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HEDGING INFLATION THROUGH ETFs: THE PERFORMANCE OF ETFs OFFERING INFLATION PROTECTION

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I hereby declare that I have compiled the thesis independently
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has not been previously presented for grading.
The document length is 8042 words from the introduction to the end of the conclusion.

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ABSTRACT

The purpose of this study is to examine how the ETFs represented by the four different asset classes have performed over three different inflation periods. At the same time, investigating ETFs' relationship with inflation and risk-adjusted returns. Inflation periods covered in this study are 1.10.2006-31.7.2008, 1.4.2015-31.2018, and 1.5.2020-31.3.2022. The study involves 14 different funds that represent stock, real estate, bond and gold asset classes. Quantitative research methods were used by utilising Sharpe's ratio, Treynor ratio and correlation analysis. The study finds that stocks tend to perform well during times of high inflation. Stock ETFs clearly outperformed other asset classes, providing protection against inflation in each study period. Results also indicated that bond ETFs are performing poorly in the inflation periods. Gold ETFs had an excellent performance during the first study period, which was during the 2008 financial crisis. On the contrary, real estate ETFs had worse performance in the first period but showed better results in later periods. Study results do not provide absolute truths, but they provide guidance for investors.

Keywords: Exchange-traded funds, Inflation, Performance, Asset classes, Hedging

INTRODUCTION

According to OECD (2022b), the recovery that economies have experienced from the Covid-19 pandemic has been strong. This quick recovery has had its downsides: increasing and broadening inflation (OECD 2022b). In addition to the Covid-19 pandemic, we can see that Russia's invasion of Ukraine has already had profound economic consequences by only accelerating inflation (OECD 2022a). A report from the U.S. Bureau of Labor Statistics (2022) shows that inflation has been on the rise to its highest levels in a decade. For rational investors, the aim is to maximise their return at a certain level of risk. However, it has been found that increasing inflation creates a lot of pressure on their portfolios (Wang et al., 2011; Arnold, Auer, 2015). Therefore, every retail and professional investor will have to ask the same question: How to keep up with inflation?

There are multiple ways to hedge against inflation. Typically, fixed income securities, equities, real estate, and commodities are ones to consider (Arnold, Auer 2015). However, there is still a debate regarding which assets provide the most effective inflation hedge. Accessing these investments can be tricky, but ETFs indirectly offer a way to do so. ETFs have gained popularity in recent years among retail and professional investors since they provide low management costs and liquidity (Ben-David et al., 2017).

To better understand the relationship between inflation and ETFs, this paper will look at the historical performance of these securities and their asset classes throughout three different inflation periods. There are limited studies that have researched ETFs and their asset classes during high inflation periods. Many previous research papers have presented conflicting results on the relationship between inflation and different asset classes. This creates a good ground for this study and strongly indicates that more research on this topic is needed.

In this thesis, the author examines the historical performance of different asset classes represented by ETFs in different inflation periods while focusing on ETFs that invest in assets that have been traditionally considered to have inflation hedge properties. The thesis aims to determine if some

specific ETF fund has been more successful in the different inflation periods and which investments do better with inflation. Thus, the thesis focuses on the following research questions:

Research question:

1. How have the inflation-protected ETF funds performed during different inflation periods?
2. Which inflation-protected ETFs show the best risk-adjusted returns?
3. How have the chosen ETFs performed compared to inflation?

Research questions are sought to be answered using quantitative research methods. The author has chosen to analyse the performance of the ETFs by using risk-adjusted measures Sharpe ratio and Treynor ratio. The inflation periods that have been selected are the three most recent significant inflation periods. The thesis looks at ETFs that invest in the U.S. markets to different asset classes that offer inflation protection. Due to various research limitations, the author has been forced to focus on traditional asset classes – bonds, equities, gold, and real estate. In this study, the author will only concentrate on gold of all the commodities, partly because gold has long been one of the most popular investments in commodities. Also, including all the commodities individually would have been challenging with the given research limitations. The sample of this study includes 14 ETFs representing four different asset classes.

The remaining parts of this thesis are structured as follows. Right after the introduction, the first chapter will look at previous literature on asset classes and inflation hedging. Additionally, the first chapter will look at ETFs as an investment vehicle. After which, in the second chapter, the research methodology and data collection will be explained. The second part includes detailed explanations of the data used in the empirical research, and the measures for fund performance are presented. Before the conclusion chapter, in the third chapter of this thesis, there is a discussion of the results, and the answers to research questions can be found.

The research has been limited to the U.S. markets because information and data for different ETF funds are more straightforward and better accessible. Some asset classes have been left out, for example, cryptocurrencies, since they are relatively new asset classes and there is not much literature or research available on them. Additionally, one limitation of this thesis is the time constraint, which limits the author’s possibilities to make a thorough review of previous literature.

1. THEORETICAL BACKGROUND

This chapter will introduce relevant literature to support this study. The author discusses theories and previous literature on asset classes and inflation and reviews ETF products throughout this section. The first part discusses inflation hedging properties of different asset classes. The second part will give an overview of ETFs as an investment vehicle. It is crucial to highlight previous literature so that the reader can better understand the purpose and results of the study.

1.1. Inflation hedging

Inflation is simply defined as the aggregate increase in prices, commonly measured by the Consumer Price Index (C.P.I.) or Wholesale Price Indes (W.P.I.). This study will have the C.P.I. as a measurement for inflation as it represents better the retail prices, and it is the most widely used measure for inflation (Vining et al. 1976). In the U.S., average inflation is around 2 per cent, so it has not been advisable to hold cash as it loses its value. This is especially true recently as inflation has been higher, around 7 per cent, and it is projected to increase (BLS 2022).

Bodie (1976) defines inflation hedging in three different ways. The first definition states that the real return of an asset should be low enough to remove or reduce the possibility of it falling below a specific floor value, for example, zero, to qualify as an inflation hedge. In the second definition, an asset is an inflation hedge if its real return is free from outside control, inflation. Lastly, the most used definition in empirical studies maintains that the real return on an asset is independent of inflation, stating that when the asset is correlating positively with inflation, it is considered an inflation hedge. When investors talk about hedging inflation, they refer to above-average inflation. In this study, the inflation hedge is referred to mitigate the potential negative impact of unexpected, above-average inflation.

The efficient market hypothesis states that (see Fama 1970), all current market prices reflect all available information. Both the economy and financial markets are uncertain when inflation is high, and this kind of high inflation distorts asset pricing. This distinction is important because of

the idea behind the efficient market hypothesis. As it expects that all known information is already incorporated into the prices of assets, it can be assumed that stock and bond prices already reflect inflation on an annual basis. Thus the average inflation does not necessarily need to be hedged away. However, we are now seeing above-average inflation, and because of this, one way to hedge for inflation is simply to have a more significant portfolio return than inflation is.

Many previous studies have examined how different asset classes can hedge against inflation, together with bonds, commodities, real estate and stocks (Bekaert, Wang 2010; Engsted, Tanggaard 2002; Hoevenaars et al., 2008; Worthington, Pahlavani, 2007). For investors holding their assets for the long term, inflation risk can be a significant concern since high inflation erodes the potential returns they will receive in the future (Sing et al. 2000). Fama and Schwert (1977) proposed a framework for testing the inflation hedging ability of different assets in different countries. However, the empirical results produced mixed and sometimes contradictory results. The main reason for the mixed results in previous studies is the difference between data sources, sample period and frequency, country coverage or econometric methodology (Arnold, Auer 2015).

1.1.1. Fixed-income securities

Inflation affects fixed-income securities, affecting how central banks change their interest rates and the real return of the bonds. Short term bonds are less sensitive because they can be quickly switched to new bonds at higher yields as they mature. In other words, they can quickly adjust for unexpected inflation. For this reason, the short term bonds may not have an inflation risk premium and thus be a poor hedge against the unexpected inflation.

Fama (1975) analysed one- to six-month U.S. Treasury bills and found that the Fisher hypothesis is true in the short-run (see Fisher 1930). Based on his findings, the capital market can be considered efficient (in the short run) in the sense that nominal interest rates are always taken into account and reflect all relevant information about future inflation rates. The study supported the efficient market hypothesis that the nominal interest rates incorporate inflation into the bond prices. A more recent study by Bekaert and Wang (2010) showed indications that short term bonds are failing to hedge unexpected inflation.

It has been shown that bonds do not have a positive relationship with inflation, according to empirical evidence from the U.S. (Briere, Signori 2012; Bekaert, Wang 2010). Nevertheless, Fama

and Schert (1997) detected from the same region that bonds issued by the government are hedged, but only for the expected inflation.

TIPS or Treasury inflation-protected securities are the only true asset linked to inflation. It is a relatively new financial product that the U.S. government issues. TIPS are paying a principle adjusted for the inflation plus a fixed coupon rate. They are indexed to the consumer price index (C.P.I.) provided seasonally by the U.S. Department of Labor. The monetary policy of the U.S. is one huge aspect that affects the hedging possibilities of TIPS (Dudley 1996). In contrast, another study says that a diversified portfolio can benefit from having TIPS securities (Kothari, Shanken (2004).

Bonds' abilities to hedge against inflation are not unambiguous, and study results vary depending on the bond types, study region and maturities. Generally can be said that bonds are sensitive to inflationary periods, and TIPS protect against inflation, at least technically and theoretically. Otherwise, bonds show a negative relationship short run, but they start doing better as the time span extends.

1.1.2. Real estate

The general idea has been that real estate is a good hedge against inflation for a long time. When investing in real estate, there are various possibilities. One could invest in public real estate, commercial properties or residential properties. The real estate value increases in practice in two ways: by receiving rental income and appreciation. When doing empirical research on real estate, it is quickly noticeable that the information on prices is not readily available or it is incomplete, which has been a problem in many related studies. Arnold and Auer (2015) argue that many of the results on the relationship between real estate returns and inflation could be biased due to the pricing problem.

Wilson & Zurbruegg (2003) highlight problems that direct ownership of real estate brings. They emphasise issues such as significant monetary investments, lack of a central market, low liquidity and high maintenance costs. Luckily, real estate investment trusts (REITs) are the answer to these problems. REITs collect money from investors and invest in real estate properties, joint ventures and income-producing mortgages.

The empirical result has supported the fact that real estate is correlated with inflation rates. Fama and Schwert (1977) studied transaction-based returns for real estate and noticed that nominal returns correlated with inflation. Also, other studies have been finding similar results as Hartzell, Hekman, and Miles (1987) in their research. Simpson et al. (2007) investigated private real estate, and they found that it provides inflation protection against expected inflation but did not manage to protect it from unexpected inflation periods.

As indirect investment through REITs, it has been expected to hedge against inflation. Nevertheless, the previous studies have not been unanimous on the hedging properties against inflation. Many studies show results on the fact that REIT has a negative correlation with inflation (Chan et al. 1990; Liu et al. 1997). Glascock et al. (2002) concluded in their study that there is a negative relationship between REITs and inflation. Still, they emphasised that the REITs can be a hedge in a mixed-asset portfolio.

Although it could be generally assumed that inflation would increase the prices of real estate and REITs, this is not always the case. Real estate is a tangible asset that some empirical studies have found to be a hedge against inflation, even though the empirical studies have had some problems with the data. As intricate investment vehicles, REITs have been found to have a negative relationship with inflation. So it can be generally said that the previous research results are indicative.

1.1.3. Stocks

Stocks are the asset class studied the most extensively with inflation hedging. Again, the results are sometimes ambiguous. Numerous empirical studies have established the negative impact of inflation on short-term stock returns, but fewer studies report the positive effect of inflation on long-term returns. Bodie (1976), for example, discovered that stock return and inflation had a negative relationship in the short run. Bodie even stated in his conclusion that: “to use common stocks as a hedge against inflation, one must sell them short”. In fact, this is far from the only such result, as previous studies have yielded similar results (Jaffe, Mandelker 1976; Fama, Schwert 1977; Gultekin 1983b). However, these contradict Fisher’s hypothesis, stating that the nominal asset return should move with expected inflation (Fisher 1930).

Other studies suggest that the time horizon should be longer to get the positive effect of inflation. Boudoukh and Rickhardson (1993) argue that the long horizon is crucial since many investors are

long term investors. Therefore it is essential to see how the stock behaves with more extended time periods. While Harrison and Zhang (1999) think that the more extended period is more suitable since short term noise in the stock market could occur due to agents trading to balance their portfolios. Some of the studies have taken advantage of the long term and gained results that support the Fisher hypothesis as the time period increases (Boudoukh, Rickhardson 1993; Engsted, Tanggaard 2002).

To sum up, the current knowledge of stocks states that the answer to wheater stocks are a hedge is ambiguous. Stocks have a poor performance during periods of inflation in the short run because inflation rates negatively affect their performance, which was confirmed by the earlier studies. More recent studies show a more positive relationship between returns and inflation. Stocks work well as inflation hedges not because they tend to perform well in high inflation periods but because their long term returns are more remarkable. However, studies show evidence to support the fact that stocks do offer an inflation hedge when the time period is long enough.

1.1.4. Gold

The old way of thinking about gold has always been the safe heaven of assets. The value of gold is formed very differently from the other investments discussed in this study, and it has additional features that make it valuably and desirable for investors. Many academic studies have focused on investigating the consensus that gold is safe heaven and that gold reflects expectations on inflation. Less academic studies can be found on hedging opportunities on inflation.

A study by Mahdavi and Zhou (1997) examined the connection between the price of gold and consumer prices. They found out that consumer prices and gold prices do not have a strong relationship. Thus, gold price did not prove its ability to predict inflation. Unlike in a study by Ghosh et al. (2004), they were able to find that it could be working as a long-run hedge in five different countries, including the U.S. In a study year earlier, Adrangi et al. (2003) detected that expected inflation and gold had a positive relationship; hence, gold could offer both short- and long-term protection against inflation. A more recent study from 2011 investigated hedging in two regions, Japan and the U.S. (Wang et al. 2011). They explored the 39 years of the U.S. and Japan, and the results showed that gold is not a hedge when the momentum regime is low. Nevertheless, there are signs that gold is either almost total or partial hedge when it is momentum regime high.

Studies investigating inflation and gold prices are not ambiguous, and their result varies subject to the sample period and the observation region. Earlier studies suggest that gold has some hedging properties, but most recent studies show that the inflation hedge is very dependent on the time period. Sometimes it beats inflation, and sometimes it does not provide any hedge.

1.2. Exchange Traded Funds

A popular investment product among investors is exchange-traded funds (ETFs). In all its simplicity, ETF is a fund listed on a stock exchange, which means it is traded in real-time among other products on the stock exchange. Many ETFs have been created to represent various indexes, such as S&P 500 artificially. Since ETFs were born in the mid-1990s, their popularity has grown tremendously, primarily due to their low transaction costs and liquidity (Ben-David et al. 2017). However, the operating principle is the same as for ordinary funds: profits and losses come from the underlying assets.

For investors that want to have an easy way to make investments, ETFs offer a great way to do so. ETFs can be found in the exchanges, and they track the performance of many different assets, for example, cryptocurrencies which may be difficult to access as an investment. ETFs allow access even to a retail investor to allocate funds between multiple asset classes, which was not previously possible or it was gruelling. Statista says the ETF market cap has increased from 204 billion U.S. dollars in 2003 to over 10 trillion in 2021 (Statista 2022). The growth has been rapid, and the number of different ETFs is increasing year by year.

As mentioned, ETFs provide benefits that explain the vast popularity of the products. Antoniewicz and Heinrichs (2014) open up the operating principles of ETFs and highlight their main advantages. The main benefits are summarised as follows:

1. ETFs has intraday tradability, which gives investor liquidity and quick access to various asset classes
2. ETFs have price transparency which makes the ETFs convenient and easy alternative for investors that wants to mitigate the potential price premium or discount to the net asset value of a security

3. ETFs have capital gain taxes only until it is sold. It has more tax benefits compared to mutual funds.
4. ETFs have allowed investors to access all markets and asset classes that would be, in other situations, very difficult and time-consuming
5. Demand for passive investment vehicles has been on the rise, and ETFs have been able to match the demand
6. ETFs are offering lower costs since they have low management fees

Portfolio risk management is a significant concern for investors. However, ETFs can be helpful in reducing the risk a portfolio is facing, in our case, inflation risk. As mentioned already, ETFs allow easy access to all asset classes, and it helps the investor to diversify its portfolio and thus reduce the exposure to inflation risk.

It can be said that ETFs are a good product, but they are not perfect. Thus some disadvantages and risks are always included. ETFs usually track the underlying asset's performance, for example, S&P 500 index. ETFs are not a good option for investors looking to beat the market as they usually will not outperform the underlying asset in returns. In addition, the value of the ETF does not always match the value of the underlying asset due to the tracking error (Frino, Gallagher 2001). This is usually seen in commodity cases such as gold. In almost all cases, ETFs do not physically own gold, but they create an artificial way of owning gold using derivatives.

2. DATA AND METHODOLOGY

This study aims to study the historical performance of ETFs during three different inflation periods and compare the performance to inflation. Hence, quantitative study methods will be utilised. The data for inflation during the periods was taken from the OECD database (OECD 2022b). The empirical part of this study covers 14 different ETFs, representing four different asset classes. The data used for the ETFs and benchmarks have been retrieved entirely from Yahoo Finance with the help of Rstudio programming software. ETFs and benchmark indexes' monthly prices for each asset class were taken from three different time periods: 1.10.2006-31.7.2008, 1.4.2015-31.2018, and 1.5.2020-31.3.2022. The chosen periods in this study are the most recent high inflation periods in the 2000s; in other words, these are the periods where can be seen that inflation is rising. The periods are different in length since the duration of high inflation varies. Based on the price data, logarithmic returns were calculated. This study uses logarithmic returns to get a more realistic estimate for the returns since it takes better into account the compounding effect on interest and makes the values more normally distributed. All the calculations were executed in Microsoft Excel.

There are many different methods for determining funds' success; however, to measure the performance of ETFs and their relationship with inflation, this study has used the Sharpe ratio(1966), Treynor ratio(1965) and correlation analysis. Also, the holding period returns have been calculated for each ETF and benchmark indexes for each period. It should be borne in mind that the calculations are not absolute truths but rather as accurate estimates as possible of reality.

2.1. Data description, collection, and limitations

The data sample consists of 14 ETFs that have been selected to represent four different asset classes: real estate, gold, stocks and bonds. All of the chosen funds are investing in the U.S. markets. The reason for selecting the U.S. market relates to the easy access to data and the fact that the financial and investment markets in the U.S. are the largest in the world. The ETFs have been selected to be representative of each asset class. Many ETFs did not meet the criteria to be chosen since, in many cases, the formation date was before the first inflation period under review. On the other hand, the market cap of many funds was not significant enough, or data from some funds were not readily available for the desired periods. For example, there were only 20 different

ETFs investing in gold, and the selected ETFs were significant enough in their respective categories. The study results should be treated with a bit of caution because the chosen ETFs might not be as fully representative for each asset class.

There were four ETFs chosen that invest in real estate. ETFs investing in stock were found in large numbers, but only five were selected for this study. As mentioned, 20 available ETFs were investing in gold, and of those, only two were selected. Finally, three different ETFs were selected from bonds, one representing TIPS and the other two representing short and long term bonds. Table 1 shows the important information on the ETFs. The table shows the ETF names, tickers, inception date and the asset class they represent.

Table 1. Information on ETFs

Symbol	**ETF Name**	**Inception date**	**Asset Class**
VNQ	Vanguard Real Estate ETF	Sep 23 2004	Real Estate
IYR	iShares U.S. Real Estate ETF	Jun 12 2000	Real Estate
RWR	SPDR Dow Jones REIT ETF	Apr 23 2001	Real Estate
ICF	iShares Cohen & Steers REIT ETF	Jan 29 2001	Real Estate
GLD	SPDR Gold Shares	Nov 18 2004	Gold
IAU	iShares Gold Trust	Jan 21 2005	Gold
SPY	SPDR S&P 500 ETF Trust	Jan 22 1993	Stocks
VTI	Vanguard Total Stock Market ETF	May 24 2001	Stocks
QQQ	Invesco Q.Q.Q. Trust	Mar 10 1999	Stocks
VUG	Vanguard Growth ETF	Jan 26 2004	Stocks
IJR	iShares Core S&P Small-Cap ETF	May 22 2000	Stocks
TIP	iShares TIPS Bond ETF	Dec 04 2003	Bonds
SHY	iShares 1-3 Year Treasury Bond ETF	Jul 22 2002	Bonds
IEF	iShares 7-10 Year Treasury Bond ETF	Jul 22 2002	Bonds

Source: ETF Database (2022)

2.2. Benchmarks and the risk-free rate

Benchmark indexes were selected in a way that they would represent the asset classes in the best possible way. As this study examines four asset classes, there was a need to take four indexes to improve the study results. The chosen benchmarks are introduced in table 2, where all the necessary information can be found. This study uses the following benchmarks for each asset class: Vanguard Real Estate Index Fund Investor Shares (Real Estate), Gold Jun 22 (GC=F) (Gold), S&P 500 (Stocks), and iShares Core U.S. Aggregate Bond (Bonds). Finding representative benchmarks for the asset class market was very challenging as the inception date for many was belated. In addition, one general benchmark used is the C.P.I., which was used to analyse the ETFs' correlation with inflation.

Table 2. Benchmark indexes for asset classes

Benchmark Index	**Asset**
Vanguard Real Estate Index Fund Investor Shares	Real Estate
Gold Jun 22 (GC=F)	Gold
S&P 500	Stocks
iShares Core U.S. Aggregate Bond	Bonds

Source: Yahoo Finance (2022)

The risk-free interest rate usually refers to the key bank interest rate or the yield on government bonds. It is traditionally used to describe the theoretical rate of return for a risk-free investment. However, no true risk-free investments cannot exist as there is always some degree of risk involved. Since this study focuses on the U.S. markets, this study uses the yield on three month U.S. Treasury bill, and the rate corresponds to each time period. The three month U.S. Treasury bill rate is widely used in many finance contexts to reflect the risk-free rate. The chosen risk-free rate was used to calculate the Sharpe’s and Treynor’s ratios.

2.3. Research methods

This study utilises performance indicators to measure the risk-adjusted returns of the funds. These indicators are Shrape's and Treynors's ratios. In addition, correlation analysis will be included in the comparison to get more information on the relationship between inflation and funds' returns.

The Sharpe ratio is a commonly used method for assessing the performance of funds which describes the success of the portfolio through risk-adjusted returns. It was developed by Sharpe (1966). Sharpe ratio takes the return of the portfolio and adjusts it for the risk-free return and portfolio volatility. In formula 1, Ri describes the return on the investment, the ETF, in this study. Rf represents the risk-free interest rate, and σi is the standard deviation of the return on investment. In other words, in the numerator is the excess return of the portfolio, and in the denominator is the volatility of the portfolio. The formula used is as follows:

$$S = \frac{R_i - R_f}{\sigma_i} \quad (1)$$

where,
S – Sharpe's ratio,
R_i – portfolio's return,
R_f – risk-free return,
σ_i – volatility of the portfolio.

Sharpes ratio helps investors compare and analyse the risk-return performance of portfolios. The larger the ratio is, the more the fund returns in relation to the risk taken. If the ratio is negative, it means that the investment has performed worse than the risk-free rate. The value between 0 and 1 means that the returns are better than the risk-free rate, but they do not offer excess returns compared to the risk.

Like Sharpe's ratio, Treynor's ratio is a key figure for comparing funds. The Treynor ratio differs from the Sharpes ratio in terms of which risk is taken into account. The Treynor ratio only takes into account the systematic risk, which is represented by the beta value of the fund. In formula 2, Ri represents the return of the fund and *Rf* the risk-free return. Beta or β_i reflects the systemic risk of the fund. The formula is as follows:

$$T = \frac{R_i - R_f}{\beta_i} \quad (2)$$

where,
T – Treynor ratio,
R_i – portfolio's return,
R_f – risk-free return,
β_i – beta value, or the systematic risk.

The value of the Treynor ratio is interpreted in the same way as the Sharpe ratio; the higher the value, the better the risk-return ratio.

In order to better understand the relationship between inflation and fund returns, this study will also consider the correlation between the two variables. The core idea of portfolio theory is that to reduce the risk to the portfolio, one needs need to select investments in the portfolio that do not correlate with each other. A low correlation between investments guarantees that the value of the entire portfolio will not decline tremendously even if the value of a couple of individual stocks collapses. The same logic can also be derived from hedging against inflation. Since inflation is rising, it is helpful to know which types of investments are typically positively correlated with inflation.

Correlation is a concept used in probability and statistics to describe the relationship between two variables. Correlation is the numeric measure that describes the degree to which two securities, asset classes or investment strategies move in relation to one another. It is measured on a scale that can vary from coefficient -1 to +1. Coefficient -1 is a complete negative correlation meaning that two variables are moving perfectly in opposite directions. In turn, +1 means the complete opposite, a positive relationship. Finally, a correlation of 0 implies that there is no correlation at all between the two variables. For example, if two securities have a correlation of 0.75, then their changes in price movements are due to 75% of the data variables, and the rest of 25% are dependent and do not explain the price movements. Correlation helps to make predictions on one variable with the information of the other variable; nevertheless, one important note to remember is that correlation does not imply causation.

3. FINDINGS AND DISCUSSION

This section aims to review the key findings and results of the study. The results begin with a review of empirical results, showing holding period return and volatility for ETFs and asset class benchmarks. Followed by the results for the Sharpes and Treynor's ratios, after which will be results for correlation analysis. Finally, there will be a discussion of the results.

3.1. Empirical Findings

Table 3 shows the holding period returns and volatility (standard deviation for the period) for the ETFs and asset class benchmarks. In all tables, period 1 refers to 1.10.2006-31.7.2008, period 2 refers to 1.4.2015-31.2018, and period 3 refers to 1.5.2020-31.3.2022. ETFs are in the same order as in table 1, so the first four represent the real estate assets class, the next two gold asset class, the following five the stocks asset class, and the last three bonds.

Table 3. ETFs and Indexes holding period returns and volatility, and inflation for the periods 1-3

	Period 1		**Period 2**		**Period 3**	
Inflation for period	7,75 %		6,59 %		10,91 %	
ETF	**H.P.R.**	**Volatility**	**H.P.R.**	**Volatility**	**H.P.R.**	**Volatility**
Vanguard Real Estate ETF	-16,33 %	5,96 %	3,23 %	3,64 %	42,39 %	4,56 %
iShares U.S. Real Estate ETF	-19,25 %	5,89 %	7,62 %	3,38 %	42,30 %	4,54 %
SPDR Dow Jones REIT ETF	-17,99 %	5,92 %	5,91 %	3,63 %	50,66 %	4,72 %
iShares Cohen & Steers REIT ETF	-16,00 %	**6,29 %**	5,95 %	3,61 %	43,01 %	4,81 %
SPDR Gold Shares	**51,47 %**	4,29 %	2,22 %	**4,02 %**	13,76 %	4,48 %
iShares Gold Trust	51,41 %	4,29 %	2,62 %	4,01 %	14,31 %	4,49 %
SPDR S&P 500 ETF Trust	-5,05 %	3,40 %	34,96 %	2,90 %	55,48 %	4,07 %
Vanguard Total Stock Market ETF	-3,09 %	3,48 %	34,45 %	2,92 %	56,11 %	4,13 %
Invesco Q.Q.Q. Trust	11,83 %	5,18 %	**63,94 %**	3,91 %	65,61 %	**5,27 %**
Vanguard Growth ETF	6,18 %	3,53 %	42,79 %	3,20 %	59,49 %	5,16 %
iShares Core S&P Small-Cap ETF	0,03 %	3,68 %	49,44 %	3,77 %	**70,29 %**	4,98 %
iShares TIPS Bond ETF	5,26 %	1,57 %	-2,20 %	0,88 %	2,69 %	1,17 %
iShares 1-3 Year Treasury Bond ETF	3,39 %	0,60 %	-1,98 %	0,23 %	-3,97 %	0,32 %
iShares 7-10 Year Treasury Bond ETF	6,25 %	1,61 %	-5,35 %	1,34 %	-11,67 %	1,37 %
Asset Benchmark Index						
Real Estate	-16,48 %	5,89 %	3,34 %	3,60 %	42,43 %	4,56 %
Gold	47,61 %	7,94 %	11,61 %	3,84 %	17,69 %	3,91 %
Stocks	-5,13 %	3,42 %	35,04 %	2,85 %	55,55 %	4,04 %
Bonds	0,25 %	0,93 %	-4,33 %	0,80 %	-8,54 %	1,02 %

Source: Author’s own calculations

As table 3 shows, results vary tremendously throughout the time periods. However, it is noticeable that the results remain somewhat similar in their own categories. For example, each real estate ETF has similar returns in different periods. In the first period, gold ETFs were clearly outperforming other ETFs, and while in the second period, stock ETFs were clearly better than others. The same is also noticeable in the third period, where stock ETFs continued to yield the most. In all periods, the asset class that was performing the best either outperformed the benchmark or was very similar with a minimal difference.

The volatility of the funds also varies widely from period to period. Therefore, it is difficult to identify a specific fund that would have been riskier throughout the time periods. From the data can be seen that bond ETFs have been showing low volatility in all periods. Still, bond ETFs have not been able to offer even reasonable returns for an investor without even beating inflation.

None of the bond ETFs was able to beat inflation in any period. During the first period, only one stock ETF was able to beat it. In the other two periods, stock ETFs clearly outperformed inflation. Gold ETFs had excellent returns in the first period, but the returns were moderate in the later periods, beating inflation in periods 1 and 3. Real estate ETFs offered the most considerable fluctuations in returns. In the first period, they had negative returns. The second period showed better returns, yet only one fund beat inflation. Going into the third period, the funds performed well, beating inflation clearly.

Table 4 gives information on the risk-adjusted returns in the form of Sharpe's and Treynor ratios. They help understand the returns compared to the investments and the market's volatility. As a reminder, Sharpe's ratio uses as a risk the volatility of the returns, and the Treynor ratio uses the market risk, which is the beta value. Beta values are different for each asset class since they use different benchmarks. In addition, the risk-free rate is different for each period as it has been taken to correspond to different periods.

Table 4. ETFs and Indexes Sharpe's and Treynor ratios for the periods 1-3.

	Period 1		**Period 2**		**Period 3**	
ETF	**Sharpe's**	**Treynor**	**Sharpe's**	**Treynor**	**Sharpe's**	**Treynor**
Vanguard Real Estate ETF	-0,758	-0,045	-0,153	-0,006	0,339	0,015
iShares U.S. Real Estate ETF	-0,795	-0,047	-0,135	-0,005	0,340	0,016
SPDR Dow Jones REIT ETF	-0,779	-0,046	-0,135	-0,005	0,382	0,018
iShares Cohen & Steers REIT ETF	-0,716	-0,043	-0,136	-0,005	0,328	0,015
SPDR Gold Shares	**-0,425**	0,172	-0,141	-0,047	0,124	0,019
iShares Gold Trust	-0,426	**0,189**	-0,139	-0,048	0,129	0,019
SPDR S&P 500 ETF Trust	-1,162	-0,040	0,038	0,001	0,471	0,019
Vanguard Total Stock Market ETF	-1,109	-0,038	0,035	0,001	0,469	0,019
Invesco Q.Q.Q. Trust	-0,618	-0,023	**0,166**	**0,005**	0,427	0,019
Vanguard Growth ETF	-0,973	-0,035	0,083	0,002	0,403	0,017
iShares Core S&P Small-Cap ETF	-1,009	-0,038	0,107	0,004	**0,473**	**0,027**
iShares TIPS Bond ETF	-2,214	-0,028	-0,856	-0,008	0,016	0,000
iShares 1-3 Year Treasury Bond ETF	-5,978	-0,074	-3,313	-0,033	-0,870	-0,012
iShares 7-10 Year Treasury Bond ETF	-2,140	-0,024	-0,623	-0,005	-0,463	-0,005

Source: Author's own calculations

As shown in Table 4, it is interesting how, surprisingly, many funds have received negative Sharpe's and Treynor ratios. The reasons for the negative ratio comes from two reasons. Either the ETF's return is smaller than the risk-free rate, or the average monthly return has been negative. Therefore must also keep in mind that ratios might give distorted values when the ratio is negative. Nevertheless, it still can be said that the higher the ratio is, the better the fund's performance has been.

Based on Sharpes' and Treynor's ratios, similar signs of which asset classes were successful can be seen between the funds as in table 3. In the first period, gold investment outperformed other asset classes and their ETFs. The second period showed again that stock ETFs were performing well compared to the others. Again in this period, the Invesco Q.Q.Q. Trust outperformed the other stock ETFs. Moving on to the third period, stock ETFs were again the top performer. However, if we look purely at the values, the ETFs did not perform that well compared to the return volatility and market risk. Mainly bond ETFs performed poorly in all periods.

Finally, Table 5 shows the correlation between the ETFs and the period during the research periods. Coefficient indicates the strength of the relationship between the variables, monthly ETF returns and inflation. Once again, the values vary between the observed time periods.

Table 5. ETF and Index correlation with CPI.

	Period 1	**Period 2**	**Period 3**
ETF	**Coefficient**	**Coefficient**	**Coefficient**
Vanguard Real Estate ETF	-0,492	-0,095	- 0,061
iShares U.S. Real Estate ETF	-0,522	-0,059	0,080
SPDR Dow Jones REIT ETF	-0,495	-0,124	0,089
iShares Cohen & Steers REIT ETF	-0,481	-0,140	0,151
SPDR Gold Shares	0,034	0,224	0,152
iShares Gold Trust	0,032	0,224	0,156
SPDR S&P 500 ETF Trust	-0,583	0,058	-0,095
Vanguard Total Stock Market ETF	-0,573	0,077	-0,164
Invesco Q.Q.Q. Trust	-0,469	0,084	-0,093
Vanguard Growth ETF	-0,484	0,146	-0,100
iShares Core S&P Small-Cap ETF	-0,532	0,063	-0,385
iShares TIPS Bond ETF	0,138	0,168	0,143
iShares 1-3 Year Treasury Bond ETF	-0,058	0,223	-0,582
iShares 7-10 Year Treasury Bond ETF	0,018	0,028	-0,255

Source: Author's own calculations

Only four ETFs had a positive coefficient during the first time period. However, some of the values of the ETFs were so small that it could be said that, in many cases, there is no correlation between the variables. During the first period, the strongest (negative) relationship was with SPDR S&P 500 ETF Trust. The negative correlation (-0,583) indicates that an increase in inflation might lead to a decrease in the average monthly returns. However, it can be seen from periods 2 and 3 that this is not true as the correlation changes in different time periods. The same is true for other funds. The values change as we move from period to period. Only funds that were able to have a positive coefficient in all periods were gold ETFs and TIPS ETF. As already mentioned, the values are still so small that they cannot be considered significant.

3.2. Discussion

The results of the study calculations show that the best performing ETFs are not the same in every time period. The holding period returns and volatilities fluctuated between the periods, but it gives signs of funds and asset classes performing better than others while also overcoming inflation. It can be said that gold ETFs were clearly the most successful funds during the first period. The excellent performance of gold ETFs in the first period could have been affected by the financial crisis, which started from the housing market. As can be seen in the remaining periods, the same success does not continue. This would also explain the poor performance of the real estate ETFs in the same period.

In the second and third periods, the stock funds were clearly leaders in terms of performance. In the third period, it was also noticeable that almost all the funds did well, and nearly 80% of the funds were able to beat inflation. Since the time periods are a bit different in length, cross-period comparisons are difficult to make. However, since the time periods are very close in length, they can be used as a guide if a comparison is made between different periods. Also, the amount of inflation in the periods is different. For example, period 2 is more of a rising inflation period, whereas the other two periods have higher inflation. Thus the discussion is more focused on the period-specific performance, but general observations between the periods can be still made.

Treynor and Sharpe's ratios were primarily negative in the first two periods, but the situation changed during the third period. As discussed earlier, the negative ratios bring problems for analysis. Still, some of the funds fared better. Funds that did well were similar to those that also did well in the first comparison between holding period returns and volatility. Gold ETFs were showing the best ratios of all the funds in the first period. Again, in the second and third periods, stock ETFs were able to beat other funds in comparison to risk-adjusted returns. The second and third periods are more similar compared to the first period, and again this can be caused by the change in the financial markets due to the financial crisis in 2008. Of course, the results are also greatly affected by the amount of risk-free interest during the study period, which was highest in the first period and almost the same in the latter two periods.

The correlation between inflation and ETFs did not show significant results from which more accurate conclusions could not be drawn. The calculated values were too small in almost all cases and did not provide much additional value for the results. Even if an occasional strong positive

correlation had been found, its interpretation would have been challenging because the asset-inflation relation is driven by multiple different factors. Still, it was interesting to see that the TIPS ETF did not show any kind of strong correlation in the three periods, although it theoretically should be inflation-protected. From a portfolio diversification perspective, it indicates that the ETFs in this study correlate very differently in the three inflation periods. Adding some of these ETFs to an investor's portfolio may add diversification benefits.

When looking at all the periods, stock ETFs did return the most on average but also with a high risk. Their risk-adjusted returns fared well in the comparison. Especially Invesco Q.Q.Q. Trust was able to beat inflation in every period and provided good returns with a moderate risk level. The most extensive variation was seen in the real estate ETFs whose returns and risk-adjusted returns varied greatly from period to period. Gold ETFs were able to beat inflation in two periods but were left behind for one period. Short term, long term and TIPS bond ETFs did not perform well at all, unable to beat inflation in any period.

Given these results, investors might consider investing in equities if they have investable cash available during an inflationary period. The reason why stocks tend to do well might be the reason that businesses have the opportunity to pass the inflation to consumers by raising the prices. Of course, this depends entirely on the business and on the industry it is operating in, especially owning companies that provide value to humans whose products will be consumed regardless of the level of inflation. Furthermore, real estate could be an investment to consider. Although it gave poor results in the first period, we can see that it could provide good yields. As noted earlier in this study, the previous research on real estate has shown promising signs of the ability to hedge against inflation. Rents usually adjust with inflation, and house prices tend to rise. Therefore REIT investors could assume to get profits from investing in these ETFs. However, there is some delay in the price changes, and based on this study, it is still difficult to verify.

CONCLUSION

The aim of this study was to find out how ETFs and their asset classes have performed during different inflation periods. The study included 14 ETFs and four asset classes in comparison that are operating in the US markets. To solve the research problem, three different time periods were taken into consideration, and the performance of the ETFs was measured by Sharpe's and Treynor's ratios. Also, a correlation analysis was executed to understand the relationship between the funds' returns and inflation.

Many studies have been researching the properties of hedging inflation with different assets but with conflicting results. This created a good background to start examing the matter from another perspective with ETFs. In particular, inflation hedging possibilities had not previously been studied through ETF funds. In addition, many investors will undoubtedly be interested in knowing how funds have fared in times of high inflation as those high inflation periods will be present in the future also.

As in many studies, this one had its own limitations as well. Firstly, the chosen study period and criteria for ETFs did eliminate funds to be selected for the sample. Funds that were selected operated in U.S. markets, restricting the research only to one region. Also, this study did not consider all of the possible asset classes and focused only on four asset classes. Lastly, the time constraint prevented the ability to review the previous literature on the topic thoroughly.

This study shows that there are ETFs that have been able to outperform inflation and thus provide inflation protection. It was also noticeable that some asset classes do better during periods of rising inflation. The results show that stock ETFs were by far the most successful during all study periods. Except for the first period, stock ETFs were able to beat the inflation, show the best risk-adjusted returns and show the highest holding period returns. The first period likely differs from the other periods due to the effects of the 2008 financial crisis. This would explain the success of gold ETFs and the depreciation of real estate ETFs. Bond ETFs were the worst performers in this study, showing poor risk-adjusted returns and losing to inflation without providing any protection against inflation. What also makes the results interesting is that the TIPS ETFs did not show any kind of correlation with inflation and performed poorly in all time periods. Considering the previous literature on the topic, it can be said that the results of this study are broadly in line with

previous literature research results. Thus reinforcing views on which asset classes do well with inflation

The results are affected by the fact that the market has seen an investor-friendly period over the last ten years or so. If changes in interest rates are seen due to inflation, this may begin to be reflected in the valuations of asset classes, and it will be more challenging to obtain returns in the future. Nevertheless, the following points and observations can be drawn from the results. ETFs had significant differences in performance during all three study periods. For investors, especially return-seeking investors, bonds are not recommended to be added to a portfolio, as they have given poor real returns. Especially if interest rates start to rise, bond yields can be relatively weak. With regard to gold, it is advisable to add it as a spice to the portfolio but not build the portfolio around it. Gold is also a poorer investment in the sense that it only offers a return to the investor as the value increases, without offering dividends, for example. Based on the study is recommended to focus on stocks and real estate. Real estate provides at least some degree of inflation protection. However, the main emphasis should be on stock, as it has been able to protect against inflation while providing a good return with tolerable risk. Also, when adding stocks to the portfolio, the choice of companies and sectors is essential.

With the findings of this study, the author proposes the following possibilities for future research:

1. To get even better results and understanding of the ETFs and their asset classes' performance in different inflation periods, it is recommended to increase the sample size and make the inflation period under review smaller and increase the amount of the periods. Also, taking into account short term and long term inflation protection properties.

2. Geographical differences could also be taken into account in order to find out the differences between market regions. Do the results change when new regions are added to the sample?

Current findings and conclusions are influenced by the chosen research methods and the sample selection. However, it is clear that future research is needed in this area. It is firmly advisable to notice this study’s research limitations in possible future research.

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