Hedges against inflation across the years: Effectiveness of different asset classes in protecting from headline, core, and energy inflation

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Abstract

Despite extensive research on inflation, the relationship between hedging capabilities under different macroeconomic conditions and inflation sub-types remains understudied. This paper aims to fill this knowledge gap by looking at the performance of six different asset returns in light of headline, energy, and core inflation within the US economy between 1982 and 2023. The findings show that while across the years treasury bills remain the most accurate hedge against core and headline inflation, asset classes' hedging abilities differ significantly depending on economic circumstances. Amongst the studied instruments, none seem to successfully hedge against energy inflation. Significantly, in the period of 2020 to 2023 none of the assets researched successfully hedged against the high post-pandemic inflation. The results, obtained through multiple regression analyses and contextualized within the wider literature, add a new, timely perspective on the issue.

Keywords: inflation, inflation hedges, energy inflation, core inflation, headline inflation, asset classes

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Inflation hedges are fundamental for market participants to be able to protect their wealth and investments from the negative effects of varied macroeconomic environments. While inflation has been studied extensively throughout the years, challenges to methodology, time spans, and assets considered lead to conflicting results even in contemporary studies (Arnold & Auer, 2015). Despite the lack of consistency in results, gold, fixed income securities, real estate, and common stocks are the assets traditionally viewed as inflation hedges and most commonly examined (Arnold & Auer, 2015). Over time research has expanded further to include new assets such as cryptocurrencies (e.g. Smales, 2023) or even niche ones such as cocoa (e.g. Salisu et al., 2019) or forestry (e.g. Washburn & Binkley, 1993). Due to the variety of approaches, as well as differences across time periods – even within the same country and more so internationally – there are no conclusive results regarding what a "preferable" inflation hedge is.

Investors need to know against which type of inflation they are aiming to hedge, as their options are varied. For instance, investors should distinguish between core and energy inflation, or other, less significant non-core components such as food (Fang et al., 2022). This perspective sheds a new light on the approach towards inflation - studied securities were found to have varying, and sometimes opposite, relationships with both types of inflation, as shown by Fang et al. (2022). Past research has discovered core inflation to have a negative risk premium within and across studied asset classes, whereas energy inflation was possible to hedge against (Fang et al., 2022). Applying this division across a wider spectrum of assets and a more recent time period can verify whether such a trend holds.

The time span of analysis is also a crucial aspect, considering the varying inflation trends and macroeconomic conditions over time. For example, during energy inflation periods, stocks are negatively correlated to bond returns, while in core inflation periods they are positively correlated to each other and negatively affected by inflation (Fang et al., 2022). To minimise the noise in the analysis, this paper focuses on the United States, particularly between 1982-2023, as the data available is the most accurate and complete.

This time period can be divided into four subcategories with different macroeconomic environments. First, between 1982 and 1989, the economy was recovering from very high inflation. Second, it was succeeded by low inflation and high economic growth from 1990 until the 2008 financial crisis. Third, the period from 2008 to 2020 was a period of recovery with low inflation and growth. This ended with the start of the fourth period, the COVID-19 pandemic lasting from 2020 until 2023, which was characterized by high inflation and low growth. While those traits are specific to the US, considering the impact that the American economy has on other countries, the findings can be generalised further to other administrative regions.

This paper first presents a literature review on hedges against inflation from a historical perspective, the macroeconomic characteristics of the four time periods, and different categories of inflation. Further, the methodology is described, followed by a presentation of the results and an analysis of their consequences and limitations.

Literature review

Types of inflation – headline vs. core and energy inflation

When discussing and analysing inflation, typically an implicit understanding is that it is the headline inflation, i.e. measures such as CPI which include a variety of items. Recently central bankers are in conflict of whether that should be relied on as a main measure, or if rather focus should be put on core inflation – the rate obtained by excluding food prices and energy from the former, as they are considered to be highly volatile items (Giri, 2021). It is also becoming increasingly disputed as to whether core inflation is indeed a representative of headline inflation – energy inflation specifically has been shown to be strongly correlated with headline inflation throughout the time (Giri, 2021). Further, the level of separation actually in place can be questioned; especially during times of energy price shocks, energy inflation appears to transpire into core inflation, affecting both its mean and variance (Lee et al., 2023).

Considering the unique aspects of various inflation types, as well as differing levels of contribution to headline inflation by its core and energy components, it is becoming increasingly prevalent to account for the differences when researching inflation hedges (Fang et al., 2022). As shown by Fang et al. (2022), some hedges can be effective against only a certain type of inflation, whereas D'Amico and King (2023) underline that the easiness of hedging between types is not the same, with doing so against headline being easier than core. This can be further connected to the specific traits of inflation types, e.g. typically, core inflation is classified as not volatile but persistent (and accumulating to 71% of the weight of total inflation), whereas energy has a significantly smaller weight of 9% and is not correlated with core and food inflation but is highly volatile and drives the headline inflation (Fang et al., 2022). Core inflation has historically been more stable than energy inflation, due to factors such as the sticky nature of core goods prices (Fang et al. 2022). Additionally, the definition of characteristics has been slightly challenged in the recent years, considering the unusual period following COVID-19 crisis, where core inflation was almost as volatile as headline inflation (Ball et al., 2021). This particular time was also the first one since no shorter than 1972 during which the established hedging relationships for some assets did not prevail, as established by D'Amico and King (2023).

Dissecting inflation into components is highly relevant amidst the aforementioned changes, as in regards to energy prices, significant fluctuations were noted throughout the years subsequent to the COVID-19 crisis – spiking initially in autumn of 2021 and reaching

120 USD per barrel of West Texas Intermediate oil in early 2022 as a consequence of the Russian invasion on Ukraine (Kilian & Zhou, 2022a). While this led to fears regarding energy prices shocks having a persistent effect on long term inflationary expectations of households, Kilian and Zhou (2022a) have shown that only the short run impact on headline inflation was of a considerable size. Should that hold over time, it is still imperative to identify what can actually protect one from negative effects of energy inflation, as this sub-category has been verified as the main source of inflation volatility and reason for 42% of variation of inflation expectations (Kilian & Zhou, 2022b).

Although the energy component of inflation is highly important, so remains the core one – conceptually, it is supposed to remain relatively steady overtime, demonstrating only the key trends and excluding the noise of other economic shocks (Ball et al., 2021). As demonstrated by Ball et al. (2021), that used to be the case – core inflation had standard deviation lower than headline by about a half in the period of 1985-2019, with it being reduced by no more than 30% since the pandemic times. Subsequently to those developments, as well as the many economic shifts that have taken place since the definition of core inflation exclusions in 1985 (e.g. the rising importance of other sectors for inflation levels), authorities worldwide are considering modification of the measure (Ball et al., 2021). Yet, some form of core inflation is likely to remain a key information point regarding price levels and a comparison point for many investors aiming to assess the profitability of their investments against inflation.

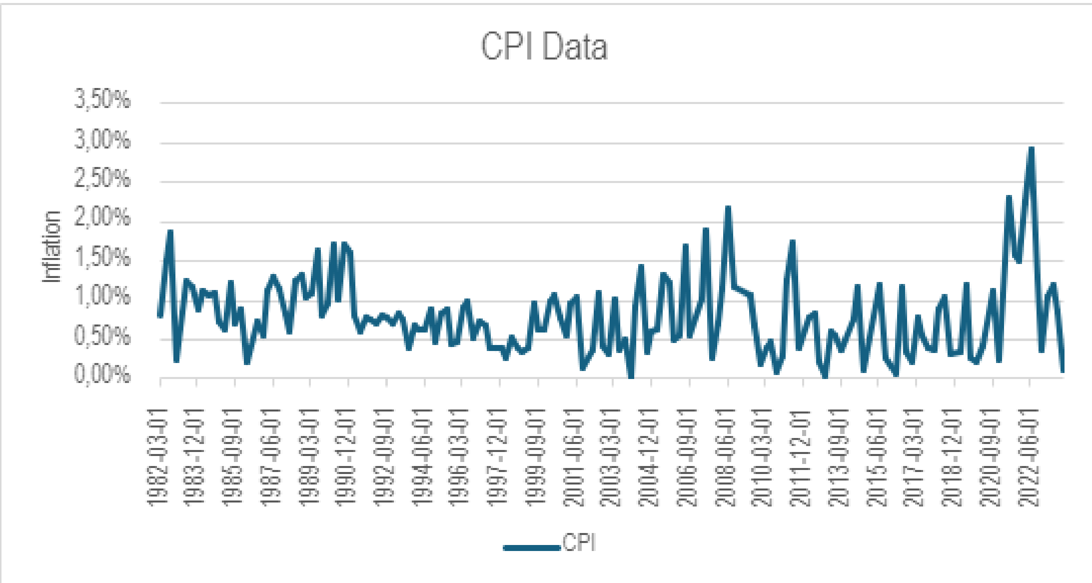
Therefore, this study separates energy and core inflation to ensure the purity of results regarding asset properties, adding further to the body of literature by extending the existing research with respect to timelines considered as well as asset classes studied.

Hedges against inflation from a historical perspective

As underlined by D'Amico and King (2023), there is no *perfect* inflation hedge, as the appropriateness of an asset for that role depends on investors' horizon, as well as the risks they are exposed to. Further, while some relationships and thus characteristics of assets as hedges typically hold, in times of crisis – e.g. such as 2020-2022 – even they can be challenged (D'Amico & King, 2023). Additionally, the various types of inflation behave differently and are key in determining what type of assets is a preferable hedge against a particular type of inflation (Fang et al., 2022). To ensure generalisability of the research, this study considers the following asset classes to reflect diverse inflation hedges: treasury bills, 10-year government bonds, corporate AAA bonds, gold, and Real Estate Investment Trusts (REITs). Further, to accurately assess their performance, the behaviour of their returns is studied in regards to inflation across an extended period of time during which various macroeconomic conditions have been experienced.

Figure 1

CPI (headline) inflation in the US, 1982-2023



Overall, the 20th and 21st centuries present the best periods to study inflation and its hedges, as not only is there the most data available, but there is also the widest range of possible assets to be studied as successful inflation hedges (Taylor, 2020). Additionally, those centuries were unique due to a general trend of continual inflation (Taylor, 2020), which can be seen in Figure 1 – the graph provides an overview of CPI headline inflation between 1982-2023. It can be observed that inflation was volatile, with periods of high inflation, such as the early 1980s, followed by periods of much lower inflation, e.g. 1990s. This creates a unique opportunity to analyse the performance of inflation hedges during vastly different macroeconomic climates experienced by the US economy between 1982-2023.

To successfully analyse the performance of different assets as inflation hedges, it is beneficial to separate the data into four distinct time periods, with different inflation and macroeconomic environments, allowing for a more in-depth analysis. Before 1982, the starting point of our analysis, the US was in a time known as the Great Inflation, with four recessions, two energy crises, and inflation reaching 14% in 1980 (Taylor, 2020). It is also important to note that between 1949 and 1970, the majority of global economies were part of the Brenton Woods system relying on the US dollar maintaining a stable value, but during this period consumer prices doubled (Taylor, 2020). Following the collapse of this system, the US devalued the dollar and a period of floating exchange rate began, followed by 1970s inflation spike due to an oil crisis (Taylor, 2020).

In 1979, Paul Volcker, became the chairman of the FED and a period of tight monetary policy, with slow reserve growth and high interest rates followed (Bryan, 2013). This led inflation to start slowing down, dropping to 4% in 1983, followed by monetary easing ensuring a moderately paced recovery, with inflation continuing below 5% for the rest of the decade and an above-trend growth in real Gross National Product (GNP) (Feldstein, 1994). The decrease in inflation was achieved through extremely high interest rates of even

14%; however, the stock market collapsed and government bonds also weakened (Feldstein, 1994). This was followed by large decreases in the Federal Funds rate, which stimulated the economy and led to high asset returns for the majority of the decade, with inflation starting to grow again towards the end (Feldstein, 1994). Combined with a stock market crash in 1987 and the credit market tightening, it was resultant in a problematic macroeconomic situation that caused a recession at the start of the next decade (Bryan, 2013). Therefore, the first period analysed is 1982-1989, to observe the performance of assets in a deflationary period with economic growth.

The 1990s started with a recession, but soon successful macroeconomic policy turned the economy around, leading to the best economic performance of the preceding three decades between 1993 and 2000 (Weller, 2002). This was particularly the case in the second half of the decade, with real economic growth of around 4.5% each year (Frankel & Orszag, 2001). Simultaneously, inflation grew at a controlled and moderate pace, further stimulating the US economy (Taylor, 2020). Throughout this time, there was exceptional growth in investment and consumption, which allowed many assets such as stocks to achieve exceptional results (Weller, 2002). This entire period was characterised by widespread investment into new technologies, the main driving factor of American economic expansion at the time and source of productivity improvement (Frankel & Orszag, 2001). This period was the longest uninterrupted stretch of expansion, which came to an end at the beginning of the 21st century, with the contraction starting in 2001 (Weller, 2002). Nevertheless, even then the inflationary climate did not drastically change and below target inflation was able to continue (Alpert, 2021). It stopped only in 2008 with the arrival of the global financial crisis, which had a drastic impact on asset prices as well as caused mild disinflation (Gilchrist et al., 2017).

During the 2008 crisis, the US economy experienced the largest contraction since the Great Depression (Gilchrist et al., 2017), which impacted the entire economy: unemployment doubled, Gross Domestic Product (GDP) fell by 4.3%, and the Federal Fund rate was decreased from 4.5 to 2 percent (Weinberg, 2013). Interest rates were kept much lower for the remainder of the decade, with inflation not exceeding 2.5% (Weinberg, 2013). The recession came to an end in early 2009, but compared to previous recessions the recovery was slow, with economic growth averaging 2% until 2013 (whereas in the early 1980s, the economic growth was more than double that following the oil crises) (Weinberg, 2013). The housing market collapsed, the S&P 500 had fallen by 53.78% at the peak of the crisis, and 10-year treasury yields fell to their lowest levels dropping by nearly 70% (Patton, 2020). This set the stage for the next decade, in which inflation was low, while growth was more moderate than in previous decades and the low interest rate environment continued (Patton, 2020). The environment drastically changed in 2020, with the arrival of the COVID-19 pandemic, which led to a very drastic increase in inflation and interest rates (Diaz et al., 2023).

Recent inflation in the USA and its implications.

Although inflation trends continuously change, the period from 2020 onwards has been particular in regards to the inflation within the US, with the aftermath of COVID-19 pandemic challenging the 40-year low inflation period (Diaz et al., 2023). From 0.1% in May 2022, inflation started rising rapidly, peaking at 9.1% in June 2022; it started stabilising around 3-4% from June 2023 onwards, being at 3.5% in March 2024 (Statista, 2024). While the causes for the spike have not been unanimously identified, Bernanke and Blanchard (2023) have pinpointed shocks to prices given the wages as the key factor, with the overheated labour market being a secondary contributor.

Significant efforts were put in place to combat the rise of prices, especially the Inflation Reduction Act (IRA), signed by the US President Joe Biden on August 16th 2022 (U.S. Department of the Treasury, 2024). The investment in the economy was one of the biggest to date and affected a variety of sectors, aiming to strengthen domestic supply chains, decrease energy expenses for households and carbon emissions, all while maintaining stable wages (U.S. Department of the Treasury, 2024). Further, this required tax reforms to allow for relevant incentives and enhance economic fairness (Samms & Hughes, 2022). Looking at the progress of inflation over time, IRA appears to have been successful.

As outlined by Kugler (cited by Romei, 2024), the decrease in inflation rates also across the UK and the Eurozone could be connected predominantly to recovery from the COVID-19 crisis and shocks caused by the Russian invasion of Ukraine. Further, the novelty of ongoing deflation is underlined by the relatively stable level of unemployment in the American economy which typically would be rising together with a decrease in inflation. Generally, the economic costs of this deflation appear to be significantly lower than usual (Romei, 2024). One possible explanation is that this is the case due to the logical and natural return to the state before the aforementioned crises (Romei, 2024). On the other hand, some experts suggest that the creation of over 80,000 new jobs within the US semiconductor industry due to the IRA and the Chips Act as another possible cause (Chu & Roeder, 2023).

Therefore, while the true cause of the changes in American inflation rates still needs to be fully determined, this paper aims to inspect whether along those fluctuations, the effectiveness of various inflation hedges also was impacted. It also creates a starting point for further predictions regarding success of the asset classes in the future depending on the economic conditions.

Methods

Data collection

The majority of data used was obtained from Federal Reserve Economic Data (FRED), an online database of economic timeseries data available free of charge and maintained by the Federal Reserve Bank of St. Louis (FRED, n.d.). Additional data was sourced from the Bloomberg terminal and from the National Association of Real Estate Investment Trusts (NAREIT) website (see Table 1 for details).

The analysis was conducted on quarterly data. This frequency was chosen as it allows for focusing on key trends without excessive generalisation (Ha et al., 2023). To ensure reliability, the time period considered was 01.01.1982 until 01.12.2023 for all variables, as this enables accurate comparisons between regression on included asset classes. Further, the selected dates allowed for the division of the timeframe into four distinct periods and a comparative assessment of the performance of various asset classes as hedges during differing periods of inflation, as described in the literature review section. This is particularly important, as these four periods cover both inflationary and deflationary environments, as well as varying macroeconomic conditions.

Table 1

Information regarding data collection

Data type	Units	Start date	End date	Original frequency	Source
3 months treasury bills	%	01.09.1981	01.02.2024	Monthly	FRED, Market Yield on U.S. Treasury Securities at 3-Month Constant Maturity
10 year government bonds	%	01.01.1960	01.12.2023	Monthly	FRED, Interest Rates: Long-Term Government Bond Yields: 10-Year: Main (Including Benchmark) for United States
Corporate AAA bonds	%	01.01.1919	01.12.2023	Monthly	FRED, Moody's Seasoned Aaa Corporate Bond Yield
Gold	Prices	30.06.1921	29.12.2023	Quarterly	Bloomberg terminal, XAU BGN Currency
S&P 500 Index	Prices	30.12.1927	29.12.2023	Quarterly	Bloomberg terminal, SPX Index
REITs	%	01.12.1971	01.04.2024	Monthly	National Association of Real Estate Investment Trusts (Nareit)
CPI Energy Inflation	Indexed data	01.01.1957	01.02.2024	Monthly	FRED, Consumer Price Index for All Urban Consumers: Energy in U.S. City Average
CPI	Indexed data	01.01.1913	01.02.2024	Monthly	FRED, Consumer Price Index for All Urban Consumers: All Items in U.S. City Average

Conceptual Model

The Fisher hypothesis is the first and yet still somewhat prevalent framework connecting inflation with asset returns. According to Fisher (1930), the expected nominal interest rate is to move concurrently to expected inflation, which thus leads to nominal interest rate being the sum of inflation rate and real returns. This relationship is demonstrated by Equation 1:

$$r_{i,t} = \alpha_i + \beta\pi_t + \varepsilon_t \; where \; \varepsilon_t \sim N(0, \sigma_\varepsilon^2) \;\; (1)$$

Where $r_{i,t}$ is the real return of asset i at time t, α_i is the constant coefficient in regression analysis for asset i, β is the coefficient on inflation at time t for this asset, and ε_t is the error which has a normal distribution with mean 0.

While this is a suitable starting point, the century of research which followed since Fisher's times allows us to further expand the basic equation, extending it by variables that have since been found crucial for analysing inflation hedges. Firstly, in line with Salisu et al. (2020), the model should account for asymmetric reactions of asset prices to fluctuations of inflation depending on the direction of the change, which is not the case in Equation 1. Those adjustments are reflected in Equation 2:

$$r_{i,t} = \alpha_i + \beta^+{\pi_t}^+ + \beta^-{\pi_t}^- + \varepsilon_t \;\; (2)$$

During the time period researched, there were 13 observations of negative headline inflation and 155 of it being positive. While an analysis of hedges during those two types of periods was conducted, the disparity of numbers can pose a threat to the internal validity of this part of the study which one should be mindful of.

Within this equation, it is possible to further decompose the inflation component as follows, showcasing that the respective π_t is equal to the lesser value from actual inflation and optimal inflation target (which does not need to be equal to 0):

$$ {\pi_t}^+ = \min(\pi^*, \pi) \; (3)$$

$$\pi_t^{-} = \min(\pi^*, \pi) \ (4)$$

Furthermore, to more extensively and accurately analyse the nature of inflation risks hedged by asset classes, inflation was decomposed into core and non-core components with a particular focus on energy amongst the latter group (Fang et al., 2022). This method does not focus on the causes of inflation, but rather the overall risk of an unexpected inflation shock, which is key when looking at different asset classes as inflation hedges (Fang et al., 2022). To implement analysis of those components within the research, regression from equation two was applied to core and energy inflation separately, which allows for testing the effectiveness of hedges against those specific types. This can be seen in Equation 5:

$$r_{i,t} = \alpha_i + \beta_E \pi_{E,t} + \beta_C \pi_{C,t} + \beta_F \pi_{F,t} + \varepsilon_t \ (5)$$

Where E, C, and F sub-indexes indicate energy, core, and food inflation respectively. Nevertheless, to conduct analyses eliminating the risks of multicollinearity or interaction effects which can occur in a multivariate analysis, separate univariate regressions in line with Equation 2 were also conducted for energy, core, and headline inflation.

Thus, looking at the model equation one can see that a perfect hedge against inflation would have the β coefficient equal to 1, whereas a positive but smaller than 1 β signifies an imperfect inflation hedge. The equations were subsequently applied to the collected data in Excel, using regression analyses. The inflation rate π is computed based on the CPI data obtained, as $\pi_t = \ln\left(\frac{cpi_t}{cpi_{t-1}}\right)$ (for each type of inflation). As a result, regression analyses for various asset classes' were conducted, with the real return of the asset being the response variable, coefficient on which was used for assessment of quality of the hedge.

Outside of an analysis spanning the entire time period of 1982 to 2023, based on the division described in the literature review section regressions divided for periods were also performed. Those periods are: 1982-1989 (Volcker's policies and deflation), 1990-2007 (stable inflation period), 2008-2019 (crisis, recovery, and stability), and 2020-2023 (COVID-

19 and following crises). This allows for assessing changes in the performance of hedges in various macroeconomic conditions, especially in the last time period which is yet to be thoroughly researched.

Thus, the paper includes the following regression analyses:

- Multivariate analyses of energy, core, and food inflation on asset returns throughout the entire time period;
- Univariate analyses of energy, core, and headline inflation on asset returns throughout the entire time period;
- Univariate analyses of energy, core, and headline inflation on asset returns divided into the four time periods;
- Univariate analyses of energy, core, and headline inflation on asset returns during periods of positive and negative headline inflation.

Results

Results across all time periods – multivariate regressions

Table 2

Summary of results of multivariate regressions of energy, core, and food inflation on researched asset classes

	π_E	π_C	π_F
Treasury bills			
coefficient (SE)	-0.822 (1.040)	**5.076*** (0.577)	-0.854 (1.142)
10-year government bonds			
coefficient (SE)	-1.447 (1.045)	**4.599*** (0.579)	-1.550 (1.148)
10-year corporate AAA bonds			
coefficient (SE)	-1.424 (0.972)	**3.853*** (0.539)	-1.517 (1.068)
REITS			
coefficient (SE)	-0.685 (1.211)	-1.074 (0.672)	-0.828 (1.331)
Gold			
coefficient (SE)	-0.228 (2.992)	-1.597 (1.659)	-0.249 (3.287)
S&P 500			
coefficient (SE)	1.100 (3.375)	-1.704 (1.871)	1.214 (3.708)

Note. *p = 1%, ***p = 10%.

Based on the multivariate regressions conducted across the entirety of the time period from 1982 until 2023, some key trends can be distinguished. Firstly, the constant coefficient alpha was statistically significant and positive for all asset classes except treasury bills (statistically insignificant but positive), which clarifies that in presence of 0% inflation across all times the asset return is predictive to be positive.

Furthermore, the only other statistically significant (p = 1%) relationships were those between core inflation and returns of treasury bills, 10-year government bonds, and AAA corporate bonds. The coefficients were respectively 5.076, 4.599, and 3.853, which suggests that all of those asset classes overhedge for core inflation. While that can be the case, having a diversified portfolio including other assets with diverging returns trends should counteract and balance the excessive hedging properties demonstrated.

The adjusted R^2 of the regressions were low, with the lowest one present for gold (-1.5%) and the highest for treasury bills (35.0%). From this, it can be inferred that the independent variables do not explain the variance of asset returns that well, which could be a result of potential multicollinearity or interaction effect – while technically the three types of inflation stem from distinct sources, they can be correlated across times. To verify whether multicollinearity exists, a Variance Inflation Factor (VIF) analysis was run in STATA between the independent variables (see Table 3 for results). As stated by UCLA (n.d.), VIF scores above 10 are typically treated as an indication of a high risk of multicollinearity, and such can be observed for energy and food inflation VIF scores. Thus, in further analyses the paper focuses on univariate studies to maximise the internal validity of the models.

Table 3

VIF Scores for Core, Food, and Energy inflation

Variable	VIF score
Energy Inflation	908.00
Core Inflation	1.14
Food Inflation	910.33
Mean VIF	606.49

Results across all time periods – univariate regressions

Table 4

Summary of results of separate univariate regressions of headline, core, and energy inflation on researched asset classes' returns

	π_H	π_E	π_C
Treasury bills			
coefficient (SE)	**1.218*** (0.367)	-0.011 (0.042)	**5.147*** (0.41)
adjusted R^2	5.7%	-0.6%	34.9%
10-year government bonds			
coefficient (SE)	**1.119*** (0.361)	-0.005 (0.042)	**4.801*** (0.544)
adjusted R^2	4.9%	-0.6%	31.5%
10-year corporate AAA bonds			
coefficient (SE)	**0.835**** (0.330)	-0.017 (0.038)	**4.038*** (0.508)
adjusted R^2	3.1%	-0.5%	27.1%
REITS			
coefficient (SE)	0.158 (0.357)	-0.062 (0.040)	-0.825 (0.632)
adjusted R^2	-0.5%	0.8%	0.4%
Gold			
coefficient (SE)	-0.512 (0.872)	-0.012 (0.099)	-1.558 (1.545)
adjusted R^2	-0.4%	-0.5%	$9 \times 10^{-3}\%$
S&P 500			
coefficient (SE)	0.538 (0.984)	-0.017 (0.112)	-1.916 (1.744)
adjusted R^2	-0.4%	-0.5%	0.1%

Note. *p = 1%, **p = 5%.

In Table 4, there were no statistically significant relationships between energy inflation and asset returns. However, there were statistically significant relationships between headline inflation and returns of treasury bills (p = 1%), 10-year government bonds (p = 1%), and AAA corporate bonds (p = 5%). The coefficients were close to 1 for all of those three relationships, with two first ones slightly overhedging, and underhedging being observed for corporate bonds. Overall, this indicates that those asset classes, which are also often perceived as the most typical inflation hedges, can indeed be used to protect oneself against inflation quite effectively looking at an extended time period.

The same three asset returns were detected to have a statistically significant and positive relationship with core inflation (p = 1%), with the size of coefficients suggesting overhedging against core inflation. Thus, what this is likely to imply is that the overhedging of core inflation but lack of hedging for energy inflation leads to a close to perfect hedging of headline inflation.

Regression results across divided time periods

Table 5

Summary of results of univariate regressions of headline inflation on researched asset classes' returns across time periods

	π_H			
	1982-1989	1990-2007	2008-2019	2020-2023
Treasury bills				
coefficient	1.214	**1.108****	0.221	-0.669
(SE)	(0.764)	(0.453)	(0.152)	(0.658)
adjusted R^2	4.7%	6.5%	2.3%	0.2%
10-year government bonds				
coefficient	1.221	**0.893****	0.172	0.009
(SE)	(0.795)	(0.341)	(0.123)	(0.393)
adjusted R^2	4.2%	7.6%	2.0%	-7.1%
10-year corporate AAA bonds				
coefficient	0.824	**0.660****	0.038	-0.048
(SE)	(0.724)	(0.306)	(0.142)	(0.315)
adjusted R^2	0.9%	4.9%	-2.0%	-7.0%
REITS				
coefficient	-1.079	-1.062	**1.861***	-1.308
(SE)	(0.836)	(0.642)	(0.656)	(1.130)
adjusted R^2	2.1%	2.4%	13.0%	2.2%
Gold				
coefficient	2.144	-1.924	0.969	**-3.656*****
(SE)	(3.696)	(1.647)	(1.388)	(1.837)
adjusted R^2	-2.2%	5.1%	-1.1%	16.5%
S&P 500				
coefficient	-1.381	**-3.465*****	**2.561*****	**-5.573*****
(SE)	(3.410)	(1.937)	(1.517)	(2.798)
adjusted R^2	-2.8%	3.0%	3.8%	16.5%

Note. **p* = 1%, ***p* = 5%.

The results in Table 5 show that every asset class analysed had statistically significant results for at least one period regarding its relationship with headline inflation. The most significant results can be seen between 1990-2007, with treasury bills, government bonds, and corporate bonds having small but positive coefficients, similarly to the results from Table 4. However, the S&P 500 returns had a significant negative relationship with headline inflation during that period. Such results fit in with the macroeconomic context at the time, as by definition, in a period of low and controlled inflation, fixed income assets are going to always act as a hedge if the interest rate they pay is above the rate of inflation. Since CPI did not exceed 1.5%, during this period (see Figure 1), all the previously mentioned assets were able to act as near perfect inflation hedges. The large negative result of the S&P 500 can be explained by the beginning of the financial crisis, as the value of the index started falling, greatly decreasing investors' returns, and thus the ability of S&P 500 to be an inflation hedge (Patton, 2020).

In the period between 2008-2019, only REITS and S&P 500 act as inflation hedges, with significant and positive coefficients. Their overhedging capabilities can be explained by the financial crisis of 2008, as the value of the S&P 500 fell by more than half and the real estate market in America had completely collapsed (Patton, 2020). Thus, those asset classes experienced sustained growth during the period, and delivered high returns considering their low value at the beginning (Patton, 2020). Those specific circumstances are very important to consider when analysing the success of these assets as inflation hedges, as when looking at the data from Table 4, there is no statistically significant relationship between these assets and headline inflation for the longer period. While Lee and Lee (2012) found that REITs started being effective inflation hedges from 1990 onwards, our findings suggest that such properties are only circumstantial.

Between 2020 and 2023, results for gold and the S&P 500 were the only statistically significant ones, both having very negative coefficients; this can be connected to the high CPI and simultaneous contracting of economy (Romei, 2024). In the case of S&P 500, higher inflation during the challenging period could have been detrimental to company performance, and subsequently the returns of the index (Valadkhani et al., 2022). For gold however, on the one hand it is in line with current scientific hypotheses of its hedging abilities diminishing across the years (Valadkhani et al., 2022), yet on the other contradicts the findings about particularly strong performance of commodities in recent high inflationary times (Neville et al., 2021).

Table 6

Summary of results of univariate regressions of energy inflation on researched asset classes' returns across time periods

π_E

	1982-1989	1990-2007	2008-2019	2020-2023
Treasury bills				
coefficient	0.065	-0.002	0.016	-0.137
(SE)	(0.100)	(0.044)	(0.016)	(0.084)
adjusted R^2	-1.9%	-1.8%	-0.0%	10.1%
10-year government bonds				
coefficient	0.100	-0.011	0.018	-0.038
(SE)	(0.103)	(0.033)	(0.013)	(0.052)
adjusted R^2	-0.2%	-1.3%	2.1%	-3.2%
10-year corporate AAA bonds				
coefficient	0.064	-0.017	0.004	-0.038
(SE)	(0.093)	(0.029)	(0.015)	(0.041)
adjusted R^2	-1.7%	-0.9%	-2.0%	-0.8%
REITS				
coefficient	0.011	-0.087	**0.213***	-0.105
(SE)	(0.109)	(0.060)	(0.067)	(0.156)
adjusted R^2	-3.3%	1.5%	16.2%	-3.8%
Gold				
coefficient	0.141	0.000	0.104	**-0.599****
(SE)	(0.472)	(0.155)	(0.145)	(0.228)
adjusted R^2	-3.0%	1.5%	-1.0%	28.2%
S&P 500				
coefficient	0.425	**-0.437****	**0.340****	-0.579
(SE)	(0.428)	(0.177)	(0.155)	(0.395)
adjusted R^2	0.0%	6.7%	0.1%	7.1%

Note. **p* = 1%, ***p* = 5%.

While Fang et al. (2022) found that real assets (i.e. stocks, commodity futures, real estate) are typically good hedges for energy inflation, the conducted analysis showcased few statistically significant results. REITS and the S&P 500 returns, had coefficients of 0.213 and 0.340 respectively in between 2008 and 2019, which can be linked to the very low starting point of both these assets following the 2008 crisis (Patton, 2020). This result highlights the importance of understanding the macroeconomic context, as the seemingly successful performance in light of energy inflation is likely to be explained by the preceding crisis and greater macroeconomic environment.

The S&P 500 had statistically significant results also during 1990 to 2007, with a coefficient of –0.437. This can be linked to how energy is vital for any company's production process, therefore an increase in these prices will impact the costs of firms included in S&P 500 (Fang et al., 2022). Energy inflation was particularly high in this period and energy prices increased faster than it was possible for companies to adjust their prices, causing their stocks to not act as a hedge against inflation. A similar pattern can be observed for gold in the 2020-2023 period, as it has a statistically significant coefficient of –0.599, a particularly interesting finding, as during that period the price of gold increased from 140 USD to 238 USD, which should have made it at least appear to be a well-performing inflation hedge (Yahoo Finance, n.d.). Therefore, it is clear that even an investment such as gold, which is often viewed as a traditional inflation hedge, is unable to act as one when energy inflation is very high.

Table 7

Summary of results of univariate regressions of core inflation on researched asset classes' returns across time periods

π_C

	1982-1989	1990-2007	2008-2019	2020-2023
Treasury bills				
coefficient	**3.751***	**4.377***	**1.855****	0.248
(SE)	(1.151)	(0.690)	(0.761)	(1.070)
adjusted R^2	23.7%	35.6%	9.5%	-6.7%
10-year government bonds				
coefficient	**3.736***	**4.333***	**-1.065*****	0.679
(SE)	(1.212)	(0.401)	(0.631)	(0.591)
adjusted R^2	21.5%	62.0%	3.8%	2.1%
10-year corporate AAA bonds				
coefficient	**3.003****	**3.694***	**-1.517****	0.432
(SE)	(1.118)	(0.376)	(0.706)	(0.482)
adjusted R^2	16.7%	57.3%	7.1%	-1.1%
REITS				
coefficient	-2.204	-1.370	0.105	-1.100
(SE)	(1.390)	(0.253)	(3.697)	(1.837)
adjusted R^2	4.7%	0.5%	-2.2%	-4.5%
Gold				
coefficient	-0.132	-4.057	4.501	-2.490
(SE)	(6.263)	(3.010)	(7.223)	(3.203)
adjusted R^2	-3.3%	1.1%	-1.3%	-2.7%
S&P 500				
coefficient	**-10.424*****	-2.675	-1.656	-5.895
(SE)	(5.438)	(3.617)	(8.124)	(4.728)
adjusted R^2	7.9%	-0.6%	-2.1%	3.6%

Note. *p = 1%, **p = 5%, ***p = 10%.

This univariate regression presents the highest number of significant results out of the analyses conducted and these confirm what was found in the relevant literature: it is most effective to hedge against core inflation. There are also many similarities between treasury bills, 10-year government bonds, and 10-year AAA corporate bonds regarding their core inflation hedging properties. The returns of those three assets statistically significantly overhedge to a similar extent in the first two time periods. Between 2008 and 2019, treasury bills continued to overhedge although to a lesser extent, whereas for the remaining two classes the relationship turned negative. This could be explained by the differences in maturity and potentially more persistent drop in returns of the more long term asset classes compared to the short-term treasury bills.

The results in Table 7 show how assets can be a good inflation hedge in certain macroeconomic environments but unsuccessful in others. Research has shown that conventional or "real" assets, such as stocks or REITS have little to no value as hedges against core inflation (Fang et al. 2022). The S&P 500 returns had a very negative, significant relationship with core inflation between 1982-1989. Considering the deflationary nature of that period, it suggests that companies included in the index were performing better in times of lower (or even negative) inflation (Taylor, 2020). This is in line with the results from table 7, as between 1982 and 1989 the inflation rate decreased and the S&P index performed better. Yet, throughout the past three decades, the relationship appears to not have been in place anymore.

Before the 1980s, inflation was very high and its decrease from 14% to 5% resulted in a decrease in prices of core goods, and thus core inflation (Taylor, 2020). Combined with the high economic growth of that decade the result is that core inflation decreased while the returns of the S&P 500 increased. Therefore, the result from 1982-1989 is particularly important, as it shows that with deflation and economic growth, the S&P is able to act as an inflation hedge even against core inflation. However, since the coefficient is negative, it indicates that the S&P 500 index is only able to acts as a hedge in deflationary episodes, which is further expanded on in Table 9.

REITS and gold returns did not have a significant relationship with core inflation during any of the time periods, which is in line with existing research (e.g. Fang et al. (2022)). Furthermore, none of the asset returns had significant hedging properties in the period following the COVID-19 crisis, possibly due to the unprecedented nature of that pandemic. Burdekin and Tao (2021) hypothesise that certain assets, *e.g.* gold, were less effective as a hedge during the 2020 crisis compared to 2008, due to a faster recovery and a lack of time to develop the hedge. From today's perspective, their argument concerning the quick pace of recovery is less tenable. The pandemic was followed by other global crises, which impeded the pace of recovery. Nevertheless, the world economy has still been faster than after the 2008 crisis, and, as such, this line of reasoning remains viable and can be extended to other asset classes.

Results for positive vs. negative inflation

Table 8

Summary of results of separate univariate regressions of headline, core, and energy inflation on researched asset classes' returns for periods of positive headline inflation

	π_H	π_E	π_C
Treasury bills			
coefficient (SE)	**1.144**** (0.496)	**-0.149*** (0.057)	**5.147*** (0.575)
adjusted R^2	2.7%	3.6%	33.9%
10-year government bonds			
coefficient (SE)	**1.100**** (0.490)	**-0.122**** (0.057)	**4.754*** (0.585)
adjusted R^2	2.6%	2.3%	29.7%
10-year corporate AAA bonds			
coefficient (SE)	**0.857***** (0.446)	**-0.112**** (0.051)	**4.014*** (0.545)
adjusted R^2	1.7%	2.4%	25.7%
REITS			
coefficient (SE)	**-0.813***** (0.427)	-0.016 (0.050)	**-1.083***** (0.601)
adjusted R^2	1.7%	-0.5%	1.4%
Gold			
coefficient (SE)	-1.290 (1.175)	-0.060 (0.137)	-1.293 (1.655)
adjusted R^2	0.1%	-0.5%	-0.2%
S&P 500			
coefficient (SE)	**-2.511**** (1.250)	-0.209 (0.146)	-1.703 (1.776)
adjusted R^2	1.9%	0.6%	-0.1%

Note. *p = 1%, **p = 5%, ***p = 10%.

Based on Table 8, it can be derived that treasury bills, 10-year government bonds, and AAA corporate bonds are almost perfect hedges for positive headline inflation. This aligns with past studies, as fixed income securities have been found to hedge well against inflation particularly in the long run (Arnold & Auer, 2015). Accounting for the remaining results, the overhedging properties for core inflation seem to be compensated by the negative relationship with energy inflation and potentially other, omitted, components, plausibly further explaining such a relationship with headline inflation.

Looking at REITs and S&P 500, the significant negative coefficients for headline inflation, and additionally core inflation for the former, showcase that those assets do not hedge respective inflation risks. Such finding is in line with what was identified by Fang et al. (2022) for core inflation in a pre-2000 sample, expanding it to headline inflation and a more recent time period. Additionally, authors such as Arnold & Auer (2015) have concluded that REITs often behave like equities in the face of inflation, and that this negative relationship with inflation holds for both commercial and residential REITs.

Table 9

Summary of results of separate univariate regressions of headline, core, and energy inflation on researched asset classes' returns for periods of negative headline inflation

	π_H	π_E	π_C
Treasury bills			
coefficient (SE)	1.020 (0.387)	0.120 (0.122)	4.178 (2.381)
adjusted R^2	-1.6%	-0.3%	14.8%
10-year government bonds			
coefficient (SE)	0.710 (1.082)	0.087 (0.117)	**4.787**** (2.081)
adjusted R^2	-5.0%	-3.9%	26.4%
10-year corporate AAA bonds			
coefficient (SE)	0.399 (1.042)	0.049 (0.113)	**4.414***** (2.007)
adjusted R^2	-7.7%	-7.2%	24.2%
REITS			
coefficient (SE)	**4.603**** (1.771)	**0.490**** (0.195)	**0.213**** (5.166)
adjusted R^2	32.4%	30.7%	-9.1%
Gold			
coefficient (SE)	-1.629 (2.689)	-0.207 (0.291)	**-11.747**** (5.183)
adjusted R^2	-5.6%	-4.3%	25.6%
S&P 500			
coefficient (SE)	**9.286**** (3.987)	**0.942**** (0.447)	-6.781 (10.999)
adjusted R^2	26.9%	22.2%	-5.4%

Note. **p* = 1%, ***p* = 5%, ****p* = 10%.

According to Salisu et al. (2020), an asset can be considered an inflation hedge when the coefficient is positive for both periods of positive and negative inflation. Based on that definition, only the 10-year government bonds and AAA corporate bonds could be classified as such and solely for core inflation.

Even though most of the other REITS results presented have limited statistical significance, Table 9 shows that Especially for headline inflation, the coefficient is rather high (4.603), which suggests significant losses on REITS in such periods. These results further reflect a positive relationship between REITS and inflation; this can also be explained by the logic of higher returns in times of greater economic uncertainty such as higher inflation (Cohen & Burinskas, 2023).

The coefficient of -11.747 on core inflation for gold contrasts with previous findings, such as those of Valadkhani et al. (2022), who determined gold to be non-responsive to lower levels of inflation (i.e. below 0.55% monthly). The disparity could be explained by the specific focus on core inflation, but this can be an area for further study.

Lastly, the results for the S&P 500 returns indicate that the index is an almost perfect hedge for energy inflation, particularly during negative headline inflation periods. A potential explanation is the relationship between the companies included in the index and the energy sector. Further, the highly positive coefficient on headline inflation in Table 9 can be linked to the high volatility of stocks particularly in periods of economic uncertainty (Časta, 2023).

Discussion

Generally, researched assets do not appear to hedge energy inflation to any meaningful extent, except for the S&P 500 during negative headline inflation periods. Since this exception is rare and can be connected to the volatility of the stock market and the presence of high performers even in times of low economic activity, the options to protect oneself from this type of inflation are limited. Hence, an extension of the analysis to other asset classes such as energy indices is recommended for future research.

Furthermore, treasury bills, 10-year government and corporate AAA bonds can all be described to demonstrate similar tendencies regarding hedging capabilities. These three asset classes are the closest to being perfect inflation hedges, looking at both headline and core inflation. Nevertheless, their performance is highly affected by macroeconomic conditions. For instance, from 2008 to 2019, a period of crisis recovery and later stability, only treasury bills retained their hedging abilities from the aforementioned assets. Based on this, t-bills can be described as the most reliable inflation hedge within the sample.

On the other hand, gold does not show a clear, meaningful relationship with any of the inflation types researched. This implies that its typically proclaimed hedging ability might not necessarily be true. Moreover, REITS returns' relationship with inflation is not straightforward either; from the positive and negative period analyses, it can be inferred that it acts almost as a counter-hedge, in particular to headline and core inflation.

The results for the S&P 500 returns are consistent with previous empirical studies. Namely, stocks are statistically negatively correlated with core and headline inflation, in most circumstances (e.g. Azar, 2020). Although in theory these results are predicted to be positively related to inflation, and some of the current work argues that inflation is unrelated to stock returns (Azar, 2020), from a statistical perspective the relationship is negative. Altogether, this aligns with the conclusion of most recent studies that the existence of a clear correlation between stocks and inflation is debateable (Časta, 2023). However, in the deflationary period of 1982 to 1989, investing in the S&P 500 did allow for obtaining high returns and thus hedge against inflation.

Although assets' performance as hedges differs significantly depending on macroeconomic conditions, there are periods in which investors can struggle to protect themselves from the effects of inflation, as between 2020 and 2023. The unprecedented nature of this time period can be seen in the lack of significant results for most of the regressions conducted within that timeframe.

Implications

The main practical implication of this paper is the importance of considering macroeconomic conditions while making investment decisions, as depending on these the asset returns perform differently in relation to inflation. To ensure satisfactory returns, an investor needs to account for the likely behaviour of inflation in the future and strategically assemble an investment portfolio, ensuring protection from the analysed types of inflation.

From a more theoretical perspective, the research contributes to challenging the current assumptions about the performance of some asset classes, such as gold, stocks, or REITS as inflation hedges. Additionally, it helps determine what conditions can further improve or deteriorate hedging abilities. Finally, this research is an important building block for future studies, which can extend over to other countries, periods, or asset classes, as well as include aspects such as interaction effects.

Limitations

A trend which can be observed across the various included regressions is a low level of R^2. While this was to be expected, since asset returns are driven by a variety of factors, it is a key piece of information for interpreting the results and applying it to investment decisions. Adding on to the R^2 scores, the high risk of omitted variables in the regressions can also be key in driving asset returns. While that risk is present in only the univariate analyses, as shown through VIF results in Table 3, the multivariate analysis can be affected by multicollinearity and potential interaction effects. Those caveats influence the reliability of results and impact the extent to which one can consider them reliable indicators for future financial decisions. Nevertheless, the clear indications of the levels of R^2 allow for critically and consciously assessing the results at each stage.

Furthermore, in the positive and negative headline inflation periods analysis, it is important to note the disparity in the quantity of data used – 13 for the former and 155 for the latter. The most prominent risk connected to this is the potential lack of representativeness of the negative sample, which potentially affected the reliability of the results.

Lastly, it is crucial to remember that all of the analyses were conducted on the American sample. Therefore, while the US economic conditions have a tendency to spread further to other countries, the inflationary periods distinguished are likely to differ, similarly to the behaviour of asset returns depending on the times. While this negatively impacts the generalisability of the study, the American sample remains the one most widely applicable to other countries.

Conclusion

This paper contributes to the existing literature on inflation hedges, in particular the impact of macroeconomic conditions and differences between positive and negative inflationary periods. Additionally, it analyses the relationship of asset returns with specific components of inflation and includes the period of high inflation following the COVID-19 pandemic. The findings presented build on existing research and provide a new outlook on inflation hedges.

The primary result of this study is that the success of an asset as an inflation hedge depends on the type of inflation that they are supposed to hedge against. For example, there are multiple hedges against headline and core inflation, but against energy inflation there does not appear to be any asset with truly relevant hedging capabilities. The second key finding is the importance of the macroeconomic environment, as assets can act as a hedge in one context against a particular type of inflation, but not be a successful hedge in another environment. The changes in behaviour of the analysed assets is visible throughout the four time periods, as there are periods of high and low inflation with high or low economic growth. For example, it can be clearly seen in the S&P 500, which against headline inflation had statistically significant positive results in a period of high growth, but very negative ones in a period with low growth.

Overall, treasury bills, corporate AAA bonds, and 10-year government bonds have been identified as the most effective hedges against core and headline inflation during majority of the time periods. Additionally, analyses have demonstrated that gold, REITS, and S&P 500 oftentimes do not provide protection against inflation, unless in specific macroeconomic conditions or negative inflation periods.

This paper creates foundations for further research regarding the performance of different asset classes as inflation hedges throughout the time and for varying inflation types. We recommend extending the research to other economies, longer time periods, as well as other asset classes to build on the existing knowledge and provide clearer insights regarding hedging capabilities.

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