The risk-return trade-off of precious metals ETFs

Fons Bok

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Supervisor: Dr. M.R.R. van Bremen

Co-reader: Dr. F. Castiglionesi

Abstract

This study investigates if there is a better risk-return trade-off for the precious metals ETFs silver, palladium and platinum compared to gold ETFs. Only physically backed ETFs are used for the period August 2010 – February 2012 to calculate both unadjusted and risk-adjusted returns. Also calculations were performed to compare the benchmarks of these precious metals with indices like the AEX, Dow Jones and S&P500. This was to investigate if gold is the only precious metal to be considered a safe haven in times of financial distress. The results indicated that there is no other precious metal ETF that has a better risk-return trade-off than gold ETFs and that gold is the only safe haven.

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1 INTRODUCTION

1.1 Background of the research

Exchange Traded Funds is a fast growing area of investing and has significantly changed investor behavior. ETFs are relatively new investment tools, which were invented by the financial industry in the last two decades. According to Investopedia (www.investopedia.com), an ETF is a security that tracks an index and represents a basket of stocks similar to an index fund, but trades like a stock on exchanges. Thus it experiences price changes throughout the day as it is bought and sold. The ETF has been widely accepted by both institutions and individual investors all over world. Because of their popularity it is a very interesting subject for research.

With the existence of ETFs there are a lot of new investment opportunities. There are many different types of ETFs, such as exposure to stock market indices of different countries, bonds, commodities, currency, energy and metals are available as an ETF.

Most research is focused on the return performance of ETFs relative to index mutual funds and their corresponding benchmark indices. This research examines the recent trends in precious metal investing, especially the physical backed ETFs. These precious metal ETFs are directly linked to their underlying gold, silver, platinum or palladium spot prices.

Because of the typical structure of ETFs, all types of investors whether retail or institutional, long-term or short-term can use it to their advantage. ETFs are a good quality investment for individual investors as well as for investment professionals. Certainly, ETFs will be a potent force in future markets (Khurana, 2010).

Just like investing in gold, investing in gold ETFs is very popular. Physical gold ETFs such as the SPDR Gold Trust ETF (NYSE: GLD) and the iShares Gold Trust ETF (NYSE:IAU) are very popular. Gold has often been associated with the existence of a safe haven. While there is no theoretical model which explains why gold is usually referred to as a safe haven asset, one major explanation could be that it was among the first forms of money and was traditionally used as an inflation-hedge (Bauer, 2009). Investing in gold and investing in gold ETFs can lead to high returns. That is a reason why many people who invest in ETFs choose to invest in gold ETFs. If you look over a longer period, investing in gold ETFs is profitable. But perhaps there are other ETFs that even have a higher return. Perhaps there is an ETF which performs better during the same period as gold ETFs. It is unknown what has a higher performance, gold, silver, platinum or palladium ETFs, and what has a better risk-return trade-off. Also if there are other precious metals that could act as safe havens.

1.2 Objective of the research

The objective of the research is to find out if a physical gold ETF has a better risk-return trade-off than a physical silver, platinum or palladium ETF and why that is. Another objective is to find out if there is another safe haven than gold.

There are many factors that can influence the performance of an ETF. These factors will help an investor to make a good choice by choosing a precious metal ETF. Three research questions are composed for answering the central question. The central question is: What is

the risk-return trade-off of physically backed gold ETFs compared to the other physically backed precious metal ETFs.

The associated research questions are:

- What are ETFs?

- What are specific risk factors to consider, and what are the driving forces of these risk factors?

- What is the return of physical backed ETFs and what causes these returns?

1.3 Structure

The structure of this study is a follows: chapter two will give an introduction in to ETFs. It discusses what these products are, how they are structured and also some history and history performance is showed. Chapter three focuses on two risk factors to consider when investing in ETFs. There is also a paragraph to explain what the driving forces are of these risk factors. Chapter four provides information of this study. It gives an overview of the sample and data used. Also the methodology and approach is discussed. Chapter five focuses on the results that are obtained. Both unadjusted and risk adjusted results are analysed. Chapter six concludes this study by summarizing the findings of chapter 5

Chapter one is the introduction of the thesis. This chapter will give an explanation why it is interesting to conduct a research like this one. Chapter two will give the answers to both theoretical questions and will form the theoretical framework of the research. Chapter three will explain the research method that is used. In chapter four the empirical results will be presented. Chapter five presents the conclusion and recommendations for further research.

2 INTRODUCTION IN TO ETFs

The first theoretical question will give an explanation what an ETF is, different structures of existing ETFs and the growth of ETFs in the past years. Later on, prior research about risk factors and the accompanying empirical part will be discussed.

2.1 What are ETFs?

ETFs are a relatively new investment instrument (Gastineau 2001). An ETF is best described as an investment fund that is traded on the stock exchange. Generally, ETFs are passively managed mutual funds with the aim to copy the performance of a specific index. The reasoning is that it is more cost efficient for an investor to invest in a particular ETF than investing directly in the underlying asset. With an ETF you can benefit from economies of scale (Gastineau 2010). It is often claimed that ETFs are a low cost investment because it saves a lot of expensive analyses by investment managers (Dellva, 2001). Baiden (2011) concludes that ETFs have a few advantages and disadvantages when using ETFs as an investment product. Some of these advantages and disadvantages also apply for physical backed ETFs. The advantages Baiden (2011) named are: low fees, diversification, allowing investment in commodities, pricing and trading, transparency and flexibility. The disadvantages named by Baiden (2011) are: market risk, narrow based structures, interest rate risk, loss of capital, 'tracking error' and lack of track record.

Banks usually issue an ETF, but also insurance companies and other institutions are free to create an ETF. A variety of investment styles are possible to track different indices. It is possible to track stock market indices of different countries, regions, industry sectors or fixed income with ETFs.

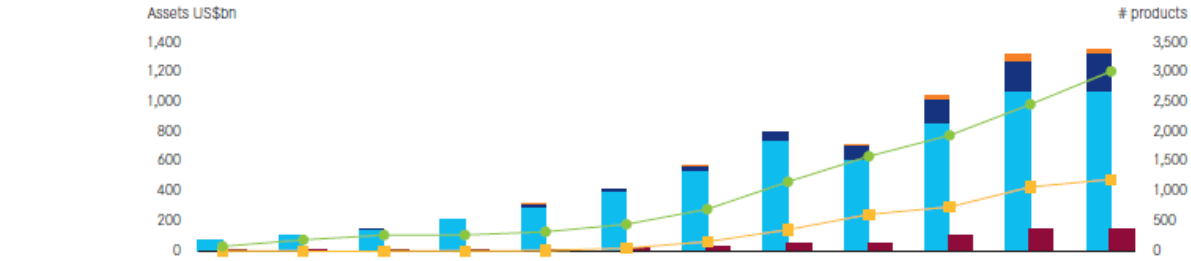
Synthetic ETFs recently appeared on the market. Synthetic ETFs have also the objective to replicate an index, but do not physically own the underlying stocks. Often derivatives like swaps are used to replicate the performance of an index. Synthetically replicating the performance of an index by using swaps is an important distinction that can be made by ETFs that physically own the underlying stocks. One motivation for using synthetic structures to replicate the index could be to reduce costs. If the index has a narrow regional or sector focus and is widely traded, replicating the ETF benchmark by owning the underlying securities can be cost-efficient. However, physical replication can be an expensive method for tracking broad market indices such as emerging market equity or fixed income indices, or other less liquid market indices (Ramawany, 2011). Because synthetic ETFs have less transaction costs and no additional transaction costs are needed if the underlying index changes they are more efficient than ETFs that physically own the underlying stocks. But these synthetic ETFs have more counterparty risk due to the use of derivatives and also the lack of transparency is a factor of criticism (Bioy et al. 2011).

If an issuer decides to physically own the stocks, it can either fully replicate or use a method that is called optimization. Optimization means that, unless the given fund constraints, it makes use of only one sample to try to replicate the index. This method is often used if full replication is not possible. This impossibility could be due to markets that are less liquid

causing wider bid-ask spreads, country-specific tax laws for foreign holdings or regulation that prevents funds to invest more than 25% of their portfolio in one fund (Bioy et al 2011). Unless this constraint this research will make use of physically backed ETFs, because of their growing popularity.

2.2 History and growth

In 1993 the first ETF was launched in the USA, the SPDR. The SPDR (pronounced as 'spider'), tracks the performance of the S&P 500 index. The introduction of the 'spider' was a success and soon after more ETFs were launched to track different indices. Thereupon this relatively new investment product grew rapidly in number and net asset value. In the period 1993 till 2000 the number of US ETFs grew from one to thirty, and assets under management (AUM) was $33 billion (Aber et al. 2009). In the early days ETFs were not a widespread phenomenon. It was after the financial crisis of 2008 that ETFs gained popularity among a wide group of investors (www.fondsnieuws.nl). Since then even more ETFs were introduced. These ETFs were tracking all kinds of indices of different countries, regions, industry sectors or fixed income. In spite of all the new ETFs, the 'spider' is even today the world's largest ETF with almost $100 billion in assets under management. In total, there are over 3000 funds worldwide representing almost $1500 billion in asset under management (Blackrock, 2011). Figure 1 shows the yearly growth in ETFs since the year 2000.



Assets (US$bn)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
ETF total	**74.3**	**104.8**	**141.6**	**212.0**	**309.8**	**412.1**	**565.6**	**796.7**	**711.1**	**1,036.0**	**1,311.3**	**1,350.9**
ETF equity	74.3	104.7	137.5	205.9	286.3	389.6	526.5	729.9	596.4	841.6	1,053.8	1,057.4
ETF fixed income	0.1	0.1	4.0	5.8	23.1	21.3	35.8	59.9	104.0	167.0	207.3	257.7
ETF commodity	-	-	0.1	0.3	0.5	1.2	3.4	6.3	10.0	25.6	45.7	31.1
ETF other[1]	-	-	-	-	-	-	-	0.6	0.6	1.8	4.5	4.6
Other ETPs total	5.1	3.9	4.1	6.3	9.3	15.9	32.5	54.6	61.2	119.7	171.3	173.5
ETP total	**79.4**	**108.7**	**145.7**	**218.3**	**319.1**	**428.0**	**598.1**	**851.3**	**772.3**	**1,155.8**	**1,482.7**	**1,524.5**
# ETFs	92	202	280	282	336	461	713	1,170	1,595	1,944	2,460	3,011
# Other ETPs	14	17	17	18	21	63	170	371	625	750	1,083	1,210
# ETPs	**106**	**219**	**297**	**300**	**358**	**525**	**884**	**1,542**	**2,211**	**2,683**	**3,526**	**4,221**

Figure 1. Reprinted from *ETF Landscape Global Handbook Q3 2011* (p3), by BlackRock Advisors (UK) limited, 2011, United Kingdom: BlackRock Investment Institute.

As shown in the figure the growth of ETFs is enormous, especially the relative growth of 'other ETPs total' the class to which precious metals belong. The percentage growth in assets in the period 2000 till 2011 is a staggering 3301%. This figure shows that precious metals can have a positive influence on your portfolio. Precious metals offer a significant diversification effect for traditional investment portfolios, as their returns are not correlated with the returns of stocks and bonds (Fassas, 2012). Jaffe (1989) and Chua et al. (1990) found evidence in their research that adding precious metals to portfolios improve overall

performance. This benefit is ascribed to the positive hedge precious metals have against inflation.

Investing in gold and silver goes back a long time. Wilcoxen (1932) found statistics of the production of gold and silver which are readily available since the year 1600. In table 1 the performance of various precious metal ETFs is shown. You can see that the return of gold is declining and that the return of the other metals is growing. But in the year 2011 all returns declined compared to the year 2010. This is due to the debt problems in the United States and Europe. Further you can see that the returns of gold ETFs did not decline as much as the returns of the other precious metal ETFs. It seems that in times of economic well-being it is more profitable to invest in precious metals other than gold. But when there is an economic down-turn it is more beneficial to invest in gold. There are several reasons for these fluctuations in the returns of the different precious metal ETFs. In different periods and different time horizons it could be more beneficial to invest in another metal than gold.

Table 1. Performance of various precious metal ETFs

	Year-to-date-return	Total return in %		
	2012	2009	2010	2011
SPDR Gold Shares	4.9%	+24.0%	+29.3%	+9.6%
PowerShares DB Silver	9.5%	+47.1%	+81.2%	-12.0%
iShares Silver Trust	9.2%	+47.7%	+82.5%	-10.7%
ETFS Physical Silver	9.2%	N/A	+82.2%	-10.4%
iPath DJ AIG Platinum Index	9.3%	+65.3%	+8.6%	-23.5%
UBS E-TRACS Long Platinum ETN	15.1%	+57.9%	+13.7%	-22.9%
ETFS Physical Precious Metals Basket	6.6%	N/A	N/A	-2.4%
ETFS Physcial Platinum	9.3%	N/A	N/A	-21.7%
iPath DJ-UBS Precious Metals	5.1%	+28.4%	+41.9%	+3.3%
PowerShares DB Precious Metals	5.3%	+26.6%	+37.6%	+4.0%
Powershares DB Gold	4.4%	+22.0%	+27.9%	+8.6%
iShares COMEX Gold Trust	5.1%	+23.9%	+29.5%	+9.6%
ETFS Physical Swiss Gold	4.9%	N/A	+29.2%	+9.6%
ETFS Physical Palladium	-0.4%	N/A	N/A	-19.2%

Adapted from www.etfreplay.com, 2012.

2.3 Conclusion

This chapter was written to clarify what an ETF is and that the popularity of precious metal ETFs is growing because it provides investors value to their portfolio.

In the following chapters, attention will be paid to the several risk factors there are when investing in precious metal ETFs. Further on there is an empirical investigation to compare the return-risk trade-off between different physical backed ETFs.

3 RISK FACTORS

In this chapter two risk factors will be discussed. A risk factor is explained as a contingent risk to a portfolio's performance. One of the earliest factors is beta; other factors that investors use are value, size, growth and volatility. Beta and volatility are explained in this chapter because they are the most influential factors in illustrating asset's risk and return (Russel, 2011).

3.1 Beta

The beta is a sensitivity measure of a stock's price relative to the market. In other words, the beta shows the overall movement of a security or portfolio relative to the market, and it is derived by examining a sample of historical returns (Aggrawal et al. 2010) Beta is one of the first factors to measure a stock's sensitivity and is a key measure of systematic risk. According to Tofallis (2006) beta refers to the slope in a linear relationship corresponding to data on the rate of return on an investment and the rate of return of the market. Beta is mostly used in the following two forms:

$$R_i = \alpha + \beta R_m$$

Where R_i represents the rate of return on an investment, and R_m is the rate of return on the market. The second form of the linear relationship deals with 'excess return', meaning the rate of return which is available from a risk-free investment:

$$R_i - r_f = \alpha + \beta(R_m - r_f)$$

Where r_f is the rate of return of the risk-free asset. Keep in mind that most providers of ETFs do not use the formula with the excess return (Bodie et al. 2002).

For estimating the beta an ordinary least squares (OLS) regression with the left side one of the above mentioned formulas as the dependant variable. The resulting slope can then be expressed as:

$$\beta = \frac{r\sigma_i}{\sigma_m}$$

Where the σ's are the standard deviations of the rate of return and r is the correlation between the rates of return. The formula can also be expressed in the following form: Mikkelsen (2001).

$$\beta = \frac{\mathrm{cov}(\mathrm{R_i}, \mathrm{R_m})}{\mathrm{var}(\mathrm{R_m})}$$

This equation means the covariance between the market and investment returns divided by the variance of the market returns. Covariance is a measure of the degree to which returns of two assets move parallel. Variance measure the variability from a mean.

If the beta is one that tells us that the price of the stock moves with the market. If the beta is less than one it means that the stock price is not as volatile as the market. If the stock price is more volatile than the market the beta is greater than one (Tofallis, 2006). Roll (1977) is critical about the use of the beta, because it is no longer sufficient for estimating returns. In times of economic prosperity or in recessions, the beta will have different values and this will influence the decision making on ETFs (Bauer et al. 2009) The next factor that illustrates assets risk and return is the volatility.

3.2 Volatility

Volatility differs from beta in that it measures a security's total, rather than relative, risk. Volatility is typically measured as the historical total return variability, or standard deviation, of a stock around its mean return. Volatility indicates the fluctuation or bumpiness of a stock's return pattern, providing a measure of the uncertainty of achieving an expected return (Russel, 2011).

Recent years the financial and commodity markets were highly volatile. This means variation of price (and therefore risk) of a financial instrument over time. The higher volatility (movement of prices) the higher the risks (www.investopedia.com). The volatility σ is defined as the standard deviation of the return per unit of time (Hull, 2007). The volatility is calculated as:

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2}$$

Where N is the number of period, x_i is the return of the asset in period i and $\bar{x}$ is the average return.

Depending on the unit of time of period i, the standard deviation of the desired unit of time can be calculated by $\sigma\sqrt{T}$. In financial market, the volatility is expressed as percentage of the average return and the annual volatility is used (Alexander, 2001). Annual volatility is then calculated as:

$$annual\ volatility = (100\sigma\sqrt{\mathrm{T}})\%$$

For example the unit of time of period i is 1 week, and the volatility is 3,46%. The volatility per year is then: 3,46%×√52 = 25%

Volatility brings besides risks also opportunities to investors. There are several reasons for volatility in commodity markets and precious metal markets in general. Investors always talk about 'trust', 'uncertainty', 'booming and bursting bubbles' and 'government intervention when they want to invest in the stock market, so also when they want to invest in ETFs. The most important and described drivers in the literature that can explain a high or low beta or volatility is described in the upcoming paragraph.

3.3 Driving forces

There are many driving forces that affect the risk factors that are described in paragraph 3.1 and 3.2. The beta and volatility of these precious metals ETFs that are considered in this research are affected could be one of the following factors: confidence risk, time horizon risk, inflation risk, business cycle risk, market-timing risk, unemployment rate, tax rate and interest rate. These factors come forward from the following surveys.
Manufacturers make more use of precious metals because precious metals fulfill an important and diversified use in jewelry, medicine, electronic and auto catalytic industries. Political unrest or extreme weather conditions in precious metal producing countries can cause supply disruptions which has his influence on supply and demand and therefore the prices of these metals (Hammoudeh, Malik and McAleer, 2011). They also state that the introduction of new financial innovations, such as Turbo's, options, futures and ETFs, and the use of precious metal as collateral for trading. These factors have their influence on volatility and beta of precious metals over time and across markets.

The dollar exchange rate is also an important driving force for volatility and beta in the markets of precious metals. The reason therefore is that precious metals are mainly dominated in the dollar currency. In times of expected inflation investors move from dollar-denominated soft assets to dollar-dominated physical assets during (e.g. a precious metal ETF) expected inflation. It is well known that investors use precious metals, particularly the yellow metal, as a safe haven in their flight to safety when the green currency weakens against the other major currencies, especially euro (Sari, Hammoudeh, Soytas, 2010). Lucey and Tully (2006) investigated the evolving relationship between gold and silver in the period 1979-2002. They found that gold is sensitive for the dollar/euro exchange rate. Furthermore, a large part of precious metals producers come from the United States and the euro land. So if there are changes in the exchange rate between the dollar and the euro, it will have his influence on the prices and the performance of these precious metals.

Also closely linked to the price of precious metals and the exchange rate is the price of oil. According to Beahm (2008) the price relationship between gold and oil is one of the five fundamentals that drive the prices of precious metals, in particular gold. The other fundamentals that Beahm found that drive the prices of precious metals are: supply and demand, dollar weakness, institutional buying and the global economic uncertainty. Also Baffes (2007) found that the prices of precious metals exhibiting a strong response to the crude oil price. This was the conclusion after a research what the influence of the oil price is on 35 other commodities, including gold and silver.

Monetary policy has also influence on the volatility and beta of precious metals. According to Jensen at al. (2002) show that the benefits of adding commodity ETFs increase almost distinctively when the Federal Reserve is following a restrictive monetary policy. Overall, their findings point out investors should monitor monetary conditions to determine the optimal allocation of commodity ETFs within a portfolio. King (2004) stated that the Federal Reserve and the Bank of England both have a reactive view in compliance with asset prices. The Federal Reserve and the Bank of England only adjust their monetary policy when asset price changes convert future outcomes of inflation.

Hillier et al. (2006) investigated that prices of precious metals are both influenced by short-term and long-term factors. Platinum (and, to a lower degree, gold and silver) is mainly delivered toward industrial uses, with the quantity supplied determined by the quantity demanded by industry. The demand is in this case a direct function of the well-being of an economy. In the long run, platinum prices will rise if the industrial activity increases. Platinum

prices will fall if industrial activity decreases. The price of gold and silver can also be influenced in a period by the amount of stock the central banks hold. Hillier et al. (2006) also conclude that silver is mainly obtained as a byproduct of gold mining (as much as two-thirds of total world silver supply comes from this source) and therefore that the price of silver is strongly related with the price of gold. Platinum is jointly obtained with other metals e.g. palladium and nickel. Platinum is mainly used in the catalytic converters industry for automobiles. Platinum is not held by central banks like gold and silver in the form of reserves. Therefore the platinum market is not directly sensitive to central bank actions.
All above mentioned driving forces have their influence on the risk factors beta and volatility. These driving forces influence the movements of the risk factors. It depends on the movements if it will have a positive or negative impact.

3.4 Conclusion

This chapter explained the important risk factors and what the driving forces of these risk factors are. It is necessary to understand these factors and driving forces to get a better insight in the risk-return trade-off of precious metals ETFs. A short literature review proves that the risk factors are influenced by several driving forces.

4 EMPIRICAL RESEARCH

4.1 Introduction

The purpose of this study is to determine what the return of these physically backed ETFs are, and what causes these returns. To find out if there is a risk-return trade-off between and what causes these differences between these physically backed ETFs, different performance measures and tracking errors are investigated. The used methodology for the performance measures and tracking errors will be largely in line with former research from Jensen (1972) Sharpe (1966), Treynor (1965) and Frino and Gallagher (2001, 2004).

4.2 Sample and data

The empirical study includes the three biggest ETFs of the precious metal gold, silver, platinum and palladium that are available. In some cases there weren't even more than three physical backed ETFs available. Swaps and futures are involved with synthetic ETFs and that has his influence on the performance of an ETF. Physically-backed ETFs are guaranteed by raw materials deposited in the vaults of a bank hired by the issuer, therefore their value is directly linked to the spot price trend of the commodity. The following physically backed ETFs are available. SPDR Gold Trust ETF, iShares COMEX Gold Trust ETF , ETFS Physical Swiss Gold Trust ETF, ETFS Silver Trust, iShares Silver Trust, ETFS Physical Silver, ETFS Physical Platinum Shares, Physical Platinum ETC, iShares Physical Platinum ETC, ETFS Physical Palladium Shares, ETFS Physical Palladium, iShares Physical Palladium ETC. Also the rate positions of the AEX, Dow Jones and the S&P 500 will be used. Daily prices from 2-8-2010 until 17-2-2012 where gathered from the Bloomberg database. The reasons for these dates are: in the summer of 2010 plans for Basel-3 were unfolded and were implemented on 12 September 2010 and on 19 February 2012 was the Greek agreement for resolving the financial crisis. The daily risk-free rate necessary for calculations will be the daily risk-free return on a one month U.S. Treasury Bill and comes from the Datastream database.

4.3 Methodology and approach

To calculate the outperformance of a physically backed ETF compared to the underlying benchmark the Jensen's alpha will be used. The parameter alpha was added to the traditional Capital Asset Pricing Model (CAPM) by Jensen (1972), to analyze the performance of a fund compared to the underlying benchmark. This risk-adjusted performance measure has the following equation:

$$R_i - R_f = \alpha_i + \beta_i(R_m - R_f) + \varepsilon_i$$

Where, Ri represents the daily return for the physically backed ETF i. Rm is the daily return on the market portfolio, which is in our case the underlying benchmark of the physically backed ETF. β_i measures the sensitivity in changes of the return on the benchmark over the

risk-free rate. An important question is if the alpha is significant for either positive or negative values. If the alpha is significantly different from zero, we can expect if a physically backed ETF outperformance or underperformance his underlying benchmark. If there is a clear outperformance of a physically backed ETF it would be a good choice to invest in it.

In 1966, a new measure for the performance of funds was introduced by W.F. Sharpe (1994). This was the reward-to-variability ratio, which is better known as the Sharpe ratio. This measure is very popular nowadays. The Sharpe ratio is the excess return divided by the standard deviation. The Sharpe ratio determines how well the return of the physically backed ETF compensates the investor for the risk. The higher the Sharpe ratio, the better the performance is. The Sharp ratio is then calculated as:

$$Sharpe\ ratio = \frac{\mathrm{R_i} - \mathrm{R_f}}{\sigma_\mathrm{i}}$$

Where $\mathrm{R_i}$ is the return of the portfolio, σ_i be the standard deviation of the portfolio return and $\mathrm{R_f}$ is the risk free interest rate.

Assumptions are made when using the Sharpe ratio. According to Luenberger (1998) the Sharpe ratio is based on the Capital Asset Pricing Model (CAPM), assuming normality in return distributions. In the real world returns of are not strictly normal distributed. In order to overcome this abashment, asymmetrical parameter-dependent performance ratios are available in the literature. Farinelli et al. (2008) conducted a research using different ratios to determine the optimal asset allocation. The result is that Sortino did outperform the Sharpe Ratio.

Pilotte and Sterbenz (2006) concluded that the Sharpe ratio is based on the total risk of an investment. If an investor wants to use all or almost everything of his budget in one security or portfolio the use of the Sharpe ratio is appropriate. When an investor is considering the addition of an investment to a well-diversified portfolio, the Treynor ratio is more appropriate ratio to use, because it is based on systematic risk. Interest rates, recession and wars all represent sources of systematic risk because they affect the entire market and cannot be avoided through diversification (www.investopedia.com).The Treynor ratio, or reward-to-volatility-ratio evaluates the investment performance by comparing the expected excess return to the expected systematic risk of the asset (Treynor, 1965). The Treynor is calculated as:

$$Treynor\ ratio = \frac{\mathrm{R_i} - \mathrm{R_f}}{\beta_\mathrm{i}}$$

Where R_i is the return of asset i, R_f is the risk free interest rate and β_i is the return beta of asset i. The higher the Treynor ratio, the better the performance is.

The tracking error formulas measure the difference in performance between the physically backed ETF and his underlying benchmark. There are several formulas for calculating the tracking error. Three tracking error formulas will be used in this research, which are described in Frino and Gallagher (2001, 2004).

The following formulas will be used to calculate the tracking errors:

$$TE_1 = \frac{1}{n}\sum_{t=1}^{n}|e_{it}|$$

This tracking error is used to calculate the average of the absolute daily differences between the returns of a physically backed ETF and his corresponding benchmark here$|e_{it}|$. N is the number of observations. The second formula that calculates the squared root of the sum of squared residuals divided by the number of observations minus the number of regression coefficients (here: α and β) is:

$$TE_2 = \sqrt{\frac{1}{n-2}}\sum_{t=1}^{n}\varepsilon_i^2$$

The last tracking error is called the standard deviation of return differences between ETFs and their benchmark. The calculation is as follows:

$$TE_3 = \sqrt{\frac{1}{n-1}}\sum_{t=1}^{n}(e_{it} - \bar{e}_i)^2$$

Where ei is the return difference on day t and $\bar{e}i$ is the average return difference over the total sample period of nn days.

The tracking error of physically backed ETFs with the benchmark is an important measure for performance. A high tracking error would indicate that there is something wrong with the composition of the physically backed ETF. It could be possible that high management fees or transactions costs are responsible for a high tracking error. T-tests will be used to find out if there is a statistical significance between the return of a precious metal ETF benchmark and the indices AEX, Dow Jones and S&P 500.

5 RESULTS

The results that are presented cover three periods, and period three is spilt up in A and B. Period one is the overall performance of the ETFs compared with their benchmark and the performance comparison of that precious metal benchmark compared to the AEX, Dow Jones and S&P 500 using t-tests. Period two is the overall performance of the ETFs compared with their benchmark and the performance comparison of that precious metal benchmark compared to the AEX, Dow Jones and S&P 500 in the period 15th March to 31 August when the gold price was at its highest. Period three is divided into two periods. The first period is one month before president Monti was sworn in as president of Italy. The second period runs for one month after the installation of Monti.

Period 1 cover all ETFs that are available in the sample period. Presented are the descriptive statistics mean and median daily returns, the standard deviation of the daily returns and highest and lowest observed daily return. The silver and palladium ETFs have a lower minimal and a higher maximum value. The skewness shown in the table has to be zero under normal distribution. If the skewness is greater than one (or less than -1) the skewness is substantial and the distribution is not-normal. Overall the ETFs and their benchmark are normal distributed except for the benchmark of silver ETFs and two silver ETFs. All the beta's from the ETFs are also presented in the table and are all are one or near one meaning that they following their underlying benchmark. So there is almost no volatility between the ETFs and their benchmark. Furthermore, the Sharpe and Treynor ratio are displayed. For all ETFs except the platinum ETFs the ratio's where positive. A negative ratio indicates that the performance return was lower than the risk-free rate. Platinum is mainly used in the jewelry and in the car industry for catalysts. A reason for these negative figures could be the financial crisis, which also affects the car industry

Table 2. Descriptive Statistics and Performance Rating. This table presents the mean and median daily return, the beta, the standard deviation and the minimum and maximum return, the skewness, the Sharpe and Treynor ratio of the ETFs and their benchmarks respectively. The sample period is from 08/02/2010 till 02/17/2012. The number of observations is 404. Under normal distribution the skewness is expected to be zero.

	Mean	Median	Beta	St. Dev.	Min	Max	Skew	Sharpe	Treynor
Gold benchmark	0,0997%	0,1455%		1,1359%	-4,79%	3,35%	-0,452		
SPDR Gold Trust	0,0984%	0,1133%	1,0026%	1,1571%	-5,47%	3,54%	-0,498	3,12%	0,04%
iShares COMEX Gold Trust	0,0991%	0,1267%	1,0015%	1,1578%	-5,60%	3,55%	-0,509	3,18%	0,04%
ETFS Physical Swiss Gold Trust	0,0985%	0,1248%	0,9992%	1,1534%	-5,50%	3,52%	-0,514	3,14%	0,04%
Silver benchmark	0,1786%	0,3353%		2,5141%	-13,19%	6,49%	-1,070		
ETFS Silver Trust	0,1792%	0,3268%	1,0154%	2,5980%	-14,27%	7,46%	-1,046	4,53%	0,12%
iShares Silver Trust	0,1791%	0,2942%	1,0200%	2,6087%	-14,15%	7,25%	-1,023	4,51%	0,12%

ETFS Physical Silver	0,1770%	0,2891%	0,7158%	2,6039%	-10,98%	9,14%	-0,838	4,44%	0,16%
Palladium benchmark	0,0944%	0,0128%		2,0350%	-6,38%	5,88%	-0,177		
ETFS Physical Palladium Shares	0,0910%	0,0000%	1,0073%	2,0979%	-6,73%	6,13%	-0,190	2,34%	0,03%
ETFS Physical Palladium	0,0931%	0,1035%	0,7897%	2,0903%	-7,41%	8,45%	-0,246	2,26%	0,04%
Platinum benchmark	0,0123%	0,0435%		1,2122%	-4,53%	4,63%	-0,485		
ETFS Physical Platinum Shares	0,0099%	0,0366%	0,9927%	1,2281%	-4,91%	4,73%	-0,498	-4,27%	-0,05%
Physical Platinum ETC	0,0131%	0,0000%	0,7997%	1,3638%	-5,33%	5,86%	-0,223	-3,61%	-0,06%

All ETFs have been regressed onto their benchmark and the results are the Jensen's alpha, standard errors, t-statistics and their p-values. T-statistics for testing whether the alphas are statistical significant are presented in table three. There is none ETF statistical significant different from zero at the 95% confidence level. Some of the alphas are negative and some are positive. A negative alpha is a sign of underperformance of the ETF compared to his benchmark. A positive alpha means an outperformance of the ETF compared to his benchmark. But as already mentioned there is none ETF statistical significant different from zero so there is no consistent underperformance or outperformance. ETFs are designed to track their benchmark, so they will be prone to market fluctuations which could occur. Therefore there are three tracking errors calculated for each ETF. The average of these tracking errors for all ETFs is zero. This is what we could expect because this ETF type has a low total expense ratio of mostly between 0.35% and 0.65% per year.

Table 3. Performance Regression Results and Tracking Errors. This table also presents the results of the risk-adjusted performance regression: $Ri- Rf= \alpha i+ \beta i (Rm- Rf)+ \varepsilon i$. In which we estimate the alphas and betas by regressing the risk-adjusted daily return of the precious metal ETF on the risk-adjusted daily return of the corresponding precious metal benchmark. T-tests are performed to test whether the alpha coefficients differ significantly from zero. The null hypothesis that the alpha coefficient does not significantly differ from zero is rejected at probability levels smaller than 0.05 (95% confidence level). This table presents the estimations of tracking error. The tracking error is the deviation between the return of the ETF and the underlying index. We have computed three different measures, where TE1 is the absolute average return difference between the ETF i and the underlying index , TE2 reflects the standard error of ETFs i performance regression and TE3 is the standard deviation of the return difference between the ETF and its underlying index. The last column displays the equally-weighted average of the three tracking errors.

	Jensen alpha	**Standard Error**	**t-Statistics**	**p-Value**	**TE1**	**TE2**	**TE3**	**Average TE**
SPDR Gold Trust	-0,0013%	0,0576%	-0,0002	0,4999	0,0012%	0,0073%	0,0116%	0,0067%
iShares COMEX Gold Trust	-0,0006%	0,0576%	-0,0001	0,4999	-0,0006%	0,0074%	0,0116%	0,0061%
ETFS Physical Swiss Gold Trust	-0,0012%	0,0574%	-0,0002	0,4999	-0,0012%	0,0073%	0,0115%	0,0059%
ETFS Silver Trust	0,0012%	0,1289%	-0,0009	0,4996	0,0006%	0,0237%	0,0260%	0,0167%
iShares Silver Trust	-0,0019%	0,1295%	-0,0001	0,4999	0,0005%	0,0236%	0,0261%	0,0167%
ETFS Physical Silver	0,0317%	0,1292%	0,0245	0,4990	0,0016%	0,0232%	0,0260%	0,0170%
ETFS Physical Palladium Shares	-0,0037%	0,1043%	0,0004	0,4998	-0,0035%	0,0058%	0,0211%	0,0078%
ETFS Physical Palladium	0,0054%	0,1039%	0,0005	0,4998	-0,0014%	0,0062%	0,0210%	0,0086%
ETFS Physical Platinum Shares	-0,0027%	0,0613%	-0,0004	0,4998	-0,0024%	0,0105%	0,0002%	0,0028%
Physical Platinum ETC	-0,0092%	0,0681%	-0,0013	0,4995	0,0086%	0,9870%	0,0136%	0,3364%

T-statistics at a 95% confidence interval where performed to see if the return of the precious metals ETFs silver, palladium and platinum significantly differ from the average performance of the gold ETFs. Palladium and platinum showed statistical significant difference but the averages of these ETFs were lower than the average gold ETFs.

Table 4. One-Sample Test Performance. ETFs compared to average performance gold ETF.

	Test Value = 0.0987					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Silver ETFs	111,166	2	0	0,08%	0,08%	0,08%
Palladium ETFs	-54,5	1	0,012	-0,09%	-0,11%	-0,07%
Platinum ETFs	-32,5	1	0,02	-0,10%	-0,15%	-0,06%

It is interesting to see what the performance of the precious metals benchmarks is compared to the AEX, Dow Jones and S&P 500 indices. There is a financial crisis and markets are volatile so we could expect that performance of gold would be statistical significant compared to the indices. But this is not the case. Only the silver and palladium benchmark perform statistical significant compared to the indices. T-statistics where performed at a 95% confidence level.

Table 5. Paired Samples Test. Precious metals benchmark compared to indices

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Performance Gold - Performance AEX	0,001	0,0163	0,00081	-0,00059	0,0026	1,236	403	0,217
Pair 2	Performance Gold - Performance S&P 500	0,00045	0,01663	0,00083	-0,00118	0,00207	0,541	403	0,588
Pair 3	Performance Gold - Performance DowJones	0,00045	0,01564	0,00078	-0,00108	0,00198	0,584	403	0,56
Pair 4	Performance Silver - Performance AEX	0,0018	0,02534	0,00126	-0,00068	0,00428	1,428	403	0,154
Pair 5	Performance Silver - Performance S&P 500	0,00125	0,02534	0,00126	-0,00123	0,00372	0,988	403	0,324
Pair 6	Performance Silver - Performance DowJones	0,00125	0,02497	0,00124	-0,00119	0,00369	1,008	403	0,314
Pair 7	Performance Palladium - Performance AEX	0,00099	0,01744	0,00087	-0,00072	0,0027	1,142	403	0,254
Pair 8	Performance Palladium - Performance S&P 500	0,00044	0,01747	0,00087	-0,00127	0,00214	0,501	403	0,617
Pair 9	Performance Palladium - Performance DowJones	0,00044	0,01731	0,00086	-0,00125	0,00214	0,513	403	0,608

Pair 10	Performance Platinum - Performance AEX	0,00013	0,01697	0,00084	-0,00153	0,00179	0,155	403	0,877
Pair 11	Performance Platinum - Performance S&P 500	-0,00042	0,01643	0,00082	-0,00203	0,00118	-0,519	403	0,604
Pair 12	Performance Platinum - Performance DowJones	-0,00042	0,0157	0,00078	-0,00195	0,00112	-0,535	403	0,593

Period 2 is the sample that runs from 15 March 2011 to 31 August 2011. This is just after the earthquake and nuclear disaster in Japan. 31 August is chosen because at that point the gold price was at his peak. The aim is to see if gold and the other precious metals are to be considered as safe havens that offer protection for geopolitical unrest, inflation, falling interest rates or natural disasters. According to Fassas (2012) investors claim these metals as safe heavens, whereas Baur (2009) states that gold only functions as a safe haven for a limited period of time, around 15 trading days. That is, gold is not a safe haven if it is hold after an extreme negative shock. After the earthquake and the following nuclear disaster the gold price had a negative shock but it rose to his peak in August later that year.

The descriptive statistics mean and median daily returns, the standard deviation of the daily returns and highest and lowest observed daily return are presented. The silver and palladium ETFs have again a lower minimal and a higher maximum value indicating more volatility. The ETFs and their benchmark are normal distributed except for the benchmark of silver ETFs and this time the three available. The betas are also one or near one meaning that they following their underlying benchmark. So there is almost no volatility between the ETFs and their benchmark. The Sharpe - and Treynor ratio's are all positive but the gold ratios are much higher than the other precious metals ratio's. So the performance of gold with respect to the risk-free rate compared to the other metals is far better. It was expected to have negative ratios for platinum because after the earthquake and nuclear disaster in Japan their car construction industry was put months behind.

Table 6. Descriptive Statistics and Performance Rating. This table presents the mean and median daily return, the beta, the standard deviation and the minimum and maximum return, the skewness, the Sharpe and Treynor ratio of the ETFs and their benchmarks respectively. The sample period is from 01/15/2011 till 08/31/2011. The number of observations is 121. Under normal distribution the skewness is expected to be zero.

	Mean	Median	Beta	St. Dev.	Min	Max	Skew	Sharpe	Treynor
Gold benchmark	0,2284%	0,2890%		1,1154%	-3,78%	3,35%	-0,406		
SPDR Gold Trust	0,2262%	0,2305%	1,0053%	1,1392%	-3,75%	3,54%	-0,231	17,36%	0,20%
iShares COMEX Gold Trust	0,2264%	0,2165%	1,0035%	1,1376%	-3,73%	3,55%	-0,237	17,41%	0,20%
ETFS Physical Swiss Gold Trust	0,2253%	0,2261%	1,0041%	1,1376%	-3,72%	3,52%	-0,232	17,31%	0,20%
Silver benchmark	0,2029%	0,6756%		2,9095%	-11,80%	6,28%	-1,14		
ETFS Silver Trust	0,1992%	0,6777%	1,0215%	3,0141%	-11,91%	7,46%	-0,97	5,67%	0,17%
iShares Silver Trust	0,1993%	0,6728%	1,0243%	3,0208%	-11,89%	7,25%	-0,96	5,66%	0,17%
ETFS Physical Silver	0,1984%	0,4100%	0,7030%	3,0905%	-10,93%	9,14%	-0,93	5,50%	0,24%
Palladium benchmark	0,1030%	0,1941%		1,7253%	-5,91%	3,72%	-0,59		
ETFS Physical Palladium Shares	0,1016%	0,0000%	0,9962%	1,7777%	-6,10%	3,85%	-0,68	4,12%	0,07%

ETFS Physical Palladium	0,1059%	0,1378%	0,7781%	1,8145%	-6,08%	4,09%	-0,74	4,28%	0,10%
Platinum benchmark	0,0723%	-0,0407%		1,0332%	-3,33%	2,14%	-5,95		
ETFS Physical Platinum Shares	0,0708%	0,0000%	0,9947%	1,0575%	-3,58%	2,09%	-0,68	4,02%	0,04%
Physical Platinum ETC	0,0694%	0,0867%	0,7156%	1,0404%	-2,91%	2,38%	-0,53	3,94%	0,06%

Also the Jensen's alpha, standard errors, t-statistics and their p-values are calculated. T-statistics for testing whether the alphas are significant are presented. There is none ETF statistical significant different from zero at the 95% confidence level. Seven ETFs have a negative alpha and that is a sign of underperformance of that ETF compared to their benchmark. But again none is statistical significant. The tracking errors are also zero or near zero.

Table 7. Performance Regression Results and Tracking Errors. This table also presents the results of the risk-adjusted performance regression: $Ri- Rf= \alpha i+ \beta i (Rm- Rf)+ \varepsilon i$. In which we estimate the alphas and betas by regressing the risk-adjusted daily return of the precious metal ETF on the risk-adjusted daily return of the corresponding precious metal benchmark. T-tests are performed to test whether the alpha coefficients differ significantly from zero. The null hypothesis that the alpha coefficient does not significantly differ from zero is rejected at probability levels smaller than 0.05 (95% confidence level). This table presents the estimations of tracking error. The tracking error is the deviation between the return of the ETF and the underlying index. We have computed three different measures, where TE1 is the absolute average return difference between the ETF i and the underlying index , TE2 reflects the standard error of ETFs i performance regression and TE3 is the standard deviation of the return difference between the ETF and its underlying index. The last column displays the equally-weighted average of the three tracking errors.

	Jensen alpha	Standard Error	t-Statistics	p-Value	TE1	TE2	TE3	Average TE
SPDR Gold Trust	0,0251%	0,1036%	0,0024	0,4990	0,0022%	0,0219%	0,1142%	0,0461%
iShares COMEX Gold Trust	-0,0027%	0,1034%	-0,0026	0,4998	-0,0020%	0,0220%	0,1143%	0,0448%
ETFS Physical Swiss Gold Trust	-0,0039%	0,1034%	-0,0038	0,4999	-0,0030%	0,0218%	0,1138%	0,0442%
ETFS Silver Trust	-0,0074%	0,2740%	-0,0003	0,4998	-0,0036%	0,0190%	0,1021%	0,0391%
iShares Silver Trust	-0,0078%	0,2746%	-0,0003	0,4998	-0,0036%	0,0190%	0,1022%	0,0392%
ETFS Physical Silver	0,0474%	0,2810%	0,0017%	0,4993	-0,0044%	0,0189%	0,1029%	0,0391%
ETFS Physical Palladium Shares	-0,0014%	0,1616%	-0,0001	0,4999	-0,0014%	0,0081%	0,0527%	0,0198%
ETFS Physical Palladium	0,0195%	0,1650%	0,0012	0,4995	0,0030%	0,0086%	0,0549%	0,0222%
ETFS Physical Platinum Shares	-0,1575%	0,0961%	-0,0164	0,4935	0,0708%	0,0047%	0,0366%	0,0374%
Physical Platinum ETC	-0,1021%	0,0946%	-0,0108	0,4957	0,0694%	0,0045%	0,0358%	0,0366%

Again t-statistics at a 95% confidence interval where performed to see if the return of the precious metals ETFs silver, palladium and platinum significantly differ from the average performance of the gold ETFs. All averages where positive but only palladium showed statistical significance.

Table 8. One-Sample Test Performance. ETFs compared to average performance gold ETF.

	Test Value = 0.2260					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Zilver ETFs	-94,92	2	0	-0,03%	-0,03%	-0,03%
Palladium ETFs	-56,86	1	0,011	-0,12%	-0,15%	-0,09%
Platinum ETFs	-222,714	1	0,003	-0,16%	-0,16%	-0,15%

The performance of the precious metals benchmarks compared to the AEX, Dow Jones and S&P 500 indices is surprising. In this period the AEX lost 15%, the Dow Jones 2.5% and the S&P 500 5%. Whereas gold rose 31%, silver 21%, palladium and platinum 11%. As expected the performance of the gold benchmark is statistical significant compared to the indices. All the indices have a negative mean and gold has a positive mean. Hillier et al. (2006) conclude that silver is mainly obtained as a byproduct of gold mining (as much as two-thirds of total world silver supply comes from this source) and therefore that the price of silver is strongly related with the price of gold. So it was expected that silver would also be statistically significant in a positive manner compared to the indices. In this sample palladium is again statistically significant compared to the indices, so palladium could be considered a safe haven. While platinum could not be considered as a safe haven in this period.

Table 9. Paired Samples Test. Precious metals benchmark compared to indices

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Performance Gold - Performance AEX	0,00363	0,01899	0,00173	0,00021	0,00705	2,103	120	0,038
Pair 2	Performance Gold - Performance S&P 500	0,00259	0,02107	0,00192	-0,0012	0,00638	1,353	120	0,179
Pair 3	Performance Gold - Performance DowJones	0,00237	0,01968	0,00179	-0,00118	0,00591	1,323	120	0,188
Pair 4	Performance Silver - Performance AEX	0,00337	0,03142	0,00286	-0,00228	0,00903	1,181	120	0,24
Pair 5	Performance Silver - Performance S&P 500	0,00234	0,03254	0,00296	-0,00352	0,00819	0,79	120	0,431
Pair 6	Performance Silver - Performance DowJones	0,00211	0,03191	0,0029	-0,00363	0,00786	0,728	120	0,468
Pair 7	Performance Palladium - Performance AEX	0,00238	0,01507	0,00137	-0,00034	0,00509	1,734	120	0,086
Pair 8	Performance Palladium - Performance S&P 500	0,00134	0,01625	0,00148	-0,00159	0,00426	0,906	120	0,367
Pair 9	Performance Palladium - Performance DowJones	0,00111	0,01575	0,00143	-0,00172	0,00395	0,778	120	0,438
Pair 10	Performance Platinum - Performance AEX	0,00224	0,01635	0,00149	-0,0007	0,00519	1,51	120	0,134
Pair 11	Performance Platinum - Performance S&P 500	0,00121	0,01773	0,00161	-0,00198	0,0044	0,749	120	0,455
Pair 12	Performance Platinum - Performance DowJones	0,00098	0,01652	0,0015	-0,00199	0,00396	0,654	120	0,514

Period 3a and 3b is chosen because of the political unrest due to the financial crisis and upcoming elections in Italy. The sample consists of two months in total. One month before the installation of president Monti and one month after.
For the periods 3a and 3b descriptive statistics are also available. As expected the mean is negative in period 3b compared to period 3a except for palladium. Palladium is also an indicator for the wellbeing of the economy. Markets rose after the installation of Monti because people where confident in his reforming program for solving the financial crisis in Italy. Further the Sharpe - and Treynor ratio's dropped considerably in period 3b compared to 3a are all positive but the gold ratios are much higher than the other precious metals ratio's. So the performance of gold with respect to the risk-free rate compared to the other metals is far better. But in period 3b it is worse than silver and palladium but not as worse as the ratio's for platinum. This could be due to a rising risk-free rate, but it is expected that it is because of the huge drop of the performance of gold and platinum in period 3b compared to period 3a.

Table 10. Descriptive Statistics and Performance Rating period 3A. This table presents the mean and median daily return, the beta, the standard deviation and the minimum and maximum return, the skewness, the Sharpe and Treynor ratio of the ETFs and their benchmarks respectively. The sample period is from 10/18/2011 till 11/15/2011. The number of observations is 20. Under normal distribution the skewness is expected to be zero.

	Mean	Median	Beta	St. Dev.	Min	Max	Skew	Sharpe	Treynor
Gold benchmark	0,3661%	0,1582%		1,2777%	-1,66%	3,15%	0,41		
SPDR Gold Trust	0,3518%	0,0668%	0,9692%	1,2511%	-1,34%	2,84%	0,35	27,13%	0,35%
iShares COMEX Gold Trust	0,3500%	0,1453%	0,9647%	1,2454%	-1,41%	2,91%	0,33	27,11%	0,35%
ETFS Physical Swiss Gold Trust	0,3529%	0,1092%	0,9813%	1,2633%	-1,44%	2,92%	0,33	26,96%	0,35%
Silver benchmark	0,4027%	0,5015%		2,4013%	-2,90%	5,14%	0,31		
ETFS Silver Trust	0,3801%	0,3350%	1,0082%	2,4397%	-3,63%	5,05%	0,25	15,07%	0,36%
iShares Silver Trust	0,3885%	0,3572%	1,0301%	2,4890%	-3,51%	5,05%	0,22	15,11%	0,37%
ETFS Physical Silver	0,5219%	0,9316%	0,7191%	2,4543%	-3,76%	4,01%	-0,39	20,76%	0,71%
Palladium benchmark	0,3551%	0,5573%		2,2879%	-3,57%	4,68%	-0,07		
ETFS Physical Palladium Shares	0,3507%	0,6452%	0,9778%	2,2577%	-3,84%	4,88%	-0,02	14,98%	0,35%
ETFS Physical Palladium	0,4353%	0,6019%	0,8094%	2,2276%	-4,02%	4,55%	-0,16	18,98%	0,52%
iShares Physical Palladium ETC	0,3734%	0,7322%	0,6433%	1,7462%	-3,39%	2,87%	-0,53	20,67%	0,56%
Platinum benchmark	0,3473%	0,3499%		1,5215%	-3,01%	2,60%	-0,44		
ETFS Physical Platinum Shares	0,3308%	0,2434%	0,9820%	1,5097%	-2,71%	2,63%	-0,20	21,09%	0,32%
Physical Platinum ETC	0,3496%	0,4288%	0,9739%	1,7839%	-3,05%	2,81%	-0,43	18,90%	0,35%
iShares Physical Platinum ETC	0,2986%	0,5814%	0,8264%	1,4745%	-2,47%	2,50%	-0,45	19,41%	0,35%

Table 11. Descriptive Statistics and Performance Rating period 3B. This table presents the mean and median daily return, the beta, the standard deviation and the minimum and maximum return, the skewness, the Sharpe and Treynor ratio of the ETFs and their benchmarks respectively. The sample period is from 11/17/2011 till 12/15/2011. The number of observations is 20. Under normal distribution the skewness is expected to be zero.

	Mean	Median	Beta	St. Dev.	Min	Max	Skew	Sharpe	Treynor
Gold benchmark	-0,4481%	0,0106%		1,4868%	-3,53%	1,79%	-0,52		
SPDR Gold Trust	-0,4507%	-0,1452%	1,0098%	1,5099%	-3,51%	1,98%	-0,37	-30,55%	-0,46%
iShares COMEX Gold Trust	-0,4473%	-0,1172%	1,0085%	1,5097%	-3,65%	1,97%	-0,43	-30,32%	-0,45%
ETFS Physical Swiss Gold Trust	-0,4474%	-0,1187%	0,9982%	1,4948%	-3,67%	1,95%	-0,48	-30,63%	-0,46%
Silver benchmark	-0,3923%	-0,4741%		2,4090%	-6,08%	3,50%	-0,36		
ETFS Silver Trust	-0,3822%	-0,6487%	1,0584%	2,5790%	-5,85%	3,62%	0,00	-15,22%	-0,37%
iShares Silver Trust	-0,3776%	-0,7102%	1,0776%	2,6263%	-5,87%	3,67%	0,02	-14,78%	-0,36%
ETFS Physical Silver	-0,5593%	-0,3775%	0,9395%	2,8135%	-8,20%	3,79%	-0,84	-20,25%	-0,61%
Palladium benchmark	0,1230%	-2,8790%		2,7395%	-4,11%	5,88%	0,35		
ETFS Physical Palladium Shares	0,1289%	-0,1145%	1,0015%	2,8029%	-3,76%	5,81%	0,37	4,23%	0,12%
ETFS Physical Palladium	-0,0166%	-0,2903%	0,9127%	3,1590%	-7,41%	5,15%	-0,35	-0,86%	-0,03%
iShares Physical Palladium ETC	0,0690%	-0,1894%	0,8387%	2,9263%	-6,64%	4,57%	-0,30	2,00%	0,07%
Platinum benchmark	-0,5761%	-0,6363%		1,4220%	-3,60%	1,56%	-0,35		
ETFS Physical Platinum Shares	-0,5870%	-0,6231%	0,9532%	1,3802%	-3,64%	1,50%	-0,32	-43,29%	-0,63%
Physical Platinum ETC	-0,6132%	-0,3253%	0,9303%	1,5349%	-5,07%	1,24%	-1,39	-40,63%	-0,67%
iShares Physical Platinum ETC	-0,5331%	-0,2521%	0,6674%	1,2305%	-4,25%	0,91%	-1,43	-44,17%	-0,81%

Also the Jensen's alpha, standard errors, t-statistics and their p-values are calculated in both periods. Again there is none ETF statistical significant different from zero at the 95% confidence level. All the tracking errors are also zero or near zero.

Table 12. Performance Regression Results and Tracking Errors period 3A. This table also presents the results of the risk-adjusted performance regression: Ri- Rf= αi+ βi (Rm- Rf)+ εi. In which we estimate the alphas and betas by regressing the risk-adjusted daily return of the precious metal ETF on the risk-adjusted daily return of the corresponding precious metal benchmark. T-tests are performed to test whether the alpha coefficients differ significantly from zero. The null hypothesis that the alpha coefficient does not significantly differ from zero is rejected at probability levels smaller than 0.05 (95% confidence level). This table presents the estimations of tracking error. The tracking error is the deviation between the return of the ETF and the underlying index. We have computed three different measures, where TE1 is the absolute average return difference between the ETF i and the underlying index , TE2 reflects the standard error of ETFs i performance regression and TE3 is the standard deviation of the return difference between the ETF and its underlying index. The last column displays the equally-weighted average of the three tracking errors.

	Jensen alpha	Standard Error	t-Statistics	p-Value	TE1	TE2	TE3	Average TE
SPDR Gold Trust	0,0090%	0,2798%	0,0003	0,4998	-0,0143%	0,0160%	0,0697%	0,0238%
iShares COMEX Gold Trust	-0,0036%	0,2785%	-0,0001	0,4999	-0,0160%	0,0159%	0,0694%	0,0231%
ETFS Physical Swiss Gold Trust	-0,0065%	0,2825%	-0,0002	0,4999	-0,0130%	0,0161%	0,0700%	0,0243%
ETFS Silver Trust	-0,0258%	0,5455%	-0,0005	0,4998	-0,0226%	0,0173%	0,0780%	0,0242%
iShares Silver Trust	-0,0259%	0,5566%	-0,0005	0,4998	-0,0142%	0,0177%	0,0797%	0,0278%
ETFS Physical Silver	0,2288%	0,5488%	0,0042	0,4983	0,1192%	0,0240%	0,1047%	0,0826%
ETFS Physical Palladium Shares	0,0032%	0,5048%	-0,0001	0,5000	-0,0044%	0,0159%	0,0180%	0,0098%
ETFS Physical Palladium	0,1455%	0,4981%	0,0029	0,4988	0,0802%	0,0199%	0,0877%	0,0626%
iShares Physical Palladium ETC	0,1405%	0,3905%	0,0036	0,4985	0,0183%	0,0170%	0,0748%	0,0367%
ETFS Physical Platinum Shares	-0,0104%	0,3376%	-0,0031	0,4999	-0,0165%	0,0150%	0,0662%	0,0216%
Physical Platinum ETC	0,0110%	0,3989%	0,0003	0,4998	0,0023%	0,0159%	0,0704%	0,0295%
iShares Physical Platinum ETC	0,0095%	0,3297%	0,0003	0,4998	-0,0487%	0,0135%	0,0600%	0,0083%

Table 13. Performance Regression Results and Tracking Errors period 3B. This table also presents the results of the risk-adjusted performance regression: Ri- Rf= αi+ βi (Rm- Rf)+ εi. In which we estimate the alphas and betas by regressing the risk-adjusted daily return of the precious metal ETF on the risk-adjusted daily return of the corresponding precious metal benchmark. T-tests are performed to test whether the alpha coefficients differ significantly from zero. The null hypothesis that the alpha coefficient does not significantly differ from zero is rejected at probability levels smaller than 0.05 (95% confidence level). This table presents the estimations of tracking error. The tracking error is the deviation between the return of the ETF and the underlying index. We have computed three different measures, where TE1 is the absolute average return difference between the ETF i and the underlying index , TE2 reflects the standard error of ETFs i performance regression and TE3 is the standard deviation of the return difference between the ETF and its underlying index. The last column displays the equally-weighted average of the three tracking errors.

	Jensen alpha	Standard Error	t-Statistics	p-Value	TE1	TE2	TE3	Average TE
SPDR Gold Trust	0,0019%	0,3325%	-0,0001	0,4999	-0,0026%	0,0217%	0,0892%	0,0361%
iShares COMEX Gold Trust	0,0047%	0,3376%	0,0001	0,4999	0,0010%	0,0216%	0,0885%	0,0370%
ETFS Physical Swiss Gold Trust	-0,0002%	0,3376%	0,0000	0,5000	0,0010%	0,0216%	0,8849%	0,3024%
ETFS Silver Trust	0,0337%	0,5767%	0,0006	0,4997	0,0101%	0,0185%	0,0348%	0,0211%
iShares Silver Trust	0,0459%	0,5873%	0,0008	0,4996	0,0147%	0,0183%	0,0782%	0,0370%
ETFS Physical Silver	-0,1914%	0,6291%	-0,3042	0,4987	-0,1670%	0,0269%	0,1126%	-0,0092%
ETFS Physical Palladium Shares	0,0042%	0,6268%	0,0001	0,5000	0,0059%	0,0056%	0,0376%	0,0164%
ETFS Physical Palladium	-0,1298%	0,7064%	-0,0018	0,4992	-0,1396%	0,0013%	0,0318%	-0,0355%

iShares Physical Palladium ETC	-0,0358%	0,6543%	-0,0006	0,4997	-0,0540%	0,0028%	0,0322%	-0,0063%
ETFS Physical Platinum Shares	-0,0384%	0,3086%	-0,0012	0,4995	-0,0109%	0,0282%	0,1152%	0,0442%
Physical Platinum ETC	-0,0780%	0,3432%	-0,0023	0,4990	-0,0371%	0,0294%	0,1205%	0,0376%
iShares Physical Platinum ETC	-0,1521%	0,2752%	-0,0055	0,4978	0,0430%	0,0256%	0,1046%	0,0578%

The t-statistics for these two periods show that in period 3a all precious metals ETFs perform better than the average gold ETFs, they are all statistically significant. In period 3b in times of lowering gold prices and lowering return of performance of the gold ETFs silver and platinum ETFs are statistically significant from the average return of gold ETFs. But these silver and platinum perform much worse than gold, whereas palladium has a positive average return in period 3b. Palladium is a product that is used much in the petroleum industry. Lower gold prices is often an indication for a better economic climate.

Table 14. One-Sample Test Performance period 3A. ETFs compared to average performance gold ETF.

	Test Value = 0.3516					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Zilver ETFs	1,711	2	0,229	0,08%	-0,12%	0,28%
Palladium ETFs	1,379	2	0,302	0,03%	-0,07%	0,14%
Platinum ETFs	-1,697	2	0,232	-0,03%	-0,09%	0,04%

Table 15. One-Sample Test Performance period 3B. ETFs compared to average performance gold ETF.

	Test Value = -0.4485					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Zilver ETFs	0,147	2	0,897	0,01%	-0,25%	0,27%
Palladium ETFs	12,054	2	0,007	0,51%	0,33%	0,69%
Platinum ETFs	-5,482	2	0,032	-0,13%	-0,23%	-0,03%

Before the elections the one month performance for the AEX was -2%, the Dow Jones 4.4% and the S&P500 was 2.6%. Gold rose in that period with 7.4%, silver with 7.7%, palladium with 6.8% and platinum with 6%. Compared to the one month period after the elections the AEX rose with 1.5%, the Dow Jones with 1% and the S&P stayed constant. Gold and silver dropped 8%, palladium rose with 1.7% and platinum felt with 9%. So the precious metals where more volatile. Only silver and palladium where statistical significant in period 3a compared to the indices. Gold, silver and palladium where statistical significant in period 3b compared to their indices.

Table 16. Paired Samples Test period 3A. Precious metals benchmark compared to indices

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Performance Gold - Performance AEX	0,00446	0,01871	0,00418	-0,00429	0,01322	1,067	19	0,299
Pair 2	Performance Gold - Performance S&P 500	0,00219	0,0179	0,004	-0,00619	0,01057	0,547	19	0,591
Pair 3	Performance Gold - Performance DowJones	0,00133	0,01636	0,00366	-0,00632	0,00899	0,364	19	0,72
Pair 4	Performance Silver - Performance AEX	0,00483	0,0197	0,0044	-0,00439	0,01405	1,097	19	0,286
Pair 5	Performance Silver - Performance S&P 500	0,00256	0,01848	0,00413	-0,00609	0,01121	0,619	19	0,543
Pair 6	Performance Silver - Performance DowJones	0,0017	0,01864	0,00417	-0,00703	0,01042	0,407	19	0,688
Pair 7	Performance Palladium - Performance AEX	0,00435	0,01755	0,00392	-0,00386	0,01257	1,109	19	0,281
Pair 8	Performance Palladium - Performance S&P 500	0,00208	0,01492	0,00334	-0,0049	0,00907	0,624	19	0,54
Pair 9	Performance Palladium - Performance DowJones	0,00122	0,01501	0,00336	-0,00581	0,00825	0,364	19	0,72
Pair 10	Performance Platinum - Performance AEX	0,00379	0,02789	0,00624	-0,00927	0,01684	0,607	19	0,551
Pair 11	Performance Platinum - Performance S&P 500	0,00151	0,02937	0,00657	-0,01223	0,01526	0,231	19	0,82
Pair 12	Performance Platinum - Performance DowJones	0,00066	0,02755	0,00616	-0,01224	0,01355	0,106	19	0,916

Table 17. Paired Samples Test period 3B. Precious metals benchmark compared to indices

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Performance Gold - Performance AEX	-0,00541	0,01396	0,00312	-0,01194	0,00113	-1,732	19	0,099
Pair 2	Performance Gold - Performance S&P 500	-0,00459	0,01215	0,00272	-0,01027	0,0011	-1,688	19	0,108
Pair 3	Performance Gold - Performance DowJones	-0,005	0,01141	0,00255	-0,01034	0,00034	-1,961	19	0,065
Pair 4	Performance Silver - Performance AEX	-0,00485	0,02004	0,00448	-0,01423	0,00453	-1,082	19	0,293
Pair 5	Performance Silver - Performance S&P 500	-0,00403	0,01795	0,00401	-0,01243	0,00437	-1,004	19	0,328
Pair 6	Performance Silver - Performance DowJones	-0,00444	0,0177	0,00396	-0,01273	0,00384	-1,123	19	0,275
Pair 7	Performance Palladium - Performance AEX	0,00031	0,02362	0,00528	-0,01075	0,01136	0,058	19	0,954
Pair 8	Performance Palladium - Performance S&P 500	0,00113	0,0217	0,00485	-0,00903	0,01128	0,232	19	0,819
Pair 9	Performance Palladium - Performance DowJones	0,00071	0,02122	0,00474	-0,00922	0,01064	0,149	19	0,883
Pair 10	Performance Platinum - Performance AEX	-0,0055	0,01895	0,00424	-0,01436	0,00337	-1,297	19	0,21
Pair 11	Performance Platinum - Performance S&P 500	-0,00468	0,0169	0,00378	-0,01259	0,00323	-1,237	19	0,231
Pair 12	Performance Platinum - Performance DowJones	-0,00509	0,0165	0,00369	-0,01282	0,00263	-1,38	19	0,184

6 CONCLUSION AND REMARKS

The objective of this research was to find if there is a better risk-return trade-off than a physical backed gold ETF compared to other precious metal ETFs and if there is another precious metal than gold that could be considered as a safe haven. Other metals that are considered precious are silver, palladium and platinum.

There are several studies that have investigated the investment benefits of adding precious metals to portfolios of U.S. equities, and many conclude that positive allocations improve overall performance e.g. Jaffe (1989) and Chua et al. (1990). There is not much research concerning ETF performance, however there are studies that have examined the pricing mechanism of ETFs and the relative performance of on-market investment vehicles relative to the underlying benchmark and index fund alternatives (Gallagher & Segara, 2005). Although, in recent years, more research has been done regarding the performance of ETFs. Fassas (2012) concludes that precious metals offer a significant diversification effect for traditional investment portfolios, as their returns are not correlated with the returns of stocks and bonds. Furthermore, investors consider them as safe havens that offer protection against inflation and/or geopolitical risk.

This research concludes that although sometimes there is a better risk-return trade-off of other precious metals ETFs compared to gold ETFs there is no better overall risk-return trade-off of other precious metals ETFs. Period one, two and the first period of sample 3 show a positive average for gold ETFs, but the other metals show several results. Gold and

in lesser extent silver are viewed as monetary assets. Platinum and palladium are well known for their industrial uses. If the average of gold rises, silver is also rising, sometimes slightly higher than gold. Gold and silver both fell in period 3b. Silver was performing even statistically significant worse. Platinum and especially platinum show several results. In times of rising gold prices the performance of the platinum and palladium ETFs stay behind in period one and two. Surprisingly the performance was better in period 3a. In period 3b when the price of gold felt, platinum ETF performance was statistically significant worse than gold ETFs. The palladium ETFs had a better performance and it was even slightly positive than gold ETFs.

The conclusion of Fassas (2012) that precious metals are considered as safe havens that offer protection against inflation and/or geopolitical risk is conflicting with the conclusion of this study. In periods of declining indices it is expected that the performance of these precious metal ETFs would increase. This is only the case for gold and gold ETFs. The other metals (the ETFs included) show different results in the different time periods when indices are declining.

Hillier et al. (2006) conclude that it is useful to invest a small allocation of an investor portfolio into precious metals during a longer time. Their results are in line with the results regarding period one of this research. This is the longest period that is investigated in this research. The indices AEX, Dow Jones and the S&P 500 are declining whereas the rate of gold, silver, platinum and palladium is rising. Also the performance of all precious metal ETFs is positive. For all other periods the results are different and the same conclusion as Hillier et al. (2006) could not be made.

Another research conducted by Conover et al. (2009) conclude that relative to platinum and silver, gold has a better stand-alone performance and appears to have a better hedge against the negative effects of inflationary pressures. This conclusion is in line with the results this research provides for the different sample periods. In all periods of declining indices gold and gold ETFs do perform better than the other precious metals.
To conclude this research, results suggest that there is no better other precious metals ETFs that performs consistently better than gold ETFs and also only gold could be viewed as a safe haven in times when indices drop in value. This conclusion is in line with the conclusion of Hillier et al. (2006) and Conover et al. (2009). But it is not in line with the conclusion of Fassas (2012). As long as the other precious metals much depend on the industrial demand these metals will never be considered as a valuable investment in times of financial distress. So the precious metals silver, platinum and palladium can't be used by investors as a safe haven, whereas gold can.

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Appendix

Tables period 1

T-Test performance ETFs compared to average performance gold ETF

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Silver ETFs	3	,178433%	,0012423%	,0007172%
Palladium ETFs	2	,011500%	,0022627%	,0016000%
Platinum ETFs	2	-,005950%	,0045538%	,0032200%

T –test Precious metals benchmark compared to indices

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Performance Gold	,0997%	404	1,13593%	,05651%

	Performance AEX	-,0006%	404	1,27112%	,06324%
Pair 2	Performance Gold	,0997%	404	1,13593%	,05651%
	Performance S&P 500	,0549%	404	1,25273%	,06233%
Pair 3	Performance Gold	,0997%	404	1,13593%	,05651%
	Performance DowJones	,0542%	404	1,13117%	,05628%
Pair 4	Performance Silver	,1795%	404	2,52033%	,12539%
	Performance AEX	-,0006%	404	1,27112%	,06324%
Pair 5	Performance Silver	,1795%	404	2,52033%	,12539%
	Performance S&P 500	,0549%	404	1,25273%	,06233%
Pair 6	Performance Silver	,1795%	404	2,52033%	,12539%
	Performance DowJones	,0542%	404	1,13117%	,05628%
Pair 7	Performance Palladium	,0984%	404	2,03598%	,10129%
	Performance AEX	-,0006%	404	1,27112%	,06324%
Pair 8	Performance Palladium	,0984%	404	2,03598%	,10129%
	Performance S&P 500	,0549%	404	1,25273%	,06233%
Pair 9	Performance Palladium	,0984%	404	2,03598%	,10129%
	Performance DowJones	,0542%	404	1,13117%	,05628%
Pair 10	Performance Platinum	,0124%	404	1,21041%	,06022%
	Performance AEX	-,0006%	404	1,27112%	,06324%
Pair 11	Performance Platinum	,0124%	404	1,21041%	,06022%
	Performance S&P 500	,0549%	404	1,25273%	,06233%
Pair 12	Performance Platinum	,0124%	404	1,21041%	,06022%
	Performance DowJones	,0542%	404	1,13117%	,05628%

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Performance Gold & Performance AEX	404	,086	,085
Pair 2	Performance Gold & Performance S&P 500	404	,033	,506
Pair 3	Performance Gold & Performance DowJones	404	,048	,333
Pair 4	Performance Silver & Performance AEX	404	,241	,000
Pair 5	Performance Silver & Performance S&P 500	404	,238	,000
Pair 6	Performance Silver & Performance DowJones	404	,245	,000

Pair 7	Performance Palladium & Performance AEX	404	,526	,000
Pair 8	Performance Palladium & Performance S&P 500	404	,522	,000
Pair 9	Performance Palladium & Performance DowJones	404	,527	,000
Pair 10	Performance Platinum & Performance AEX	404	,066	,188
Pair 11	Performance Platinum & Performance S&P 500	404	,110	,027
Pair 12	Performance Platinum & Performance DowJones	404	,102	,040

Tables period 2

T-Test performance ETFs compared to average performance gold ETF

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Zilver ETFs	3	,198967%	,0004933%	,0002848%
Palladium ETFs	2	,103750%	,0030406%	,0021500%
Platinum ETFs	2	,070100%	,0009899%	,0007000%

T –test Precious metals benchmark compared to indices

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Performance Gold	,0023	121	,01115	,00101
	Performance AEX	-,0013	121	,01259	,00114
Pair 2	Performance Gold	,0023	121	,01115	,00101

	Performance S&P 500	-,0003	121	,01470	,00134
Pair 3	Performance Gold	,0023	121	,01115	,00101
	Performance DowJones	-,0001	121	,01317	,00120
Pair 4	Performance Silver	,0020	121	,02910	,00265
	Performance AEX	-,0013	121	,01259	,00114
Pair 5	Performance Silver	,0020	121	,02910	,00265
	Performance S&P 500	-,0003	121	,01470	,00134
Pair 6	Performance Silver	,0020	121	,02910	,00265
	Performance DowJones	-,0001	121	,01317	,00120
Pair 7	Performance Palladium	,0010	121	,01725	,00157
	Performance AEX	-,0013	121	,01259	,00114
Pair 8	Performance Palladium	,0010	121	,01725	,00157
	Performance S&P 500	-,0003	121	,01470	,00134
Pair 9	Performance Palladium	,0010	121	,01725	,00157
	Performance DowJones	-,0001	121	,01317	,00120
Pair 10	Performance Platinum	,0009	121	,01044	,00095
	Performance AEX	-,0013	121	,01259	,00114
Pair 11	Performance Platinum	,0009	121	,01044	,00095
	Performance S&P 500	-,0003	121	,01470	,00134
Pair 12	Performance Platinum	,0009	121	,01044	,00095
	Performance DowJones	-,0001	121	,01317	,00120

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Performance Gold & Performance AEX	121	-,276	,002
Pair 2	Performance Gold & Performance S&P 500	121	-,315	,000
Pair 3	Performance Gold & Performance DowJones	121	-,305	,001
Pair 4	Performance Silver & Performance AEX	121	,024	,792
Pair 5	Performance Silver & Performance S&P 500	121	,004	,961
Pair 6	Performance Silver & Performance DowJones	121	,002	,979
Pair 7	Performance Palladium & Performance AEX	121	,527	,000
Pair 8	Performance Palladium & Performance S&P 500	121	,492	,000
Pair 9	Performance Palladium & Performance DowJones	121	,491	,000
Pair 10	Performance Platinum & Performance AEX	121	,001	,990

Pair 11	Performance Platinum & Performance S&P 500	121	,036	,698
Pair 12	Performance Platinum & Performance DowJones	121	,034	,711

Tables period 3a

T-Test performance ETFs compared to average performance gold ETF

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Zilver ETFs	3	,430167%	,0795543%	,0459307%
Palladium ETFs	3	,386467%	,0437875%	,0252807%
Platinum ETFs	3	,326333%	,0257917%	,0148909%

One-Sample Test

	Test Value = 0.3516					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Zilver ETFs	1,711	2	,229	,0785667%	-,119057%	,276191%
Palladium ETFs	1,379	2	,302	,0348667%	-,073907%	,143641%
Platinum ETFs	-1,697	2	,232	-,0252667%	-,089337%	,038804%

T –test Precious metals benchmark compared to indices

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Performance Gold	,0037	20	,01278	,00286
	Performance AEX	-,0008	20	,01883	,00421
Pair 2	Performance Gold	,0037	20	,01278	,00286
	Performance S&P 500	,0015	20	,01847	,00413
Pair 3	Performance Gold	,0037	20	,01278	,00286
	Performance DowJones	,0023	20	,01673	,00374
Pair 4	Performance Silver	,0040	20	,02401	,00537
	Performance AEX	-,0008	20	,01883	,00421
Pair 5	Performance Silver	,0040	20	,02401	,00537
	Performance S&P 500	,0015	20	,01847	,00413
Pair 6	Performance Silver	,0040	20	,02401	,00537
	Performance DowJones	,0023	20	,01673	,00374
Pair 7	Performance Palladium	,0036	20	,02288	,00512
	Performance AEX	-,0008	20	,01883	,00421
Pair 8	Performance Palladium	,0036	20	,02288	,00512
	Performance S&P 500	,0015	20	,01847	,00413
Pair 9	Performance Palladium	,0036	20	,02288	,00512

	Performance DowJones	,0023	20	,01673	,00374
Pair 10	Performance Platinum	,0030	20	,01591	,00356
	Performance AEX	-,0008	20	,01883	,00421
Pair 11	Performance Platinum	,0030	20	,01591	,00356
	Performance S&P 500	,0015	20	,01847	,00413
Pair 12	Performance Platinum	,0030	20	,01591	,00356
	Performance DowJones	,0023	20	,01673	,00374

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Performance Gold & Performance AEX	20	,348	,132
Pair 2	Performance Gold & Performance S&P 500	20	,390	,090
Pair 3	Performance Gold & Performance DowJones	20	,411	,072
Pair 4	Performance Silver & Performance AEX	20	,601	,005
Pair 5	Performance Silver & Performance S&P 500	20	,650	,002
Pair 6	Performance Silver & Performance DowJones	20	,633	,003
Pair 7	Performance Palladium & Performance AEX	20	,661	,001
Pair 8	Performance Palladium & Performance S&P 500	20	,759	,000
Pair 9	Performance Palladium & Performance DowJones	20	,755	,000
Pair 10	Performance Platinum & Performance AEX	20	-,284	,225
Pair 11	Performance Platinum & Performance S&P 500	20	-,456	,043
Pair 12	Performance Platinum & Performance DowJones	20	-,424	,063

Tables period 3b

T-Test performance ETFs compared to average performance gold ETF

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Zilver ETFs	3	-,439700%	,1036022%	,0598147%
Palladium ETFs	3	,060433%	,0731273%	,0422201%
Platinum ETFs	3	-,577767%	,0408405%	,0235793%

One-Sample Test

	Test Value = -0.4485					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Zilver ETFs	,147	2	,897	,0088000%	-,248562%	,266162%

Palladium ETFs	12,054	2	,007	,5089333%	,327275%	,690592%
Platinum ETFs	-5,482	2	,032	-,1292667%	-,230720%	-,027813%

T –test Precious metals benchmark compared to indices

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Performance Gold	-,0045	20	,01487	,00332
	Performance AEX	,0009	20	,01900	,00425
Pair 2	Performance Gold	-,0045	20	,01487	,00332
	Performance S&P 500	,0001	20	,01603	,00358
Pair 3	Performance Gold	-,0045	20	,01487	,00332
	Performance DowJones	,0005	20	,01505	,00337
Pair 4	Performance Silver	-,0039	20	,02409	,00539
	Performance AEX	,0009	20	,01900	,00425
Pair 5	Performance Silver	-,0039	20	,02409	,00539
	Performance S&P 500	,0001	20	,01603	,00358
Pair 6	Performance Silver	-,0039	20	,02409	,00539
	Performance DowJones	,0005	20	,01505	,00337
Pair 7	Performance Palladium	,0012	20	,02739	,00613
	Performance AEX	,0009	20	,01900	,00425
Pair 8	Performance Palladium	,0012	20	,02739	,00613
	Performance S&P 500	,0001	20	,01603	,00358
Pair 9	Performance Palladium	,0012	20	,02739	,00613

	Performance DowJones	,0005	20	,01505	,00337
Pair 10	Performance Platinum	-,0046	20	,01318	,00295
	Performance AEX	,0009	20	,01900	,00425
Pair 11	Performance Platinum	-,0046	20	,01318	,00295
	Performance S&P 500	,0001	20	,01603	,00358
Pair 12	Performance Platinum	-,0046	20	,01318	,00295
	Performance DowJones	,0005	20	,01505	,00337

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Performance Gold & Performance AEX	20	,685	,001
Pair 2	Performance Gold & Performance S&P 500	20	,693	,001
Pair 3	Performance Gold & Performance DowJones	20	,709	,000
Pair 4	Performance Silver & Performance AEX	20	,590	,006
Pair 5	Performance Silver & Performance S&P 500	20	,667	,001
Pair 6	Performance Silver & Performance DowJones	20	,681	,001
Pair 7	Performance Palladium & Performance AEX	20	,532	,016
Pair 8	Performance Palladium & Performance S&P 500	20	,611	,004
Pair 9	Performance Palladium & Performance DowJones	20	,639	,002
Pair 10	Performance Platinum & Performance AEX	20	,351	,129
Pair 11	Performance Platinum & Performance S&P 500	20	,343	,139
Pair 12	Performance Platinum & Performance DowJones	20	,322	,166