the Sharpe ratio, excess return on value at risk, the conditional Sharpe ratio, and the modified Sharpe ratio. I will describe the reasoning behind using each of the ratios and detailed explanations of the equations used to calculate each of the measures will be presented.

5.1 The Sharpe ratio

The Sharpe ratio is perhaps the most well-known risk-adjusted performance measure. A number of financial information providers publish Sharpe ratios for many mutual funds, ETFs, and other investments. The Sharpe ratio is defined as follows,

on an *ex-post* basis:

$$\text{Sharpe ratio}_i = \frac{\bar{E}_i}{\sigma_i} \tag{5.1}$$

Where:

$\bar{E}_i$ = the mean excess return for asset i over the period from day $t = 1$ through T

$$= \frac{1}{T} \cdot \sum_{t=1}^{T} E_{it}$$

E_{it} = the excess return on asset i on day t

$$= R_{it} - RF_t$$

R_{it} = the daily return on asset i on day t

RF_t = the risk-free return on day t

$$\sigma_i = \text{the standard deviation of excess returns} = \sqrt{\frac{1}{T-1} \cdot \sum_{t=1}^{T} (E_{it} - \bar{E}_i)^2}$$

Excess return is defined the same way in the numerator of each of the performance measures examined in this thesis. The difference between each performance ratio lies in the risk measure used to scale the average excess return.

The Sharpe ratio uses the standard deviation of excess returns as the measure of risk:

$$(\sigma_i)$$

The standard deviation, by definition, measures both positive and negative deviations around the mean excess return. As such, it measures the *dispersion* of observations around the mean.

The Sharpe ratio provides a simple and convenient way of comparing the performance of different investments. The Sharpe ratio breaks down an investment's extra return per unit of risk, and enables market practitioners to easily compare the Sharpe ratios of different investments. For example, one can compare the

Sharpe ratios of an index fund and a hedge fund to determine which provides the greater risk-adjusted excess return.

The main criticism of the Sharpe ratio is that it is not appropriate when returns do not follow the normal distribution. Critics argue that the use of the Sharpe ratio in situations where returns follow any asymmetrical distribution will result in erroneous risk assessment. For example, use of the standard deviation in a case where the return distribution exhibits fatter tails and a greater probability of extreme losses would lead one to underestimate risk and overestimate risk-adjusted performance. The performance measures that follow are designed to address this problem as the risk measures they incorporate provide a more accurate method of capturing the *risk of loss*, rather than the *dispersion* of returns around a central value.

5.2 Excess return on value at risk

Excess return on value at risk is similar to the Sharpe ratio, but it uses value at risk (VaR) as the risk measure in the denominator of the ratio:

$$\text{Excess return on value at risk}_i = \frac{\bar{E}_i}{VaR_i} \tag{5.2}$$

Where:

$$\bar{E}_i = \text{the mean excess return for asset } i \text{ over the period from day } t = 1 \text{ through } T$$
$$= \frac{1}{T} \cdot \sum_{t=1}^{T} E_{it}$$
$$E_{it} = \text{the excess return on asset } i \text{ on day } t$$
$$= R_{it} - RF_t$$
$$R_{it} = \text{the daily return on asset } i \text{ on day } t$$
$$RF_t = \text{the risk-free return on day } t$$
$$VaR_i = \text{value at risk} = -(\bar{E}_i + z_\alpha \sigma_i)$$
$$z_\alpha = \text{the } \alpha - \text{quantile of the standard normal distribution}$$
$$\sigma_i = \text{the standard deviation of excess returns} = \sqrt{\frac{1}{T-1} \cdot \sum_{t=1}^{T} (E_{it} - \bar{E}_i)^2}$$

VaR is used extensively in financial risk management. It represents a threshold value for the probable loss on an investment portfolio or asset. Eling (2008) defines VaR as the probable loss that is not exceeded with a given probability of

$$(1 - \alpha)$$

For example, VaR can be used if one would like to know the maximum loss that is likely to be incurred on a portfolio or asset 99% of the time. In this case,

$$(1 - \alpha) = 0.99$$

Alternatively, we can state that there is a 1% chance that the loss incurred over the given period will exceed the VaR.

The advantage of excess return on value at risk relative to the traditional Sharpe ratio is that using VaR as the risk metric provides a greater emphasis on downside

risk. It provides a simple way of evaluating the likelihood of incurring losses over and above the VaR. The main drawback to the use of VaR is that it does not consider the *magnitude* of those losses. This weakness led to the development of conditional value at risk (CVaR). CVaR is the risk metric used in the conditional Sharpe ratio, which is explained below.

5.3 Conditional Sharpe ratio

The conditional Sharpe ratio incorporates conditional value at risk (CVaR) and is defined below:

$$\text{Conditional Sharpe ratio}_i = \frac{\bar{E}_i}{CVaR_i} \tag{5.3}$$

Where:

$$\begin{aligned}
\bar{E}_i &= \text{the mean excess return for asset } i \text{ over the period from day } t = 1 \text{ through } T \\
&= \frac{1}{T} \cdot \sum_{t=1}^{T} E_{it} \\
E_{it} &= \text{the excess return on asset } i \text{ on day } t \\
&= R_{it} - RF_t \\
R_{it} &= \text{the daily return on asset } i \text{ on day } t \\
RF_t &= \text{the risk-free return on day } t \\
CVaR_i &= \text{conditional value at risk} = E(-E_{it} \mid E_{it} \leq -VaR_i)
\end{aligned}$$

For a given confidence level, CVaR quantifies the expected loss given that VaR is exceeded. CVaR is an improvement relative to VaR because it directly considers the distribution of excess returns below the VaR and provides an average estimate of the magnitude of losses if the VaR threshold is exceeded.

The disadvantage of using CVaR is that it only considers losses in excess of VaR.

Losses that are smaller than the

$$\alpha$$

percentile are not considered. It can also be argued that CVaR fails to properly quantify extreme losses that don't occur frequently, since it is based on an average loss. Modified value at risk (MVaR) corrects for the deficiencies of both VaR and CVaR, as we will see below in the discussion of the modified Sharpe ratio.

5.4 Modified Sharpe ratio

The modified Sharpe ratio is defined as follows:

$$\text{Modified Sharpe ratio}_i = \frac{\bar{E}_i}{MVaR_i} \tag{5.4}$$

Where:

$$\bar{E}_i = \text{the mean excess return for asset } i \text{ over the period from day } t = 1 \text{ through } T$$

$$= \frac{1}{T} \cdot \sum_{t=1}^{T} E_{it}$$

$$E_{it} = \text{the excess return on asset } i \text{ on day } t$$

$$= R_{it} - RF_t$$

$$R_{it} = \text{the daily return on asset } i \text{ on day } t$$

$$RF_t = \text{the risk-free return on day } t$$

$$MVaR_i = \text{modified value at risk}$$

$$= -\{\bar{E}_i + \sigma_i[z_\alpha + (z_\alpha^2 - 1) \cdot \frac{S_i}{6} + (z_\alpha^3 - 3z_\alpha) \cdot \frac{K_i}{24} - (2z_\alpha^3 - 5z_\alpha) \cdot \frac{S_i^2}{36}]\}$$

$$\sigma_i = \text{the standard deviation of excess returns}$$

$$= \sqrt{\frac{1}{T-1} \cdot \sum_{t=1}^{T} (E_{it} - \bar{E}_i)^2}$$

$$z_\alpha = \text{the } \alpha - \text{quantile of the standard normal distribution}$$

$$S_i = \text{skewness} = \frac{\frac{1}{T} \cdot \sum_{t=1}^{T} (E_{it} - \bar{E}_i)^3}{\sigma_i^3}$$

$$K_i = \text{excess kurtosis} = \frac{\frac{1}{T} \cdot \sum_{t=1}^{T} (E_{it} - \bar{E}_i)^4}{\sigma_i^4 - 3}$$

Modified value at risk (MVaR) is the alternative method of calculating VaR that accounts for the skewness and kurtosis of non-normal return distributions. As such, it is a significant improvement on both VaR and CVaR because it considers the entire distribution of returns as well as the shape of the distribution.

Chapter 6

Hypotheses

The ultimate investment objective of any rational investor is to maximize return. As we have seen, it is not enough to evaluate different investments simply by comparing nominal returns. The return must be scaled by an appropriate risk measure to reflect the risk that was borne by the investor in order to generate the return. As such, we can state that the ultimate investment objective for any rational investor should be to maximize their *risk-adjusted* returns. For investors who wish to gain exposure to appreciation in the price of gold, the best investment will be the one that provides the greatest risk-adjusted return.

The first step in the evaluation of the different gold investments is to calculate the risk measures and risk-adjusted performance measures described in the preceding Chapter. The results of these calculations on both an individual and group basis can be found in Chapter 7. The second step in the evaluation of the different gold investments is to compare the different investments using the risk-adjusted performance measures. The following sections of this Chapter will examine the methods that will be used for comparison as well as the hypotheses that will be tested.

6.1 Testing for the equality of means across groups

A comparison of the average risk-adjusted performance across the three samples is important for a number of reasons. As previously mentioned, it allows investors to properly assess the relative performance of each of the groups (ETFs, mutual funds, and stocks) and facilitates the investment decision-making process. Second, the comparison across groups has important implications for the investment management industry as a whole. For example, the entire existence of the mutual fund industry is predicated on mutual funds being able to add value for investors by consistently outperforming their respective benchmarks. If a comparison of the mean risk-adjusted performance across the three samples were to show that there were no differences in performance between the three groups, we could be inclined to conclude that there was little value to holding a mutual fund relative to an ETF. In such a case, the funds' relatively higher fees would not be justified by their performance relative to that of the ETFs, and there would be no advantage to holding mutual funds. This has obvious implications not only for individuals, but also for institutional investors.

The following section will describe the single-factor analysis of variance (ANOVA) model we will use to examine the differences between each of the average risk-adjusted performance measures across the three samples.

6.1.1 Single-factor ANOVA model

We use the following single-factor ANOVA model to test the equality of factor level means:

$$\mathbf{Y} = \mathbf{XB} + \boldsymbol{\epsilon} \tag{6.1}$$

Where:

$$\mathbf{Y} = \begin{bmatrix} Y_{1,1} \\ \vdots \\ Y_{1,11} \\ Y_{2,1} \\ \vdots \\ Y_{2,14} \\ Y_{3,1} \\ \vdots \\ Y_{3,64} \end{bmatrix} \qquad \mathbf{X} = \begin{bmatrix} 1 & 0 & 0 \\ \vdots & \vdots & \vdots \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ \vdots & \vdots & \vdots \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ \vdots & \vdots & \vdots \\ 0 & 0 & 1 \end{bmatrix} \qquad \mathbf{B} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \end{bmatrix} \qquad \boldsymbol{\epsilon} = \begin{bmatrix} \epsilon_{1,1} \\ \vdots \\ \epsilon_{1,11} \\ \epsilon_{2,1} \\ \vdots \\ \epsilon_{2,14} \\ \epsilon_{3,1} \\ \vdots \\ \epsilon_{3,64} \end{bmatrix}$$

$\mathbf{Y}$ = a vector containing the performance ratio being examined across groups

Y_{ij} = the jth calculation of the performance ratio being examined for the ith factor level

i = one of three factor levels identifying group membership

$i = 1$ if the ratio is for an ETF

$i = 2$ if the ratio is for a mutual fund

$i = 3$ if the ratio is for a stock

$\mathbf{X}$ = a matrix of dummy variables identifying group membership

$\mathbf{B}$ = a vector containing the factor level means

$\boldsymbol{\epsilon}$ = a vector of error terms, where $\epsilon_{ij} = Y_{ij} - \mu_i$

As mentioned at the beginning of this section, we are interested in determining whether the factor level means μ_i are equal. As such, the two alternatives we wish to test are the following:

$$H_0 : \mu_1 = \mu_2 = \mu_3$$

$$H_a : \text{not all } \mu_i \text{ are equal}$$

The test statistic that we use to choose between the two alternatives is defined as follows:

$$F^* = \frac{MSTR}{MSE}$$

Where:

$$MSTR = \text{treatment mean square} = \frac{SSTR}{r-1} = \frac{SSTR}{2}$$

$$SSTR = \sum_i n_i(\bar{Y}_{i.} - \bar{Y}_{..})^2$$

$$MSE = \text{error mean square} = \frac{SSE}{n_t - r} = \frac{SSE}{86}$$

$$SSE = \sum_i \sum_j (Y_{ij} - \bar{Y}_{i.})^2 = \sum_i \sum_j \epsilon_{ij}^2$$

$$r = \text{the number of factor levels} = 3$$

$$n_t = \text{the total number of cases} = 89$$

The decision rule is to reject H_0 if :

$$F^* > F(1-\alpha; 2, 86)$$

Where:

$$F(1-\alpha; 2, 86)$$

is the $(1-\alpha)100$ percentile of the F distribution with 2 and 86 degrees of freedom. The critical value at the 95% significance level ($\alpha = 0.05$) is:

$$F(0.95; 2, 86) = 3.10$$

We therefore reject H_0 if :

$$F^* > 3.10$$

We repeat the test for the equality of factor level means for each performance ratio being examined: the Sharpe ratio, excess return on value at risk, the conditional Sharpe ratio, and the modified Sharpe ratio. These hypotheses are enumerated and explained in greater detail in the sections that follow.

6.1.2 The Sharpe ratio

The first hypothesis we test is for equality of the mean Sharpe ratio across factor levels:

$$H_0 : \mu_1 = \mu_2 = \mu_3$$

$$H_a : \text{not all } \mu_i \text{ are equal}$$

Where:

μ_1 = the mean Sharpe ratio for factor level 1 (ETFs)

μ_2 = the mean Sharpe ratio for factor level 2 (mutual funds)

μ_3 = the mean Sharpe ratio for factor level 3 (stocks)

6.1.3 Excess return on value at risk

The second hypothesis we test is for equality of the mean excess return on value at risk across factor levels:

$$H_0 : \mu_1 = \mu_2 = \mu_3$$

$$H_a : \text{not all } \mu_i \text{ are equal}$$

Where:

μ_1 = the mean excess return on value at risk for factor level 1 (ETFs)

μ_2 = the mean excess return on value at risk for factor level 2 (mutual funds)

μ_3 = the mean excess return on value at risk for factor level 3 (stocks)

6.1.4 Conditional Sharpe ratio

The third hypothesis we test is for equality of the mean conditional Sharpe ratio across factor levels:

$$H_0 : \mu_1 = \mu_2 = \mu_3$$

$$H_a : \text{not all } \mu_i \text{ are equal}$$

Where:

μ_1 = the mean conditional Sharpe ratio for factor level 1 (ETFs)

μ_2 = the mean conditional Sharpe ratio for factor level 2 (mutual funds)

μ_3 = the mean conditional Sharpe ratio for factor level 3 (stocks)

6.1.5 Modified Sharpe ratio

The fourth hypothesis we test is for equality of the mean modified Sharpe ratio across factor levels:

$$H_0 : \mu_1 = \mu_2 = \mu_3$$

$$H_a : \text{not all } \mu_i \text{ are equal}$$

Where:

μ_1 = the mean modified Sharpe ratio for factor level 1 (ETFs)

μ_2 = the mean modified Sharpe ratio for factor level 2 (mutual funds)

μ_3 = the mean modified Sharpe ratio for factor level 3 (stocks)

The results of each of these hypothesis tests are presented and discussed in the following chapter.

Chapter 7

Results

Table 7.1 below contains the risk measures and performance ratios for each of the three samples. It is interesting to note that while the ETF sample had a lower average excess return (0.06%) relative to that of the mutual funds (0.08%), the ETFs seemed to be the riskier investment. Modified value at risk (MVaR) for the ETFs, for example, was 11.35 relative to 8.68 for the mutual funds. The stock sample had the highest average excess return (0.1%) but investing in gold stocks entailed assuming a much higher level of risk relative to gold funds or ETFs , since each of the risk measures for the stock group was at least twice as large as those for the mutual fund sample. Mutual funds seemed to do better than ETFs when we look at risk-adjusted performance as well. Each of the performance ratios for the mutual funds was higher than that of the ETFs, which in turn seemed to do better than stocks. For example, the modified Sharpe ratio (MSR) for the mutual funds was 0.009 relative to 0.006 for the ETFs and 0.002 for stocks.

Table 7.2 contains the results from our tests for the equality of mean performance using the single factor ANOVA model. From Table 7.2, we see that for each of the first three performance ratios (the Sharpe ratio, excess return on value at risk, and the conditional Sharpe ratio) we fail to reject the null hypothesis of no difference in mean performance between the three samples. In each case, the F^* statistic is less than our critical F value (3.10). However, the results are different when

we use the modified Sharpe ratio (MSR) as our performance measure. We see from the last row of Table 7.2 that F^* (4.98) is greater than our critical F value (3.10), leading to a rejection of the null hypothesis of no difference in mean performance across the three groups (at the 1% level of significance). This suggests that taking the higher moments into consideration is important when calculating risk measures and performance ratios for return distributions that deviate from normality, as it leads to different conclusions when comparing investments. This is consistent with the results of Gregoriou and Gueyie (2003) but contradicts those of Eling (2008).

Table 7.3 contains the risk measures and performance ratios for each of the ETFs. When we used the modified Sharpe ratio as our performance criterion, we found that the ETF with the best risk-adjusted performance was the ETFS Physical Swiss Gold Shares. It had the highest modified Sharpe ratio (0.0275). The ETF with the poorest performance was the Global X Gold Explorers ETF, with a modified Sharpe ratio of -0.0138.

Table 7.4 contains the risk measures and performance ratios for each of the funds in the mutual fund sample. The funds in this group are of particular interest to individual investors since the mutual fund sample had better risk-adjusted performance relative to both ETFs and stocks, when performance was measured using the modified Sharpe ratio. The fund still in existence at the time of this writing with the highest modified Sharpe ratio (0.0124) was the Tocqueville Gold Fund (the Gold Bank Equity Fund had a modified Sharpe ratio of 0.0163, but this fund was delisted in 2006). The fund still in existence with the poorest risk-adjusted performance (with a modified Sharpe ratio of 0.0073) was the Fidelity Select Gold Portfolio (the Mercury Gold and Mining Fund had a modified Sharpe ratio of -0.0011, but was acquired by Merrill Lynch in 1997).

Table 7.5 contains the risk measures and performance ratios for each of the gold miners in the stock sample. The stock with the best risk adjusted performance was Miramar Mining Corp., with a modified Sharpe ratio of 0.0129. This com-

pany was acquired by Newmont Mining Corp. in 2007, making Richmont Mines Ltd. the currently active stock with the best risk-adjusted performance (with a modified Sharpe ratio of 0.0105). It is interesting to note that a majority of Richmont's exploration and mining activities take place right here in the province of Quebec. The stock with the lowest modified Sharpe ratio (-0.0029) was Royal Oak Mines Ltd. (which went bankrupt in 1999) followed by Hecla Mining Co. (with a modified Sharpe ratio of -0.0011).

Table 7.1: Risk measures and risk-adjusted performance ratios by group

Table 7.1 below provides risk measures and risk-adjusted performance ratios for each sample, where: $\bar{E}$=the mean daily excess return; VaR=value at risk; CVaR=conditional value at risk; MVaR=modified value at risk; Sharpe=the Sharpe ratio; $\bar{E}$/VaR=excess return on value at risk; CSR=the conditional Sharpe ratio; MSR=the modified Sharpe ratio.

GROUP	$\bar{E}$	**VaR**	**CVaR**	**MVaR**	**Sharpe**	$\bar{E}$**/VaR**	**CSR**	**MSR**
ETFs	0.06	5.05	7.40	11.35	0.029	0.012	0.009	0.006
Mutual funds	0.08	4.81	6.82	8.68	0.036	0.016	0.011	0.009
Stocks	0.1	11.2	16.3	43.1	0.022	0.010	0.007	0.002

Table 7.2: ANOVA results - Tests for equality of mean performance by performance measure

PERFORMANCE MEASURE	**Source**	**Df**	**Sum Sq**	**Mean Sq**	**F value**	**Pr(>F)**
Sharpe ratio	Group	2	0.001370	0.000685	2.155364	0.122079
	Residuals	86	0.027339	0.000318		
Excess return on value at risk ($\bar{E}$/VaR)	Group	2	0.000268	0.000134	2.211910	0.115683
	Residuals	86	0.005215	0.000061		
Conditional Sharpe ratio (CSR)	Group	2	0.000126	0.000063	1.842024	0.164695
	Residuals	86	0.002951	0.000034		
Modified Sharpe ratio (MSR)	Group	2	0.000317	0.000158	4.989495	0.008910**
	Residuals	86	0.002731	0.000032		

**Significant at the 1% level

Table 7.3: Risk measures and risk-adjusted performance ratios by ETF

Table 7.3 below provides risk measures and risk-adjusted performance ratios for each ETF, where: $\bar{E}$=the mean daily excess return; VaR=value at risk; CVaR=conditional value at risk; MVaR=modified value at risk; Sharpe=the Sharpe ratio; $\bar{E}$/VaR=excess return on value at risk; CSR=the conditional Sharpe ratio; MSR=the modified Sharpe ratio.

FUND	$\bar{E}$	**VaR**	**CVaR**	**MVaR**	**Sharpe**	$\bar{E}$**/VaR**	**CSR**	**MSR**
Direxion Daily Gold Miners Bull 2X Shares	-0.0651	11.8056	13.5193	14.3893	-0.0129	-0.0055	-0.0048	-0.0045
ETFS Physical Swiss Gold Shares	0.0750	2.6424	3.7011	2.7269	0.0643	0.0284	0.0203	0.0275
Global X Gold Explorers ETF	-0.0792	5.6086	6.9072	5.7606	-0.0334	-0.0141	-0.0115	-0.0138
Global X Pure Gold Miners ETF	-0.0377	4.5824	5.6023	4.4372	-0.0193	-0.0082	-0.0067	-0.0085
iShares Gold Trust	0.0778	2.9863	3.9552	4.0889	0.0592	0.0261	0.0197	0.0190
Market Vectors Gold Miners ETF	0.0608	6.6062	9.3154	14.1046	0.0212	0.0092	0.0065	0.0043
Market Vectors Junior Gold Miners ETF	0.0355	5.5331	7.4345	5.3381	0.0148	0.0064	0.0048	0.0066
PowerShares DB Gold Fund	0.0743	3.0199	3.9932	4.2075	0.0560	0.0246	0.0186	0.0177
PowerShares Global Gold & Precious Metals Portfolio	0.0737	6.1907	10.1104	15.0425	0.0274	0.0119	0.0073	0.0049
ProShares Ultra Gold	0.1631	5.6782	7.6165	7.4014	0.0651	0.0287	0.0214	0.0220
SPDR Gold Shares	0.0769	2.9548	3.9693	3.6998	0.0591	0.0260	0.0194	0.0208

Table 7.4: Risk measures and risk-adjusted performance ratios by mutual fund

Table 7.4 below provides risk measures and risk-adjusted performance ratios for each fund, where: $\bar{E}$=the mean daily excess return; VaR=value at risk; CVaR=conditional value at risk; MVaR=modified value at risk; Sharpe=the Sharpe ratio; $\bar{E}$/VaR=excess return on value at risk; CSR=the conditional Sharpe ratio; MSR=the modified Sharpe ratio.

FUND	$\bar{E}$	**VaR**	**CVaR**	**MVaR**	**Sharpe**	$\bar{E}$**/VaR**	**CSR**	**MSR**
Fidelity Select Gold Portfolio	0.0793	4.9451	7.2773	10.8005	0.0368	0.0160	0.0109	0.0073
First Eagle SoGen Gold Fund	0.0763	4.1483	5.6411	6.9438	0.0421	0.0184	0.0135	0.0110
Franklin Gold & Precious Metals Fund	0.0781	4.6536	6.8559	9.2727	0.0385	0.0168	0.0114	0.0084
Gold Bank Equity Fund	0.0356	1.8466	2.2886	2.1756	0.0440	0.0193	0.0155	0.0164
Lexington Goldfund	0.0559	4.5997	6.6413	6.4283	0.0280	0.0122	0.0084	0.0087
Mercury Gold and Mining Fund	-0.0124	3.9053	4.8280	11.5454	-0.0074	-0.0032	-0.0026	-0.0011
OCM Gold Fund	0.0889	5.4642	7.6051	10.1185	0.0373	0.0163	0.0117	0.0088
Oppenheimer Gold & Special Minerals Fund	0.0883	5.0898	7.2830	9.2640	0.0398	0.0174	0.0121	0.0095
Scudder Gold Fund	0.0786	4.9154	7.0753	9.2475	0.0367	0.0160	0.0111	0.0085
Tocqueville Gold Fund	0.0925	4.6756	6.6121	7.4732	0.0452	0.0198	0.0140	0.0124
U.S. Gold Shares Fund	0.0765	5.1692	6.8168	8.1708	0.0340	0.0148	0.0112	0.0094
U.S. World Gold Fund	0.0655	4.9689	6.9163	7.9129	0.0303	0.0132	0.0095	0.0083
Van Eck International Investors Gold Fund	0.0865	5.3972	7.6759	9.0201	0.0367	0.0160	0.0113	0.0096
Vanguard Gold and Precious Metals Fund	0.0693	4.2739	6.1442	6.2095	0.0372	0.0162	0.0113	0.0112

Table 7.5 - Risk measures and risk-adjusted performance ratios by stock

Table 7.5: This table provides risk measures and risk-adjusted performance ratios for each stock, where: $\bar{E}$=the mean daily excess return; VaR=value at risk; CVaR=conditional value at risk; MVaR=modified value at risk; Sharpe=the Sharpe ratio; $\bar{E}$/VaR=excess return on value at risk; CSR=the conditional Sharpe ratio; MSR=the modified Sharpe ratio.

COMPANY	$\bar{E}$	**VaR**	**CVaR**	**MVaR**	**Sharpe**	$\bar{E}$**/VaR**	**CSR**	**MSR**
AGNICO EAGLE MINES LTD	0.0822	7.6468	11.0564	13.0433	0.0248	0.0108	0.0074	0.0063
ALEXCO RESOURCE CORP	0.1291	11.0240	14.0815	19.9294	0.0270	0.0117	0.0092	0.0065
ALLIED NEVADA GOLD CORP	0.2795	11.6368	16.5802	42.1201	0.0546	0.0240	0.0169	0.0066
ALMADEN MINERALS LTD	0.1560	11.7956	13.9259	25.2524	0.0304	0.0132	0.0112	0.0062
AUGUSTA RESOURCE CORP	0.1352	12.5803	15.1439	41.3783	0.0248	0.0107	0.0089	0.0033
AURICO GOLD INC	0.0473	9.2963	13.1813	13.6051	0.0118	0.0051	0.0036	0.0035
AURIZON MINES LTD	0.1306	9.2697	11.9510	17.5986	0.0324	0.0141	0.0109	0.0074
BANRO CORP	0.1171	11.8855	17.3346	36.0310	0.0227	0.0099	0.0068	0.0033
BARRICK GOLD CORP	0.0569	6.2279	8.3545	12.9584	0.0211	0.0091	0.0068	0.0044
BATTLE MOUNTAIN GOLD CO	-0.0284	10.6317	13.0047	38.3878	-0.0062	-0.0027	-0.0022	-0.0007
BEMA GOLD CORP	0.1806	12.7209	17.0715	32.6825	0.0326	0.0142	0.0106	0.0055
BENGUET CORP	0.2730	20.6214	29.5148	30.8680	0.0304	0.0132	0.0092	0.0088

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Table 7.5 – *Continued from previous page*

COMPANY	$\bar{E}$	**VaR**	**CVaR**	**MVaR**	**Sharpe**	$\bar{E}$**/VaR**	**CSR**	**MSR**
BRIGUS GOLD CORP	0.0169	12.0328	17.4021	73.2721	0.0033	0.0014	0.0010	0.0002
CAMBIOR INC	0.0896	11.6997	16.9370	25.7436	0.0177	0.0077	0.0053	0.0035
CANYON RESOURCES CORP	0.0798	11.4390	17.4431	23.1505	0.0162	0.0070	0.0046	0.0034
CARDERO RESOURCE CORP	0.0452	11.0182	13.6827	22.9893	0.0095	0.0041	0.0033	0.0020
CLAUDE RESOURCES INC	0.0975	10.3561	14.4980	20.2976	0.0217	0.0094	0.0067	0.0048
COEUR D ALENE MINES CORP ID	0.0488	10.9958	15.9738	21.9225	0.0103	0.0044	0.0031	0.0022
CORRIENTE RESOURCES INC	0.1441	8.9167	13.0906	15.3641	0.0371	0.0162	0.0110	0.0094
CRYSTALLEX INTERNATIONAL CORP	0.0781	15.3753	26.2975	82.8316	0.0118	0.0051	0.0030	0.0009
DAYTON MINING CORP	0.1903	23.0620	30.6928	43.3750	0.0191	0.0083	0.0062	0.0044
ELDORADO GOLD CORP NEW	0.1649	8.6543	13.4269	16.1060	0.0436	0.0191	0.0123	0.0102
ENTREE GOLD INC	0.0857	11.5937	16.6290	24.9783	0.0171	0.0074	0.0052	0.0034
EXETER RESOURCES CORP	0.1299	11.0108	15.8099	20.1642	0.0272	0.0118	0.0082	0.0064
FREEPORT MCMORAN COPPER & GOLD	0.0736	7.2812	10.1095	10.0811	0.0233	0.0101	0.0073	0.0073
GLAMIS GOLD LTD	0.1056	8.1975	9.9618	13.7285	0.0296	0.0129	0.0106	0.0077

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Table 7.5 – *Continued from previous page*

COMPANY	$\bar{E}$	**VaR**	**CVaR**	**MVaR**	**Sharpe**	$\bar{E}$**/VaR**	**CSR**	**MSR**
GOLD RESERVE INC	0.1196	12.3116	16.8542	34.7265	0.0224	0.0097	0.0071	0.0034
GOLDCORP INC NEW	0.1290	7.1996	9.5016	12.6764	0.0410	0.0179	0.0136	0.0102
GOLDEN STAR RESOURCES LTD	0.0670	13.1185	17.5114	33.6702	0.0118	0.0051	0.0038	0.0020
GREAT BASIN GOLD LTD	0.0857	10.6753	15.0970	45.7694	0.0186	0.0080	0.0057	0.0019
H S RESOURCES INC	0.1075	6.7952	9.0507	11.7836	0.0363	0.0158	0.0119	0.0091
HECLA MINING CO	-0.0255	11.7317	15.4089	23.1526	-0.0051	-0.0022	-0.0017	-0.0011
HOMESTAKE MINING CO	-0.0077	7.1382	8.9306	11.7742	-0.0025	-0.0011	-0.0009	-0.0007
IAMGOLD CORP	0.1264	7.6646	10.8680	14.3834	0.0378	0.0165	0.0116	0.0088
INTERNATIONAL TOWER HILL MINES	0.1324	10.4509	12.1976	16.4747	0.0292	0.0127	0.0109	0.0080
IVANHOE MINES LTD	0.2133	10.9462	15.9986	28.2519	0.0445	0.0195	0.0133	0.0075
JAGUAR MINING INC	0.1067	11.2377	16.5152	25.4960	0.0219	0.0095	0.0065	0.0042
KEEGAN RESOURCES INC	0.1092	12.5785	17.5616	36.3057	0.0201	0.0087	0.0062	0.0030
KINROSS GOLD CORP	0.0750	7.6996	10.5419	13.8831	0.0225	0.0097	0.0071	0.0054
MERIDIAN GOLD INC	0.1325	8.4240	10.8403	16.9115	0.0361	0.0157	0.0122	0.0078

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Table 7.5 – *Continued from previous page*

COMPANY	$\bar{E}$	**VaR**	**CVaR**	**MVaR**	**Sharpe**	$\bar{E}$**/VaR**	**CSR**	**MSR**
MINCO GOLD CORP	0.1123	13.6768	18.9655	37.4121	0.0190	0.0082	0.0059	0.0030
MINEFINDERS CORP LTD	0.1009	8.6783	11.4157	16.6160	0.0268	0.0116	0.0088	0.0061
MIRAMAR MINING CORP	0.1949	8.9789	12.1483	15.0832	0.0495	0.0217	0.0160	0.0129
NEVSUN RESOURCES LTD	0.1796	12.0132	16.2096	35.7989	0.0343	0.0149	0.0111	0.0050
NEW GOLD INC	0.1537	12.7845	19.0974	105.6958	0.0277	0.0120	0.0080	0.0015
NEWMONT MINING CORP	0.0719	5.8947	8.1841	12.1746	0.0281	0.0122	0.0088	0.0059
NORTHERN DYNASTY MINERALS LTD	0.0725	9.4504	12.6450	18.5592	0.0177	0.0077	0.0057	0.0039
NORTHGATE MINERALS CORP	0.1288	9.1593	13.1548	37.0324	0.0323	0.0141	0.0098	0.0035
NOVAGOLD RESOURCES INC	0.1642	12.3028	24.1424	84.8606	0.0307	0.0134	0.0068	0.0019
OREZONE RESOURCES INC	0.0716	14.0307	21.6180	96.3983	0.0118	0.0051	0.0033	0.0007
PACIFIC RIM MINING CORP	0.0804	12.7643	18.8613	31.6903	0.0146	0.0063	0.0043	0.0025
PLACER DOME INC	0.0372	6.9633	8.9213	13.8416	0.0124	0.0053	0.0042	0.0027
RICHMONT MINES INC	0.1597	8.6028	11.4569	15.1477	0.0425	0.0186	0.0139	0.0105
ROYAL OAK MINES INC	-0.0911	13.5136	17.7677	30.8462	-0.0158	-0.0067	-0.0051	-0.0030

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Table 7.5 – *Continued from previous page*

COMPANY	$\bar{E}$	**VaR**	**CVaR**	**MVaR**	**Sharpe**	$\bar{E}$**/VaR**	**CSR**	**MSR**
RUBICON MINERALS CORP	0.1820	10.6319	14.4557	31.4727	0.0392	0.0171	0.0126	0.0058
SEABRIDGE GOLD INC	0.1677	9.4359	12.2483	17.1256	0.0407	0.0178	0.0137	0.0098
SOLITARIO EXPLOR & ROYALTY CORP	0.0130	9.4394	12.0546	17.2873	0.0032	0.0014	0.0011	0.0008
T V X GOLD INC	0.0155	14.6256	21.0701	29.6273	0.0025	0.0011	0.0007	0.0005
TANZANIAN ROYALTY EXPL CORP	0.1212	9.8983	14.4502	22.8417	0.0282	0.0122	0.0084	0.0053
TASEKO MINES LTD	0.1157	10.2207	13.4261	15.5321	0.0261	0.0113	0.0086	0.0074
TECK RESOURCES LTD	0.1392	10.4929	15.5062	17.8852	0.0305	0.0133	0.0090	0.0078
U S GOLD CORP	0.0637	11.3344	15.2894	21.0115	0.0130	0.0056	0.0042	0.0030
VISTA GOLD CORP	0.2668	19.8462	23.8734	61.1841	0.0309	0.0134	0.0112	0.0044
YAMANA GOLD INC	0.0972	8.2872	11.4234	12.7089	0.0270	0.0117	0.0085	0.0076

Chapter 8

Conclusion

Prior studies have shown that investing in gold can, to varying degrees, provide a hedge against inflation and some of the negative effects of economic recessions. Investors wishing to invest in gold have a number of choices available to them, which for even the most sophisticated investors can be a daunting task. The purpose of this thesis was to assess whether there are differences in the performance of three investments in gold in order to help individual investors choose the best way to gain exposure to appreciation in the price of gold.

We used a single-factor ANOVA model to compare the Sharpe ratio, excess return on value at risk, the conditional Sharpe ratio, and the modified Sharpe ratio in order to assess the difference in mean risk-adjusted performance across three samples of gold exchange-traded funds, mutual funds and stocks. We cannot be certain that investors have a preference for the higher moments, such as skewness and kurtosis, of return distributions; but to the extent that they do, the modified Sharpe ratio, as a measure of risk-adjusted performance, captures these moments, and for the selection of gold investments studied, reveals differences in performance that would be missed by the other measures. In particular, we found that mutual funds outperformed both exchange-traded funds and stocks on a risk-adjusted basis. Investors wishing to gain exposure to appreciation in the price of gold should therefore favour gold mutual funds over both gold ETFs and gold stocks.

It should be noted that the assessment of the risk-adjusted performance of the three gold investments was done as if each investment were to be held alone when, in fact, it is expected that investors would include them in portfolios that vary in their degree of diversification. No attempt was made to assess the investments on the basis of their systematic risk, and how they might, in turn, affect the performance of the portfolios in which they are placed. This is left to future work.

Chapter 9

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