Master's thesis

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Norwegian University of Science and Technology
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Department of Economics

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Real Asset Returns during Different Inflationary Regimes

Examining the stagflation and cost-push scenarios

Master's thesis in Financial Economics
Supervisor: Joakim Kvamvold
June 2022

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Kunnskap for en bedre verden

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Preface

This Master's thesis concludes my Master of Science in Financial Economics conducted at the Norwegian University of Science and Technology. I want to thank my supervisor, Joakim Kvamvold, for introducing an interesting and relevant research topic and for providing valuable advice throughout the writing process of this thesis.

Abstract

In this thesis, I analyze the real historical return on several assets and investment strategies during different inflationary regimes using U.S. data. First, I separate historical inflationary regimes based on whether they coincide with booming or bad economic times. I do this regime classification in two different ways: *method 1b*, in which *unemployment* is used as a proxy for the economic activity level, and *method 2*, in which *real growth indicators* are used as a proxy for the activity level. Second, I separate inflationary periods based on whether they are mainly caused by demand or supply side disruptions.

I find that the *energy equity portfolio*, investments in some *commodity indexes* as well as some *dynamic equity factor strategies* are inflation hedges during both stagflation and inflationary periods caused by supply-side shocks. The *energy equity portfolio* generates positive real annualized returns of 5,55% during supply-induced inflation and 5,94% (2,20%) during stagflation for method 1b (2). Additionally, the *energy commodity index* is the winner during stagflation, with a real annualized return of almost 13% for both the regime classification methods. *Momentum* is the best hedge compared to the other dynamic strategies, which has a 3,16% real annualized return during supply induced inflation and 4,15% (8,11%) in stagflation for method 1b (2).

Sammendrag

I denne avhandlingen analyserer jeg den historiske realavkastningen til en rekke aktiva og investeringsstrategier i ulike inflasjonsregimer basert på data fra USA. Først separerer jeg inflasjonsregimene basert på det generelle aktivitetsnivået i økonomien. For å klassifisere regimene bruker jeg her to ulike metoder: *metode 1*, hvor *arbeidsledighet* benyttes som proxy på det økonomiske aktivitetsnivået, og *metode 2*, hvor ulike *indikatorer for realvekst* brukes som proxy på aktivitetsnivået. Deretter separerer jeg inflasjonsregimene basert på om inflasjonen hovedsakelig skyldes tilbuds- eller etterspørselssjokk.

Resultatene viser at *aksjeporteføljen energi*, investering i noen *råvareindekser*, samt visse *dynamiske faktor strategier,* sikrer investorer mot tap, både i perioder med stagflasjon og i inflasjonsregimer drevet av tilbudssidesjokk. *Aksjeporteføljen energi* genererer en positiv årlig realavkastning på 5,55% under tilbudsdrevet inflasjon og 5,94% (2,20%) under stagflasjon for metode 1b (2). For råvarer er *energiindeksen* vinneren i perioder med stagflasjon, med en årlig realavkastning på nærmere 13% for begge metodene. *Momentum* er vinneren blant de dynamiske strategiene, med en årlig realavkastning på 3,16% under tilbudsdrevet inflasjon og 4,15% (8,11%) under stagflasjon for metode 1b (2).

Contents

1 Introduction

Recently, inflation rates have exceeded expectations, rising to the highest level since the 1980s for the U.S. economy. The general price level increase is mainly driven by supply-side disruptions (cost-push inflation) caused by the corona crisis and Russia´s invasion of Ukraine. The Great Inflation of the 1970s showed that supply shocks may cause inflation to coincide with stagnation. During stagflation, the purchasing power of each dollar decreases while the economic growth is low and the unemployment rate high. Assets and strategies that generate positive real returns during stagflations are valuable for investors because they pay off in a time of need, and therefore hedge against loss.

Table 1 summarizes the assets and strategies that generate positive returns in the cost-push inflationary regime as well as during inflationary stagnation for both methods 1b and 2. I find that *energy* is the only equity portfolio that generates positive real returns in these regimes. *Precious metals, energy,* and *livestock* are the commodity winners during these market conditions, while *high minus low (HML)*, *conservative minus aggressive* (*CMA),* and *momentum* are the equity factor strategies that generate positive real returns. *Gold* and *energy* are, notably, not included in the cost-push/demand pull analysis because of limited data availability. Table 1 reports the highest real returns for the commodities. However, I find relatively high commodity return variations between specific inflationary regimes. High return volatility for the commodities limits their relative inflation hedging ability compared to other winners.

Table 1: Assets and strategies with positive real returns.
The table summarizes the performance of the assets and strategies which generates positive real annualized returns during inflationary stagnation according to method 1b and 2, as well as in the defined cost-push inflationary regimes. *Gold* and *energy* are not included in the cost-push/demand-pull analysis because of limited data availability. The reported t-statistics shows whether the mean return in each specified regime is significantly larger than the mean return for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	Inflationary stagnation 1b		Inflationary stagnation 2		Cost-push inflation	
	Real return	t stat	Real return	t stat	Real return	t stat
Energy (Equity portfolio)	5,94 %	-0,13	2,20 %	-0,39	5,55 %	-0,21
Gold	5,21 %	0,60	5,22 %	0,48	-	-
Precious metals	0,34 %	0,01	2,10 %	0,29	34,03 %	2,11**
Energy (Commodity index)	12,72 %	0,74	12,61 %	0,53	-	-
Livestock	10,81 %	1,36*	5,35 %	0,58	3,80 %	0,41
HML - 'Value'	0,52 %	-0,41	3,46 %	0,49	1,71 %	-0,04
CMA - 'Investment'	1,16 %	-0,24	6,91 %	1,80**	3,95 %	0,77
Momentum	4,15 %	-0,20	8,11 %	0,46	3,16 %	-0,42

The Federal Reserve Economic Data (FRED) reported a headline year-over-year (YOY) percentage change in the Consumer Price Index (CPI) of 8,5% for March 2022, which is the highest inflation level reached since December 1981. Reilly et al. (1970) define inflation as an increase in the general price level, or equivalently, as a decrease in the value of money. Within limits, inflation is healthy for the economy and central banks usually aim at an annual inflation target of about 2%. However, very low (high) levels below (above) the expected inflation level are alarming. Rational investors maximize utility and should therefore be concerned with how many goods and services they can buy with their current and future wealth. To avoid negative utility shocks, investors seek to hedge against unexpected inflation surges. Hedging has the objective of ensuring investors against loss on investments. Hence, an investment that safeguards investors against unexpected general price level increases can be considered an inflation hedge.

Literature generally agrees that unexpected inflation is bad news for fixed income assets as well as short-term equity returns (Neville et al. (2021), Ilmanen (2011, s. 462), Fama & Schwert (1977), among others). Inflation-linked securities, some commodity futures as well as real estate do, according to Ilmanen (2011, s. 341), hold value amidst inflation. A popular working paper on SSRN by Neville et al. (2021) "The Best Strategies for Inflationary Times" identifies eight inflationary regimes in the U.S. from 1926 to 2021. Compared to other empirical work on the relation between inflation and real asset returns, they analyze a relatively broad range of both passive and dynamic investment strategies. Neville et al. (2021) suggest that some of the equity factor strategies and dynamic trend strategies, as well as investment in certain commodities, provide the best hedge against unexpected inflation. However, they report relatively large variations in returns between different specific inflationary time periods, for some of the assets and strategies. For instance, the *energy commodity index* has a total return of -6% during the Korean War regime of the 1950s, and a total return of 264% during the OPEC oil embargo of the 1970s. The variation in asset returns between different inflation regimes indicates that we can't necessarily generalize the findings of Neville et al. (2021) to represent real returns during current market conditions.

Rouse et al. (2021) argue that the inflationary spike followed by the corona crisis inhabits similarities to the inflationary period after the Second World War: post-crisis increase in consumer demand, combined with not operational supply chains. Russia's invasion of Ukraine in February 2022 fueled the rising inflation by further accelerating energy prices. According to

FRED, the WTI crude oil price reached 119 dollars per barrel at the beginning of March. The war also puts upward pressure on other commodities like wheat, corn, palladium, and titanium sponge, as Ukraine and Russia are prime commodity exporters (Liadze et al., 2022). Despite the increase in consumer demand, it is clear that the current inflationary regime is predominantly driven by supply-side disruptions. Another characterization of the current market conditions is the fear of stagflation. Investors are drawing parallels to the 1970s oil shocks that caused a simultaneous combination of high inflation and stagnation (Romei & Smith, 2022).

My thesis builds on the work of Neville et al. (2021) but expands the analysis in two distinct ways. First, I use the methodology of Ilmanen (2011, s. 461) and include a dimension for the real economic activity level to be able to make a distinction between inflationary booms and inflationary stagnations. I do the regime classification in two different ways: method 1b and method 2, in which unemployment is used as a proxy for the economic activity level in method 1b, and real growth indicators are used as a proxy for the activity level in method 2. Secondly, I separate the inflationary regimes depending on the underlying cause of inflation, cost-push or demand-pull, to investigate whether asset returns are different in these two types of inflationary regimes.

I study historical asset returns in the U.S. for a period of up to 96 years, from 1926 to 2022. For the following asset classes, I report the real annualized returns for each classified inflationary regime: the *S&P 500*, 12 equity portfolios, commodities, *residential real estate*, and dynamic equity strategies. For U.S. Treasury and corporate bonds, I analyze real yields instead of real returns. Additionally, I estimate the hit rate, which is the percentage of sub-periods within each regime with positive returns, and the t-statistic which tests whether the mean return in each regime is significantly larger than the mean return for all periods. Moreover, in the first part of the thesis, I examine whether the inclusion of a growth dimension reduces the observed asset return variations between specific inflationary regimes in Neville et al. (2021). Likewise, in the second part of the thesis, I analyze whether the separation into cost-push and demand-pull inflation reduces the asset return variations.

2 Literature review

In May 2021, the paper "The Best Strategies for Inflationary Times" by Neville et al. was published. They analyze returns on passive and active investment strategies for the U.S. during periods of inflationary regimes and include additional insights from U.K. and Japan. The data spans from 1926 to April 2021. They use the Bureau of Labor Statistics headline CPI index as the measure of inflation and identify inflationary regimes as periods in which the inflation is accelerating and moves to a level of 5% or more. They identify eight such regimes in the U.S.. Neville et al. (2021) analyze the multiple strategies by reporting both the total real return during each regime and the compound annual growth rate (CAGR) across all regimes, for each asset class or strategy.

Concerning the passive strategies, they find that both bonds and equities have negative average real returns during inflation surges. Whereas the performance of bonds gets weaker as duration increases. Only the *energy* sector experiences positive real returns during the regime, while the *consumer durables* sector has the worst performance. Treasury inflation-protected securities (TIPS) have approximately the same real returns independently of regimes. The return of commodities differs. However, all the individual commodities analyzed in the paper generate positive real returns in inflationary times. *Residential real estate* has a small negative return during the same periods. They also consider the collectibles, art, wine, and stamps which all generate positive real returns.

In addition to passive strategies, Neville et al. (2021) analyze several active equity factor strategies and dynamic trend strategies. They find that the Fama and French (2014) long/short factors provide some inflation protection. *Momentum* is the best inflation hedge with a real return of 8% during inflationary regimes, and *small minus big (SMB)* performs poorly with a real return of -4%. The dynamic trend strategies are constructed for four asset classes: equity, FX, commodities, and bonds. The bonds and commodities trend strategies perform best, but the annualized real return is positive for all strategies. The conclusion is that some dynamic trend strategies and investments in certain commodities provide the best hedge against unexpected inflation. The equity factor strategies also perform relatively well and have the advantage of a robust capacity, which the trend strategies have not.

Looking at the total real return during each inflationary regime, there is an observable asymmetry in asset returns between different regimes for multiple asset classes and strategies. For instance, the return on equities spans between -32% and 35% during the observed inflationary periods, *silver* between -41% and 210%, and the *momentum* strategy between -18% and 44%. My thesis takes a deeper look at possible causes for this asymmetric behavior of asset returns in different inflationary periods.

In chapter 26 in "Expected returns", Ilmanen (2011, s. 461) introduces a real growth dimension in the analysis of historical returns for the U.S. during inflationary periods. He classifies each calendar quarter from 1960 to 2009 into one of the following quadrants; disinflationary boom, disinflationary stagnation, inflationary boom, or inflationary stagnation. Further, he creates two composite dummy series. The composite series used as the real growth proxy consists of the following six normalized, equally-weighted series; expected next year real GDP growth, realized past year real GDP growth, real earnings growth, the CFNAI index, the IMS measure of business confidence, and the Conference Board measure of consumer confidence. The inflation proxy is an equally-weighted average of the following four series; headline CPI, core CPI, the GDP deflator, and a consensus forecast inflation rate. The classification of inflationary and disinflationary periods is based on the sign of the dummy for the inflation proxy, while booms and stagnations are classified by the sign of the real growth dummy.

Ilmanen (2011, s. 642) reports that returns on both equities and bonds are significantly reduced during inflationary regimes, both in booms and stagnations. The effect of the real growth dimension, however, is less clear and consistent through the regimes. The average real quarterly return of equity during inflationary stagnation, -0,26%, is somewhat higher than during inflationary boom -0,46%. On the other hand, during disinflationary times, the average equity returns are higher during booms than during stagnation. For bonds, the effect is the opposite; during disinflation, the return during stagnation outperforms the return in booms, while in inflationary periods, the return on bonds during booms is higher than during stagnations.

While the inflation dimension is most critical for bonds and stocks, the growth dimension seems more critical for commodities and housing. Both have the highest real quarterly return during the inflationary boom regime. Small-cap and value stocks have a larger real return than the equity market in most regimes, especially during inflationary periods. Value stocks also stand out in boom regimes. Both equity momentum strategies and trend-following strategies have

positive returns in all regimes and do especially well during inflationary booms. Furthermore, Ilmanen (2011, s. 641) combines the inflation dimension with a volatility dimension. Among other results, he finds that stable market conditions are the best environment for all types of stocks and that bonds outperform stocks during volatile stagnations.

Hess and Lee (1999) expand the literature on the relationship between inflation and equity returns by splitting the causes of inflation into demand and supply shocks. They use a bivariate time-series model to examine data from the U.S., the U.K., Japan, and Germany. Their findings suggest that supply shocks lead to a negative relationship between stock returns and inflation, while demand shocks result in the opposite. Therefore, the relationship between inflation and equity returns is regime-dependent: the returns differ depending on the relative importance of the two types of shocks. Furthermore, they argue that supply shocks are mainly due to real output shocks, and demand shocks mainly reflect monetary shocks. In addition, their results point to demand shocks being transitory, while supply shocks have a more permanent effect on stock prices.

My thesis adds to the literature on the relation between inflation and asset returns by combining insights, ideas, and methodologies from these three studies. I expand the analysis of Neville et al. (2021) of multiple passive and dynamic assets by including the growth dimension introduced by Ilmanen (2011, s. 461) and by making the separation between demand and supply disruptions introduced by Hess and Lee (1999).

3 Inflation: causes and implications

3.1 Why inflation matters for investors and asset returns

Long-lived assets like bonds and equities are more sensitive to permanent than temporary inflation shocks (Neville et al., 2021). If investors believe that inflation will pass within the near future, the impact on asset prices will be minimal. In addition, investors wish to hedge against unexpected surges. However, it is difficult to completely isolate expected and unexpected inflation. An inflation regime will likely have both components. Surges consist of positive inflation surprises at the beginning of the period, and after a peek, the inflation rate will start to decline, and there will be negative inflation surprises. Positive surprises are bad news for investors, while negative surprises are a good sign for the future. For this reason, I expect that the prices of traditional assets will have a stronger reaction to the first kind of surprise. Typically, the change in the rate of inflation is used as a proxy for unexpected inflation, which assumes that the best forecast of the next period's inflation rate is the current period's rate (Neville et al., 2021). This is in line with the assumption of adaptive expectations, i.e., agents use past trends to forecast future inflation, contra rational inflation expectations, i.e., agents use the best available information to predict future inflation. Chow (2011) presents econometric evidence that adaptive expectations is a relatively accurate representation of actual agent behavior.

Bonds have an embedded inflation expectation in the bond yield. If inflation rises, the yield increases, and the bond price falls. In addition, higher inflation uncertainty may also increase the required inflation risk premium, which further lowers current prices (Ilmanen (2011)). Therefore, rising inflation will hurt the realized return for bondholders. There are various explanations for the negative short-term relation between equity returns and inflation. For companies with limited market power, margins might shrink in higher inflation environments as increased costs of raw materials can only partially be passed on to the consumer. Also, increasing inflation uncertainty will likely reduce a company´s willingness to make long-term investments and therefore harm growth (Neville et al., 2021). Another explanation is the money-illusion hypothesis of Modigliani and Cohn (1979) which suggests that investors incorrectly discount real cash flows with nominal discount rates. The implication of this hypothesis during periods of high inflation is that the markets' subjective equity-premium expectation is lower than the rational expectation, which results in an undervalued stock market (Randolph, 2005).

Rental income is a central contributor to real estate return, and rent is a roughly constant proportion of personal income which increases during inflation (Ilmanen, 2011, s. 354). This might explain why real estate seems to hold value during inflation. Rental income is, however, not relevant for primary residential homes. For commodities, *energy* has historically been the best inflation hedge (Ilmanen, 2011, s.355). This is likely linked to the fact that rising energy prices are often the main driver, or one of the drivers, behind inflation spikes (see Section 4.1.2).

3.2 Underlying causes

The underlying source for rising inflation can be complex and is not necessarily attributed to one incident, market condition or monetary policy change. However, some historical inflationary periods inhabit similarities, and separating inflation surges based on whether they are mainly caused by cost-push or demand-pull inflation can be a useful categorization. Cost-push inflation is characterized by increasing production costs, for example, raw materials or the price of labor, which results in a limited supply of goods and services (Hyerczyk, 2021). If the demand is unchanged, the same quantity of money is chasing fewer goods (Tatom, 2012, s. 281). The increasing input cost and decline in resource use are usually associated with unexpected events, like natural disasters, wars, plagues, monopolies, government regulation, or exchange rate changes (Hyerczyk, 2021). Demand-pull inflation is, on the other hand, associated with a booming economy and increasing aggregate demand (Hyerczyk, 2021). If the supply of goods and services cannot keep up with the increase in demand, more money chases the same goods (Tatom, 2012, s. 281). According to Ilmanen (2011, s.345) supply-driven inflation is a larger concern because it prompts high inflation levels to coincide with bad economic times, while demand-driven inflation does not.

4 Data and methodology
4.1 Regime classification
4.1.1 Part 1

For the first part of the analysis, I use the quadrant classification system for the regime classification from Ilmanen (2011, s. 641).

Disinflationary boom	Inflationary boom
Disinflationary stagnation	Inflationary stagnation

Method 1a: Preliminary

The first method I use for the definition of inflation regimes is based on the methodology by Neville et al. (2021), in which eight U.S. inflationary regimes are identified. The regimes are defined as periods when headline, YoY inflation is above 2%, accelerating and moves to 5% or more. Neville et al. (2021) use the change in the headline inflation rate as a measure of unexpected inflation. To isolate the part of the regime consisting of positive surprises, they end a regime when the inflation rate reaches its peak without having fallen below 50% of its maximum annual rate in rolling 24-month observation windows. Regimes that last less than six months are excluded. I adjust some of the start or end dates of the regimes due to small differences in the data. Additionally, I add a ninth regime starting in March 2021 caused by the aftermath of the coronavirus crisis and later followed by Russia´s invasion of Ukraine.

To classify the different states of the economy, I use the unemployment rate as an indicator. High levels are associated with low economic activity and a low unemployment rate indicates the opposite. To define the high unemployment regimes, I use a threshold value of 6,86%. This is a long-term average, found by using rolling 30-month observation windows. I consider high unemployment periods of less than six months too short to constitute a regime change. A problem with this approach is the insufficient number of observations in the stagflation regime. Only 17 of 1154 months are classified as stagflation, which is the regime quadrant of prime interest in my analysis.

Method 1b: Adjusted

To increase the number of observations in the inflationary stagnation regime, I do some adjustments to method 1a which I name method 1b. The first adjustment I do is to lower the

threshold value from 6,86% to 5,5%, to expand the stagnation regimes. As the second adjustment, I change the definition of when the inflation regimes end. Instead of defining the end as the peak, I allow the inflation rate to fall after the peak until the average inflation rate of the original regime is reached. I do this to capture some of the negative surprises when the inflation rate is still high, but decelerating. Throughout the analysis, I focus exclusively on the adjusted version of method 1.

For method 1, I use monthly data spanning from January 1926 to February 2022. For the inflation rate I use the YOY percentage change in the CPI. The pre-war data is not seasonally adjusted and retrieved from the U.S. Bureau of Labor Statistics, while the postwar data is seasonally adjusted and collected from the FRED. For the unemployment rate I use seasonally adjusted data retrieved from FRED. In the absence of reliable data for the prewar unemployment rate, I combine four different unemployment rate series by taking the equally-weighted average in which the years overlap. The first series is yearly data from 1900 to 1947, forward filled to monthly data, and collected from the National Bureau of Economic Research. The three other series are all taken from FRED: monthly seasonally adjusted data from April 1929 to June 1942, monthly seasonally adjusted data from January 1940 to December 1946, and monthly unadjusted data for the year 1947.

Method 2

The second method is based on Ilmanen (2011, s. 641). I create two composite dummy series, used as inflation and real growth proxies. The proxies are based on equally-weighted normalized series. The growth proxy consists of three individual series, while the inflation proxy consists of four series. All the individual series are standardized by subtracting each observation by the mean and dividing it by the standard deviation of the series. This implies computing the Z-score for every observation in each series. The classification is based on the sign of the equally-weighted Z-scores. For the inflation proxy, I classify quarters with positive signs to the inflationary regime and those with negative signs to the disinflationary regime. For the real growth proxy, quarters with positive signs are classified as boom, and those with negative signs are classified as stagnation.

For the second method of regime classification, I use quarterly data. All inflation measures included in the inflation proxy are retrieved from FRED and span from the first quarter of 1960 to the fourth quarter of 2021. The series for headline inflation is the same as in method 1. The

measure of core inflation is the YOY percentage change in the CPI less food and energy, and for the GDP deflator, I use the percentage change in the U.S. Implicit Price Deflator from the preceding period. For the growth proxy, two of the series start in the second quarter of 1967; the CFNAI index is retrieved from FRED, and the Conference Board measure of consumer confidence is collected from the Eikon database. The three other series span from 1960 to 2021. The ISM measure of business confidence is taken from the Eikon database, while the YOY percentage change in the Real Gross Domestic Product and the Hourly Earnings growth rate are collected from FRED.

Comparison of method 1b and 2

The YOY CPI of method 1b and the inflation proxy of method 2 are both measures of increases in the general price level in the U.S. economy. Therefore, they are not identical but inhabit the same patterns. Stagnations are characterized by slow economic growth and substantial unemployment. Accordingly, the unemployment rate of method 1b and real growth proxy of method 2 are different measures of good and bad economic times. These variables have opposite interpretations: high unemployment is a symptom of stagnation, while high real growth is linked to booming times.

Table 2: Data for different regimes.
The table describes the frequency of each regime in months and as a percentage of total months for methods 1a, 1b, and 2, the start and end month/quarter, as well as data frequency.

	Method 1a	Method 1b	Method 2
Disinflationary boom	599/1154 months 52,9 %	388/1154 months 33,6 %	70/248 quarters 210/744 months 28,2 %
Disinflationary stagnation	335/1154 months 29,0 %	467/1154 months 40,5 %	92/248 quarters 276/744 months 37,1 %
Inflationary boom	203/1154 months 17,6 %	265/1154 months 14,3 %	54/248 quarters 162/744 months 21,8 %
Inflationary stagnation	17/1154 months 1,5 %	134/1154 months 11,6 %	32/248 quarters 96/744 months 12,9 %
Start	Jan 1926	Jan 1926	Q1 1960
End	Feb 2022	Feb 2022	Q4 2021
Frequency	Monthly	Monthly	Quarterly

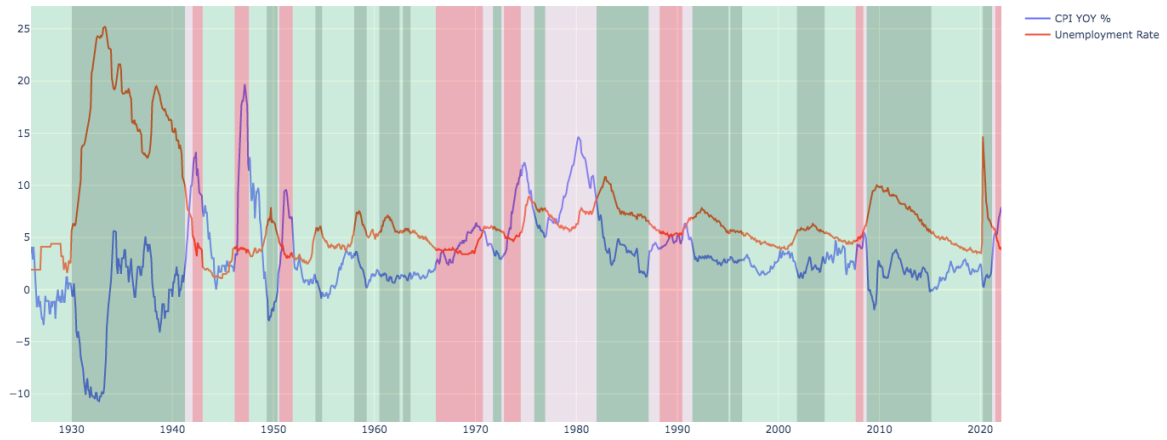

Figure 1: Visualization of the regimes for method 1b. The figure shows the YOY CPI and the unemployment rate from January 1926 to February 2022. The regimes for method 1b are highlighted in different colors: light green represents disinflationary boom, dark green is disinflationary stagnation, red is inflationary boom, and pink represents inflationary stagnation.

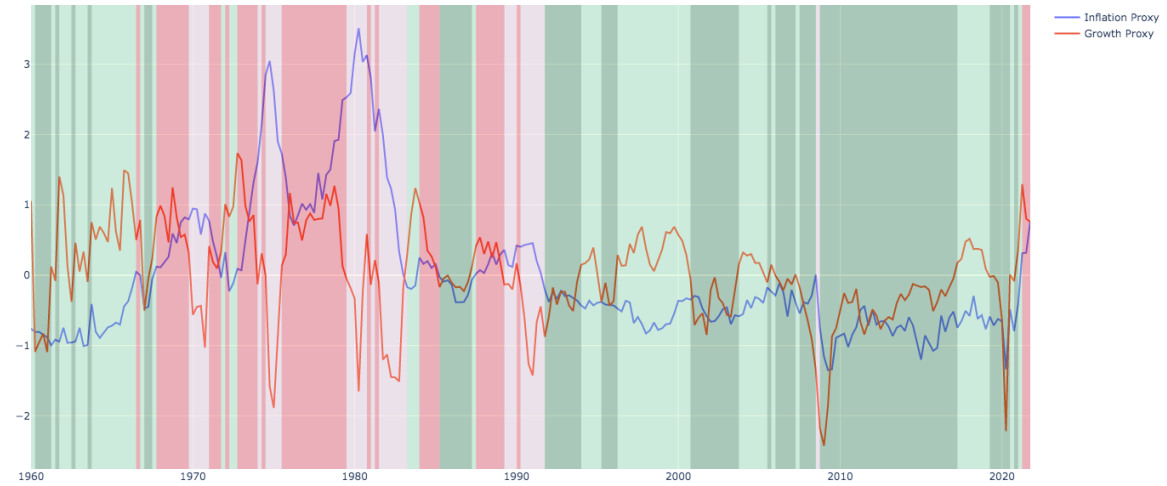

Figure 2: Visualization of the regimes for method 2. The figure shows the Z-scores for the inflation and growth proxy from January 1960 to December 2021. The regimes for method 2 are highlighted in different colors: light green represents disinflationary boom, dark green is disinflationary stagnation, red is inflationary boom, and pink represents inflationary stagnation.

Figure 1 illustrates the different periods classified in each regime quadrant for method 1b, while Figure 2 shows the periods classified in each specific regime for method 2. The different regimes are highlighted in different colors: light green represents disinflationary boom, dark green is disinflationary stagnation, red is inflationary boom, and pink represents inflationary stagnation. I find some differences between the methods concerning the number of months

classified for each regime from 1960 to 2021. The number of months in the disinflationary boom regime is about equal for the two methods. For the disinflationary stagnation regime method 1b classifies about 20 additional months. There are approximately 45 more months in the inflationary boom regime for method 2, and about 30 extra months are classified as inflationary stagnation for method 1b.

The data for method 2 starts in 1960. Therefore, it excludes the Great Depression of the 1930s, characterized by deflation and severe stagnation. Additionally, method 2 excludes three inflationary spikes: the start of WW2, the end of WW2, and the Korean War. Figures 1 and 2 show that method 2 classifies a larger part of the 1970s as inflationary boom, while method 1b classifies a larger part of the decade as inflationary stagnation. The inflationary stagnation regime at the beginning of the 1980s lasts longer for method 2. The mid part of the 1980s has components of both inflationary and disinflationary boom for method 2, while for method 1b, the mid part of the 1980s is solely characterized by disinflationary stagnation. Additionally, inflationary stagnation at the beginning of the 1990s also lasts longer for method 2. However, the stagnation after the Great Recession in 2008 lasts longer for method 1b.

4.1.2 Part 2

In the second part of the analysis, I investigate the underlying cause of the inflationary periods by making a distinction between cost-push and demand-pull inflation. I classify each of the eight inflationary regimes defined by Neville et al. (2021), as well as the current inflationary regime, as mainly caused by demand or supply side disruptions. Some of the inflationary regimes have components of both. In these cases, I emphasize how Neville et al. (2021) name the regimes in the separation between cost-push and demand-pull inflation.

The first of the eight inflationary regimes starts when the U.S. enter World War 2. Since business as usual is impossible during war conditions, and the supply of goods and services is limited, I define the resulting price acceleration as cost-push inflation. The second inflationary regime is induced by multiple factors as the war ends. The rationing and price controls introduced as a response to the first inflation spike are lifted. In addition, there are still supply shortages and diminished crops, combined with a postwar increase in consumer demand (Reed, 2014). I consider the second spike as mainly driven by cost-push inflation because it is a result of a war.

The third inflationary regime starts when the Korean War brings the U.S. into wartime status once again. Consumer demand increase as consumers anticipate price controls, which accelerate prices (Reed, 2014). I classify this regime as a supply disruption because the demand surge is caused by the news of war and expectations of raw material price spikes and supply limitations. The fourth inflationary period, the Ending of Bretton Woods, is in contrast to the former regimes a symptom of a highly stimulated and booming economy and is therefore classified as a demand-pull regime (Reed, 2014).

During the 1970s there are two big energy shocks. The first starts in 1972 and is caused by an oil embargo implemented by the Organization of Arab Petroleum Export Countries (OPEC) (Rouse et al., 2021). The second big shock reach an even higher peak and is caused by a reduction in oil production during the Iranian Revolution and the Iran-Iraq War (Rouse et al., 2021). Both these shocks cause cost-push inflation as oil and gas are central input factors in many production processes as well as in transportation and therefore affect the supply of goods and services.

During the seventh inflationary regime, the U.S. economy recovers from the 1982 recession, and therefore, the demand for goods and services increase. An energy shock resulting from the first Gulf War can partially explain the price increase of the period, but even the core CPI reach 5,5% by late 1990 (Reed, 2014). I emphasize the fact that Neville et al. (2021) name the regime Regan´s boom and classify it as mainly demand driven. The period between 2003 and 2011 is characterized by rising commodity prices accompanied by a global expansion (Farooki, 2011, s. 57). The commodity price rise, which peaked in 2008, has been associated with China´s resource-intensive growth and increasing demand for base metals (Farooki, 2011, s. 57). Therefore, I classify the inflation of this period as demand-pull. I classify the ninth regime as cost-push due to the considerable supply-chain disruptions following the corona crisis combined with energy price spikes.

To analyze cost-push and demand-pull inflation, I use the YOY percentage change in the headline CPI for the period January 1926 to February 2022. I adjust the start and end dates of the original regimes in Neville et al. (2021) because I use seasonally adjusted postwar data instead of unadjusted.

Table 3: Cost-push and demand-pull regimes. The table describes the number of months in each regime defined for part 2, the regime start and end dates, and the total number of months classified as cost-push and demand-pull regimes.

	Obs.	Period
US enters WW2	14	Apr 1941 - May 1942
End of WW2	13	Mar 1946 - Mar 1947
Korean War	9	Aug 1950 - Apr 1951
OPEC oil embargo	28	Aug 1972 - Nov 1974
Iranian Revolution	40	Dec 1976 - Mar 1980
The Coronavirus Crisis	12	Mar 2021 - Feb 2022
All cost-push regimes	**116**	
Ending of Bretton Woods	49	Feb 1966 - Feb 1970
Regan´s boom	44	Mar 1987 - Oct 1990
China demand boom	11	Sep 2007 - Jul 2008
All demand-pull regimes	**104**	

4.2 Assets returns

For all asset classes and investment strategies, I analyze real returns, except for fixed income, where I look at real yields. To perform the data analysis I use Excel and Stata, as well as Python for figure creations.

4.2.1 The aggregate regime returns

I aggregate the data in each regime by calculating the CAGR across all periods classified as a specific regime for each asset class or strategy. The CAGR is the mean annualized growth rate over a specific period of time and is calculated using the following formula:

$$1)\quad CAGR = \left(\frac{Ending\ value}{Beginning\ value}\right)^{\left(\frac{1}{n}\right)} - 1$$

Because of limited access to data for bond *returns*, I analyze the *yields* of treasury and corporate bonds. The market yield is expressed as the average annual rate an investor expects to earn from the bond if it is held to maturity. Since the yield is an annualized measure of what an investor expects to earn from a bond, I do not calculate the CAGR, but rather analyze the average yield in each regime. These two measures are not identical: the CAGR gives the actual average payoff an investor receives from holding a security for a particular period, while the yield is forward-looking: it states the return you can expect from purchasing a bond at the market value and holding it to maturity. Therefore, I will not directly compare the bond yields to the realized asset returns.

4.2.2 Regime dependent variations

After I present the annualized returns for each regime, I analyze the total returns during specific inflationary regimes for some of the assets and investment strategies. I choose assets based on total return variations reported in Neville et al. (2021) and available return history. Additionally, I include at least one representation from each asset class.

The included assets are: the *S&P 500*, the *health* portfolio, the *consumer durables* portfolio, the *20-year Treasury bond*, *silver, energy, SMB, momentum,* and *residential real estate*. For the Treasury bond, I report the average real yield during the specific inflationary regimes. Yield is not directly comparable to asset return and is therefore colored grey in the tables of these result

sections. The objective of Section 5.1.6 is to investigate whether the inclusion of a growth dimension reduces the variations in these asset returns between different inflationary regimes. While the objective of Section 5.2.6 is to check if the separation into cost-push and demand-pull inflation reduce the variations.

4.2.3 Transformation into real returns

I analyze real returns because it reflects the purchasing power of the money invested. All nominal returns are transformed into real returns using the following formula:

2) $Real\ return = \frac{(1+nominal\ return)}{(1+inflation)} - 1$

In the transformation, I use the 1-month percentage change in headline CPI, except for bonds. The real bond yield is calculated by using the YOY inflation as a proxy for yearly expected inflation.

4.2.4 Assets and strategies

Equity

I use the real total return price for the *S&P 500* from December 1925 to February 2022 retrieved from Robert Shiller's website. The data is monthly averages of daily prices and in real terms. The value-weighted returns on the 12 industry portfolios are collected from Kenneth R. French's website and span from July 1926 to February 2022. See the Appendix for the definition of the portfolios.

Fixed Income

The market yield for the *1-year, 10-year*, and *20-year* constant maturity U.S. Treasury securities spans from April 1953 to February 2022. For the *investment grade* yield, I use Moody´s Seasoned Aaa Corporate Bond Yield, and as a proxy for the *medium-grade* yield, I use the Moody´s Seasoned Baa Corporate Bond Yield from January 1926 to February 2022. These monthly yields are based on Moody´s Daily Corporate Bond Yield Averages for bonds with maturities of 20 years and longer. All yields are retrieved from FRED, and none of them are seasonally adjusted.

Commodities

All commodity returns are based on S&P Goldman Sachs Total Return indexes and retrieved from the Eikon database. These indices measure fully collateralized commodity futures investments that are rolled forward from the fifth to the ninth business day of each month. The indices are production-weighted and comprise the commodities within each class that have active, liquid futures markets (S&P Global, 2022). The start month for the returns on *commodities (all), livestock*, and *agriculture* is January 1970. The returns on *silver* and *precious metals* starts in February 1973, *industrial metals* in February 1977, *gold* in January 1978, and *energy* in January 1983. All commodity returns span until February 2022.

Real estate

The *residential real estate* return is based on the S&P Case Shiller house price index. For the period of January 1975 to January 2022, the data is seasonally adjusted and retrieved from the Eikon database. For the period of January 1953 to December 1974, the data is not seasonally adjusted and collected from multpl.com. The data from 1953 to 1974 is quarterly and I have therefore linearly interpolated it into monthly index values.

Dynamic equity strategies

I analyze the same seven dynamic equity factor strategies as Neville et al. (2021). The data for the *SMB* factor, *HML* factor, Momentum, the *robust minus weak (RMW)* factor and the *CMA* factor are collected from the Kenneth R. French website. The nominal returns for the strategies *bet against beta (BAB)* and *quality minus junk (QMJ)* are retrieved from the AQR website and based on the work of Frazzini and Pedersen (2014) and Asness et al. (2019). As in Neville et al. (2021), I add the risk-free rate to the nominal returns of the strategies and subtract a 2% annual trading cost. The approximated trading cost for the strategies is the maximum of a range set by Harvey et al (2019). See the Appendix for a description of the dynamic strategies.

Table 4 summarizes the monthly mean real return, standard deviation, number of observations and the time period for all the assets and strategies. However, for bonds I tabulate the annualized average real yield. The equity portfolios have in general highest real mean return, and *residential real estate* the lowest. Some equity portfolios and commodities, like *consumer non-durables, business equipment, energy* and *silver* have the largest return volatility, while *residential real estate* has the lowest.

Table 4: The table shows the monthly mean real return/yield, standard deviation, number of observations and the time period for all the assets and strategies. Note that for the fixed income securities, the yield is annualized.

	Mean	St.div.	Obs.	Period
Equity				
Equities (S&P 500)	0,682 %	4,463	1154	Jan 1926 - Feb 2022
Consumer non-durables	0,724 %	4,604	1148	Jul 1926 - Feb 2022
Consumer durables	0,930 %	7,949	-	-
Manufacturing	0,802 %	6,664	-	-
Energy	0,777 %	6,332	-	-
Chemicals	0,787 %	5,709	-	-
Business equipment (Tech)	0,915 %	7,431	-	-
Telecoms	0,607 %	4,618	-	-
Utilities	0,637 %	5,488	-	-
Retail	0,791 %	5,823	-	-
Health	0,842 %	5,565	-	-
Financials	0,780 %	6,776	-	-
Other	0,612 %	6,505	-	-
Fixed Income				
US Treasury 1 yr	1,148 %	2,272	827	Apr 1953 - Feb 2022
US Treasury 10 yr	2,093 %	2,258	-	-
US Treasury 20 yr	2,325 %	2,232	-	-
Investment grade (AAA)	2,743 %	3,918	1154	Jan 1926 - Feb 2022
Medium grade (BAA)	3,838 %	4,312	-	-
Commodities				
Commodities (all)	0,412 %	5,839	626	Jan 1970 - Feb 2022
Gold	0,278 %	5,317	530	Jan 1978 - Feb 2022
Silver	0,453 %	9,427	589	Feb 1973 - Feb 2022
Precious metals	0,386 %	6,309	-	-
Industrial metals	0,464 %	6,543	541	Feb 1977 - Feb 2022
Energy	0,575 %	9,290	470	Jan 1983 - Feb 2022
Livestock	0,242 %	5,014	626	Jan 1970 - Feb 2022
Agriculture	0,122 %	5,820	-	-
Real estate				
Residential real estate	0,087 %	0,507	829	Jan 1953 - Jan 2022
Dynamic equity strategies				
SMB - 'Size'	0,053 %	3,194	1147	Jul 1926 - Jan 2022
HML - 'Value'	0,206 %	3,537	-	-
RMW - 'Profitability'	0,160 %	2,249	703	Jul 1963 - Jan 2022
CMA - 'Investment'	0,162 %	2,011	-	-
Momentum	0,495 %	4,741	1141	Jan 1927 - Jan 2022
BAB (Bet-against-Beta)	0,526 %	3,284	1094	Des 1930 - Jan 2022
QMJ (Quality - Junk)	0,251 %	2,258	775	Jul 1957 - Jan 2022

4.3 Regression as a robustness check

The returns of the asset and strategies may vary within each regime. As a robustness check of the results in the first section, I include a simple linear regression of the asset returns. The regressions use the entire variation in each explanatory variable, also within regimes. I include the same assets as presented in the specific regime variation sections. For the first regression, OLS 1, I use two explanatory variables, and the second, OLS 2, includes an interaction term between the two variables.

OLS 1

3) $R = \beta_0 + \beta_1 I + \beta_2 A + \varepsilon$

OLS 2

4) $R = \beta_0 + \beta_1 I + \beta_2 A + \beta_3 IA + \varepsilon$

The response variable (R) is the real monthly return for all assets, except for the *20-year Treasury* bond, in which I use the real yield. The explanatory variables are the YOY inflation rate (I) and the unemployment rate (A) for method 1b. Whereas for method 2 it is the real inflation proxy (I) and real growth proxy (A). Running Breusch-pagan tests for heteroskedasticity reveals non-constant variances, and for that reason, I use robust standard errors. The z-scores for the inflation and real growth proxies are quarterly. For method 2, I therefore approximate the quarterly returns of the assets and strategies by summarizing the monthly returns for each quarter. Additionally, because the z-scores are standardized, I standardize the inflation series and unemployment rate in method 1b.

5 Results

5.1 Part 1: Inflation and growth

5.1.1 Equity

Panel A in Table 5 shows the annualized real return for the *S&P 500* and 12 equity portfolios for each regime defined for method 1b. Additionally, Panel B shows the hit rates and the t-statistics, where the hit rate is the percentage of sub-periods within each regime with positive returns, and the t-statistic shows whether the mean return in each regime is significantly larger than the mean return for all periods. Table 6 shows the corresponding values for method 2.

The results for the *S&P 500* for both methods 1b and 2, indicate that the inflationary dimension has a considerably greater impact on equity returns than the real growth dimension. The findings in method 1b are that the equity returns are statistically significantly lower than the average return during inflationary times, independent of whether the economy is booming or in stagnation. On the contrary, this is only the case for the inflationary boom scenario in method 2. The additional impact of stagnation on equity return is however not consistent between the two methods for the inflationary regimes. During inflationary times, the equity return is lower during the stagnation scenario according to method 1b, while method 2 reports the opposite. Why method 2 reports a positive return of 5,5% during inflationary stagnation and method 1b reports a negative return of -1,53% during the same regime is likely attributed to differences in sample periods and regime classifications, which I further elaborate in the next result section. Even though the real return during inflationary stagnation is positive, according to method 2, the t-statistic is not significant and the hit rate is only 56%. This indicates that the return is volatile and negative during 46% of the sub-periods.

The finding that inflation is bad news for real equity returns is consistent with both Ilmanen (2011, s. 462) and Neville et al (2021). For the real growth dimension my results are similar to Ilmanen (2011, s. 643), who reports a higher return during booms than stagnations for disinflationary times, and the opposite for inflationary times. Even though he reports a higher return during inflationary stagnations than booms, it is still negative, which is not in line with the results for method 2. The series I have used as inflation and growth proxies are based on Ilmanen (2011, s. 641), however not identical, due to limited data availability. For instance, Figure 2 illustrates a positive z-score for the inflation proxy in the first years of the 1980s as

well as the beginning of the 1990s, while Ilmanen's (2011) proxy only barely exceeds zero for a limited period. These pink shaded areas, indicating high inflation and low growth, report a relatively high return for the *S&P 500*, which might contribute to raising the return in inflationary stagnation periods, relative to Ilmanen's (2011) returns. These are both aftermaths of inflationary spikes, in which inflation is falling. The negative inflation surprises might explain these positive returns, in addition to stocks' forward-looking nature. Ilmanen (2011, s. 463) explains the poor performance of equity returns during inflationary booms with monetary tightening and attributes the strong performance of disinflationary stagnation to monetary policy easing. The average short-rate move was +32 bp during the quarters he defines as inflationary booms, -45 bp during his defined disinflationary stagnation quarters, and about zero for the two others (Ilmanen, 2011, s. 464). These are, however, just averages and not the case for all quarters.

Table 5: Equity returns, hit rate and t-statistics for Method 1b. Panel A shows the annualized real return for the *S&P 500* and 12 equity portfolios for each regime defined for method 1b. The best (worst) performers for each regime are shown in green (pink) cells. Panel B shows the hit rates and the t-statistics for the assets for each regime. The hit rate is the percentage of sub-periods within each regime with positive returns, while the t-statistic tests whether the mean return in each regime is significantly larger than the mean return for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	Disinflationary boom		Disinflationary stagnation		Inflationary boom		Inflationary stagnation	
A	Average real annual returns							
Equities (S&P 500)	10,72 %		10,11 %		-1,10 %		-1,53 %	
Consumer non-durables	8,10 %		12,57 %		-1,76 %		2,04 %	
Consumer durables	6,60 %		18,66 %		-4,75 %		-7,33 %	
Manufacturing	10,94 %		11,23 %		-2,91 %		-2,97 %	
Energy	5,93 %		8,72 %		6,65 %		5,94 %	
Chemicals	9,40 %		12,15 %		-0,81 %		-0,35 %	
Business equipment (Tech)	14,96 %		11,13 %		-3,35 %		-6,36 %	
Telecoms	7,49 %		12,06 %		-4,82 %		-2,79 %	
Utilities	12,56 %		6,79 %		-3,06 %		-2,87 %	
Retail	9,44 %		12,53 %		-1,90 %		-0,86 %	
Health	11,62 %		10,80 %		1,82 %		1,16 %	
Financials	9,62 %		10,44 %		-2,75 %		-0,81 %	
Other	7,59 %		8,45 %		-6,08 %		0,08 %	
B	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**
Equities (S&P 500)	85 %	0,94	100 %	0,92	50 %	-2,26**	44 %	-1,84**
Consumer non-durables	77 %	-0,06	100 %	1,40*	50 %	-2,08**	56 %	-0,86
Consumer durables	77 %	-0,49	93 %	1,88**	50 %	-2,23**	22 %	-2,16**
Manufacturing	77 %	0,52	86 %	0,96	25 %	-2,23**	33 %	-1,44
Energy	85 %	-0,37	93 %	0,43	75 %	-0,23	89 %	-0,13
Chemicals	85 %	0,24	86 %	1,07	63 %	-1,9**	44 %	-1,21*
Business equipment (Tech)	85 %	1,09	79 %	0,70	50 %	-2,17**	22 %	-1,98**
Telecoms	85 %	0,28	93 %	1,67**	25 %	-2,61**	67 %	-1,86**
Utilities	77 %	1,45*	86 %	0,37	63 %	-2,08**	56 %	-1,72**
Retail	77 %	0,19	100 %	1,15	50 %	-1,85**	33 %	-1,06
Health	69 %	0,56	79 %	0,62	50 %	-1,32	56 %	-1,03
Financials	85 %	0,30	93 %	0,91	63 %	-1,83**	56 %	-1,12
Other	77 %	0,28	86 %	0,88	38 %	-2,00**	33 %	-0,62

The two methods agree that the *energy* sector has the highest historical real return during inflationary booms. Method 2 reports a high value for *retail* during inflationary stagnation with a hit rate of 78%, while 1b reports *energy* as the best performer with a hit rate of 89%. The results from method 2, show that none of the portfolios have a significantly lower return than average during inflationary stagnation. On the other hand, method 1b reports statistically significantly lower returns for *consumer durables*, *business equipment*, *utilities*, and *telecoms*. Again, the two methods do not agree on the hedging ability of stocks during inflationary stagnation. Nevertheless, both methods agree with Neville et al. (2021), that the *energy* sector generates positive real returns during times of inflation, which is not significantly lower than average. The result from method 1b suggests that the weakest sector during stagflation is the *consumer durables* sector, which is also the worst performer during inflationary times according to Neville et al. (2021). On the other hand, method 2 indicates that the weakest sector during stagflation is the *technology* sector.

Table 6: Equity returns, hit rate and t-statistics for Method 2. Panel A shows the annualized real return for the *S&P 500* and 12 equity portfolios for each regime defined for method 2. The best (worst) performers for each regime are shown in green (pink) cells. Panel B shows the hit rates and the t-statistics for the assets for each regime. The hit rate is the percentage of sub-periods within each regime with positive returns, while the t-statistic tests whether the mean return in each regime is significantly larger than the mean return for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5%, or 1% probability level, respectively.

	Disinflationary boom		Disinflationary stagnation		Inflationary boom		Inflationary stagnation	
A	Average real annual returns							
Equities (S&P 500)	10,66 %		8,50 %		-1,26 %		5,55 %	
Consumer non-durables	5,85 %		13,38 %		-0,65 %		14,05 %	
Consumer durables	6,62 %		13,55 %		-3,25 %		2,40 %	
Manufacturing	11,68 %		10,58 %		-3,15 %		0,84 %	
Energy	13,48 %		5,38 %		1,75 %		2,20 %	
Chemicals	6,47 %		12,00 %		-4,26 %		7,30 %	
Business equipment (Tech)	17,49 %		8,69 %		-3,64 %		-1,37 %	
Telecoms	6,04 %		8,57 %		0,35 %		6,33 %	
Utilities	7,51 %		9,28 %		-2,63 %		8,43 %	
Retail	8,70 %		11,54 %		-2,18 %		14,56 %	
Health	11,38 %		9,83 %		-1,47 %		11,87 %	
Financials	9,58 %		9,15 %		0,32 %		6,62 %	
Other	9,66 %		7,78 %		-4,10 %		4,86 %	
B	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**
Equities (S&P 500)	84 %	1,15	87 %	0,59	38 %	-2,01**	56 %	-0,07
Consumer non-durables	74 %	-0,61	73 %	1,22	62 %	-1,76**	78 %	0,86
Consumer durables	58 %	-0,06	80 %	1,16	38 %	-1,57*	44 %	-0,46
Manufacturing	84 %	0,92	67 %	0,81	31 %	-1,72**	67 %	-0,57
Energy	84 %	1,14	80 %	-0,12	46 %	-0,82	56 %	-0,39
Chemicals	89 %	0,00	93 %	1,29*	31 %	-1,98**	78 %	0,25
Business equipment (Tech)	89 %	1,54*	87 %	0,32	46 %	-1,74**	44 %	-0,81
Telecoms	63 %	0,01	80 %	0,67	38 %	-1,23	56 %	0,11
Utilities	68 %	0,34	80 %	0,85	46 %	-2,07**	56 %	0,44
Retail	74 %	0,05	80 %	0,66	46 %	-1,67**	78 %	0,82
Health	79 %	0,64	67 %	0,36	46 %	-1,73**	67 %	0,56
Financials	74 %	0,40	67 %	0,43	62 %	-1,14	78 %	0,06
Other	74 %	0,76	73 %	0,47	38 %	-1,47*	56 %	0,09

5.1.2 Fixed Income

The yield on bonds is in general increasing in duration and credit risk; therefore, I do not highlight the worst and best performers but rather discuss the impact of the inflation and growth dimension. For method 1b, the t-statistic in Table 7 is negative for both inflation scenarios, indicating a below-average real yield. For treasury bonds, the yield is lower during inflationary stagnation. The significance level increases in duration, meaning that the inflation dimension has a greater impact on high duration government bond yields. For corporate bonds, the yield is lower during inflationary booms. This result is consistent with method 2, except that the *1-year Treasuries* perform better during inflationary booms. For disinflationary times, higher growth has a negative impact on yields for all bonds, except the *1-year Treasury*. For method 2, the opposite is true, except for *medium grade credit*. Therefore, the results are more consistent for inflationary than for disinflationary times.

Table 7: Bond yields and t-statistics for Method 1b.
Panel A shows the average real yield for US Treasuries with durations of 1-year, 10-years, and 20-years, as well as investment grade and medium grade credit, for each regime defined for method 1b. Panel B shows t-statistics that test whether the mean yield in each regime is significantly larger than the mean yield for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5%, or 1% probability level, respectively.

	Disinflationary boom	Disinflationary stagnation	Inflationary boom	Inflationary stagnation
A	**Average yield**			
US Treasury 1 yr	1,48	1,25	1,15	0,19
US Treasury 10 yr	2,02	3,00	1,30	0,69
US Treasury 20 yr	2,23	3,40	1,30	0,76
Investment grade (AAA)	2,39	4,63	-0,40	1,05
Medium grade (BAA)	3,15	6,10	0,37	2,24
B	**t stat**			
US Treasury 1 yr	2,40***	0,59	-0,02	-4,20***
US Treasury 10 yr	-0,53	5,70***	-3,49***	-5,95***
US Treasury 20 yr	0,00	7,69***	-4,33***	-6,43***
Investment grade (AAA)	-1,71**	8,66***	-8,08***	-6,27***
Medium grade (BAA)	-3,10***	9,28***	-8,73***	-5,80***

Bonds generate a return in two ways: 1) through coupon payments while holding the bond, and 2) by selling the bond at a premium or by buying the bond at a discount in the secondary market. When the inflation rate increase, so does the bond yield. Equivalently, the price of the bond falls. Lower bond prices mean that bondholders have to sell at a discount in the secondary market or hold the bond to maturity receiving a lower return than what alternative newly issued bonds would yield. The results in Tables 7 and 8 suggest that the increase in yield does not keep up with the increase in YOY inflation. Therefore, bondholders receive a considerably lower real return on their bonds during times of inflation. Additionally, reduced bond prices indicate

that bond holders must sell at a discount, losing money in the secondary market. Therefore, bonds are a poor investment hedge during times of inflation, especially combined with stagnation. This result is consistent with Ilmanen (2011), who finds that the returns on high-yield, credit, and treasury bonds are lowest during stagflation.

Table 8: Bond yields and t-statistics for Method 2.
Panel A shows the average real yield for US Treasuries with durations of 1-year, 10-years, and 20-years, as well as investment grade and medium grade credit, for each regime defined for method 2. Panel B shows the t-statistics that test whether the mean yield in each regime is significantly larger than the mean yield for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	Disinflationary boom	Disinflationary stagnation	Inflationary boom	Inflationary stagnation
A	**Average yield**			
US Treasury 1 yr	1,99	0,43	1,30	1,16
US Treasury 10 yr	2,77	2,03	1,88	1,52
US Treasury 20 yr	3,00	2,50	1,92	1,52
Investment grade (AAA)	3,62	3,44	2,48	2,22
Medium grade (BAA)	4,34	4,47	3,45	3,57
B	**t stat**			
US Treasury 1 yr	5,19***	-4,46***	0,65	0,03
US Treasury 10 yr	3,95***	-0,66	-1,12	-1,79**
US Treasury 20 yr	3,86***	0,71	-2,03**	-2,57***
Investment grade (AAA)	3,13***	2,01**	-2,80***	-2,59***
Medium grade (BAA)	1,49*	2,24**	-2,64***	-1,45

5.1.3 Commodities

The results for the *all-commodities* index show that commodities, on average, excel in the inflationary boom environment. However, the results from method 2 show that this is not the case for *gold, silver*, and *precious metals*. Furthermore, there are large variations in returns between commodity classes. For instance, the findings from both methods show that *silver* has a negative real return of about -5% while the *energy* index has an average real return of almost 13%. Examining the reported historical real returns during inflationary times for different commodities, the *energy* index is a clear overall winner and shines in inflationary booms. For the stagflation scenario method 1b and 2 agree that *energy i*s the best performer, for method 1b *silver* is the worst performer, while method 2 suggests that *industrial metals* is the worst performer. None of these are, however, significantly different from the average return, indicating a high standard deviation. In addition, I want to emphasize the fact that especially *energy* and *gold* have a limited return history. The fact that *energy* has been an inflation hedge on average for the last four decades does not imply that it will for certain continue to be a hedge.

Table 9: Commodity returns, hit rate, and t statistics for Method 1b.

Panel A shows the annualized real return for eight of the S&P Goldman Sachs commodity indexes, for each regime defined for method 1b. The best (worst) performers for each regime are shown in green (pink) cells. Panel B shows the hit rates and the t-statistics for the assets. The hit rate illustrates the percentage of sub-periods within each regime with positive returns, while the t statistic tests whether the mean return in each regime is significantly larger than the mean return for all periods. The t statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	Disinflationary boom		Disinflationary stagnation		Inflationary boom		Inflationary stagnation	
A	Average real annual returns							
Commodities (all)	-6,80 %		1,23 %		31,76 %		5,13 %	
Gold	1,51 %		1,05 %		-1,84 %		5,21 %	
Silver	1,01 %		0,59 %		5,19 %		-5,01 %	
Precious metals	1,16 %		1,73 %		10,44 %		0,34 %	
Industrial metals	1,83 %		-0,63 %		23,44 %		3,52 %	
Energy	-8,10 %		-0,37 %		37,08 %		12,72 %	
Livestock	-6,66 %		3,36 %		-1,96 %		10,81 %	
Agriculture	-10,32 %		0,00 %		33,29 %		-4,91 %	
B	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**
Commodities (all)	50 %	-1,45*	63 %	-0,37	100 %	2,80***	88 %	0,32
Gold	75 %	-0,18	50 %	-0,16	67 %	-0,54	40 %	0,60
Silver	25 %	-0,21	71 %	0,03	50 %	0,36	50 %	-0,07
Precious metals	50 %	-0,47	57 %	-0,18	50 %	0,80	50 %	0,01
Industrial metals	25 %	-0,34	50 %	-0,62	67 %	1,45*	40 %	0,24
Energy	50 %	-0,86	67 %	-0,27	100 %	2,26**	75 %	0,74
Livestock	0 %	-1,76**	75 %	0,34	40 %	-0,34	88 %	1,36*
Agriculture	50 %	-2,03**	50 %	0,03	100 %	2,72***	38 %	-0,5

Table 10: Commodity returns, hit rate, and t statistics for Method 2.

Panel A shows the annualized real return for eight of the S&P Goldman Sachs commodities indices, for each regime defined for method 1b. The best (worst) performers for each regime are shown in green (pink) cells. Panel B shows the hit rates and the t-statistics for the assets. The hit rate is the percentage of sub-periods within each regime with positive returns, while the t-statistic tests whether the mean return in each regime is significantly larger than the mean return for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	Disinflationary boom		Disinflationary stagnation		Inflationary boom		Inflationary stagnation	
A	Average real annual returns							
Commodities (all)	9,42 %		-4,58 %		10,39 %		1,26	
Gold	-4,39 %		7,69 %		-9,63 %		5,22	
Silver	7,34 %		3,02 %		-9,23 %		-5,73	
Precious metals	-0,11 %		7,18 %		-4,58 %		2,10	
Industrial metals	11,08 %		-3,50 %		20,33 %		-7,80	
Energy	13,85 %		-9,70 %		19,21 %		12,61	
Livestock	2,61 %		-3,80 %		7,41 %		5,35	
Agriculture	-3,66 %		-0,22 %		7,03 %		-7,73	
B	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**
Commodities (all)	92 %	0,99	50 %	-1,17	73 %	1,10	44 %	-0,09
Gold	40 %	-1,43*	90 %	1,00	14 %	-1,29*	33 %	0,48
Silver	60 %	0,54	60 %	0,20	33 %	-1,16	25 %	0,10
Precious metals	50 %	-0,70	90 %	0,64	22 %	-0,84	38 %	0,29
Industrial metals	80 %	1,00	40 %	-1,04	43 %	1,40	33 %	-0,98
Energy	70 %	1,03	50 %	-1,75**	75 %	1,07	50 %	0,53
Livestock	67 %	0,15	50 %	-1,19	55 %	0,96	67 %	0,58
Agriculture	75 %	-0,67	60 %	0,08	55 %	1,06	33 %	-0,75

The results for the second method show that commodities do well in any kind of growth environment, which is consistent with the findings of Ilmanen (2011). While the results from method 1b suggest that the inflation dimension is the most critical, and the overall commodity index has the lowest return during disinflationary booms. The importance of the inflation

dimension is consistent with the results of Neville et al. (2021), who conclude that commodities perform considerably better during periods of high inflation, especially *energy*.

The large variation in returns between the two methods implies that the commodity returns are sensitive to the regime definitions. A few deviations in the months included in each regime results in large variations in returns. For instance, a -6,80% return versus a 9,42% return for the *all-commodity* index during disinflations booms, for methods 1b and 2 respectively. This is a sign of volatile asset returns. Relatively low absolute values of the t-statistics compared to the parameter values, point in the same direction. Some commodity classes have generated highly positive returns during inflationary times; however, the high volatility limits the asset's hedging ability.

5.1.4 Residential real estate

The results from both method 1b and 2 agrees that the disinflationary boom regime is the best environment for *residential real estate*, in which the real return is significantly larger than the mean return for all periods. In general, inflation is bad news for *residential real estate* returns. However, the two methods show inconsistent results for the additional impact of the growth dimension. According to method 1b, the return is negative and highly significant during the inflationary boom regime, but barely positive and significantly lower than average in the inflationary stagnation regime. For method 2, the inflationary stagnation regime is clearly the worst environment, while the return during inflationary boom is positive. Summarizing the results of the two methods, I conclude that *residential real estate* is not an inflation hedge, especially not during bad economic times.

The negative impact of the inflation dimension is in line with the results of Neville et al. (2021), who report a negative and significant value of -2% during inflationary times. The positive returns in both boom regimes for method 2, are consistent with the findings of Ilmanen (2011, s. 463). Nevertheless, he reports the inflationary boom regime as the best environment for housing returns. Additionally, the results from method 2 agree with Ilmanen (2011, s. 463) that housing generates the lowest real returns during inflationary stagnation.

Table 11: Real estate returns, hit rate, and t-statistic for Method 1b.
Panel A shows the annualized real return for the S&P Case Shiller house price index, for each regime defined for method 1b. The best (worst) environment for real estate return is highlighted in green (pink) cells. Panel B shows the hit rates and the t-statistics for the real estate return. The hit rate is the percentage of sub-periods within each regime with positive returns, while the t-statistic tests whether the mean return in each regime is significantly larger than the mean return for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	Disinflationary boom		Disinflationary stagnation		Inflationary boom		Inflationary stagnation	
A	Average real annual returns							
Residential real estate	2,20 %		1,39 %		-1,42 %		0,04 %	
B	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**
Residential real estate	56 %	2,51***	44 %	0,82	20 %	-4,38***	63 %	-1,60*

Table 12: Real estate returns, hit rate, and t-statistics for Method 2.
Panel A shows the annualized real return for the S&P Case Shiller house price index, for each regime defined for method 2. The best (worst) environment for real estate return is highlighted in green (pink) cells. Panel B shows the hit rates and the t-statistics for the real estate returns. The hit rate is the percentage of sub-periods within each regime with positive returns, while the t-statistic tests whether the mean return in each regime is significantly larger than the mean return for all periods. The t statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	Disinflationary boom		Disinflationary stagnation		Inflationary boom		Inflationary stagnation	
A	Average real annual returns							
Residential real estate	2,57 %		0,91 %		1,57 %		-2,82 %	
B	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**
Residential real estate	63 %	3,68***	40 %	-0,24	54 %	1,18	11 %	-7,24***

5.1.5 Dynamic equity strategies

During inflationary times, *momentum* is the overall best performer of the factor strategies, especially during inflationary stagnation, in which the mean real return is 4,15% and 8,11% for methods 1b and 2, respectively. This relatively large return variation between the two methods might suggest that also *momentum* is sensitive to the regime definitions. The strategy has in general a somewhat larger standard deviation than the others but generates a relatively high and positive return during most regimes. *BAB, QMJ,* and *CMA*, are three strategies that also generate positive and relatively high returns during the inflationary stagnation environment. Despite the fact that none of the strategies generate negative real returns during the stagnation regime, none of them are significantly larger than average, except *CMA*, according to method 2.

Neville et al. (2021) report *BAB* and *SMB* as having the worst real returns during inflationary times. Results from my analysis suggest that this bad performance can be attributed to a combination of inflation and booming times, and does not exist during stagflation. Neville et al. (2021) also find that *QMJ*, *momentum,* and *CMA* generate positive returns during

inflationary times. According to Ilmanen (2011), *momentum* also performs well in all regimes. Additionally, he finds that value stocks stand out in all boom regimes and that small-cap stocks outperform the stocks market during stagnations. My findings suggest that the long value and short growth factor strategy generate positive returns during booms, while the long small and short big stocks factor strategy perform better in stagnations. Despite this, these strategies only outperform the *S&P 500* during non-inflationary times. However, this is not the case for method 2, which reports a 5,5% average return on stocks during stagflation.

Table 13: Equity strategy returns, hit rate, and t-statistic for Method 1b. ¨

Panel A shows the annualized real return for seven long/short equity strategies for each regime defined for method 1b. The best (worst) performers for each regime are shown in green (pink) cells. Panel B shows the hit rates and the t-statistics for the strategies. The hit rate is the percentage of sub-periods within each regime with positive returns, while the t-statistics tests whether the mean return in each regime is significantly larger than the mean return for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	Disinflationary boom		Disinflationary stagnation		Inflationary boom		Inflationary stagnation	
A	Average real annual returns							
SMB - 'Size'	-2,49 %		4,15 %		-6,80 %		2,03 %	
HML - 'Value'	1,57 %		2,52 %		1,10 %		0,52 %	
RMW - 'Profitability'	1,25 %		1,96 %		1,41 %		1,75 %	
CMA - 'Investment'	0,44 %		2,38 %		2,90 %		1,16 %	
Momentum	11,94 %		0,17 %		3,77 %		4,15 %	
BAB (Bet-against-Beta)	3,31 %		11,60 %		-1,40 %		2,16 %	
QMJ (Quality - Junk)	5,35 %		0,54 %		5,21 %		1,44 %	
B	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**
SMB - 'Size'	23 %	-1,14	64 %	1,74**	13 %	-2,28**	33 %	0,57
HML - 'Value'	54 %	-0,15	64 %	0,38	50 %	-0,34	56 %	-0,41
RMW - 'Profitability'	40 %	-0,06	67 %	0,13	60 %	-0,13	75 %	0,00
CMA - 'Investment'	40 %	-0,54	56 %	0,33	80 %	0,46	63 %	-0,24
Momentum	92 %	1,57*	64 %	-0,88	63 %	-0,38	44 %	-0,20
BAB (Bet-against-Beta)	62 %	-0,96	100 %	2,23**	38 %	-2,83***	44 %	-1,04
QMJ (Quality - Junk)	75 %	1,15	45 %	-1,06	100 %	0,95	75 %	-0,55

Table 14: Equity strategy returns, hit rate, and t-statistics for Method 2.

Panel A shows the annualized real return for seven long/short equity strategies for each regime defined for method 2. The best (worst) performers for each regime are shown in green (pink) cells. Panel B shows the hit rates and the t-statistics for the strategies. The hit rate is the percentage of sub-periods within each regime with positive returns, while the t-statistic tests whether the mean return in each regime is significantly larger than the mean return for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	Disinflationary boom		Disinflationary stagnation		Inflationary boom		Inflationary stagnation	
A	Average real annual returns							
SMB - 'Size'	-1,66 %		1,07 %		-0,45 %		3,21 %	
HML - 'Value'	2,02 %		-0,93 %		4,16 %		3,46 %	
RMW - 'Profitability'	1,14 %		2,65 %		1,49 %		0,14 %	
CMA - 'Investment'	-0,74 %		1,18 %		1,90 %		6,91 %	
Momentum	8,41 %		1,50 %		7,00 %		8,11 %	
BAB (Bet-against-Beta)	5,33 %		12,17 %		5,43 %		7,94 %	
QMJ (Quality - Junk)	4,03 %		1,33 %		2,58 %		4,48 %	
B	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**	**Hit rate**	**t stat**
SMB - 'Size'	32 %	-0,53	40 %	0,27	46 %	-0,22	67 %	0,73
HML - 'Value'	53 %	0,15	53 %	-0,91	46 %	0,86	67 %	0,49
RMW - 'Profitability'	73 %	-0,15	67 %	0,47	77 %	-0,12	56 %	-0,68
CMA - 'Investment'	40 %	-1,13	42 %	-0,22	54 %	0,13	78 %	1,80**
Momentum	74 %	0,66	73 %	-0,83	69 %	0,28	44 %	0,46
BAB (Bet-against-Beta)	74 %	-0,86	73 %	1,23	31 %	-0,99	56 %	-0,05
QMJ (Quality - Junk)	68 %	0,56	40 %	-0,55	77 %	-0,13	67 %	0,58

5.1.6 Return variations between regimes

By including a growth dimension, the span in equity return variation is reduced to some extent. In method 1b, I find that the largest return variation is during inflationary booms: -25,41% to 30,77%, which is a reduction of about 11 percentage points compared to the variation in Neville et al. (2021). For method 2, this range is -18% to 14,72%, which is a reduction of almost 33 percentage points. The largest return variation between specific regimes for *consumer durables* is reduced by almost 10 percentage points according to method 1b and about 18,5 percentage points for method 2. While for *health* it is reduced by only 4 percentage points for method 1b and about 19.5 percentage points for method 2. The fact that variations between regimes are still relatively large, especially for method 1b, suggests that the inclusion of a growth dimension cannot solely explain the significant return variations.

The average *20-year U.S. Treasury* yield has a total variation of about 8 percentage points according to method 1b and approximately 11 percentage points according to method 2. Since the reported yield is annualized, while the reported value for the other asset classes is not, the yield variation is relatively large. For *silver*, return variation is significantly reduced by including a growth dimension, about 114 percentage points less variation for method 1 and 133 percentage points less variation for method 2. *Energy* also experiences a large reduction in returns, about 200 percentage points for both methods. However, if I consider the same period, only data after 1983, the decline in return variations is only about 55 percentage points. Nevertheless, the variation in returns is still considerably larger for the commodities than for the other asset classes.

The variation in *residential real estate* is relatively small. The inclusion of a growth dimension does not reduce it much further: the range is reduced by only 2 percentage points for method 2 and 13 percentage points for method 1b. For the dynamic equity strategies, the variation in *SMB* is only reduced by 1 percentage point and 11 percentage points for method 1b and 2, respectively, while *momentum* experience a variation increase of 23 percentage points for method 1b and a reduction of 1 percentage point for method 2. This indicates that the inclusion of a growth dimension cannot explain the variation in these strategy returns. For most assets, the return variation is reduced to some degree. However, the return variations are still large, which suggests that there are other important factors affecting the asset returns.

Table 15: Total returns for inflationary boom method 1b.

The table shows the total real return during the specific inflationary boom regimes defined for method 1b for multiple asset classes, as well as the total price level change during each sub regime.

	Inflationary boom							
Start month	Jan 1942	Mar 1946	Aug 1950	Feb 1966	Nov 1972	Apr 1988	Sep 2007	Jul 2021
End month	Des 1942	Jul 1947	Nov 1951	Sep 1970	Jun 1974	Jun 1990	Mai 2008	Feb 2022
Total price level chg	8,94 %	22,84 %	9,35 %	22,96 %	16,11 %	11,50 %	3,36 %	4,88 %
Lenght (mths)	12	17	16	56	20	27	9	8
Strategy								
Equities (S&P 500)	7,45 %	-24,24 %	30,77 %	-16,27 %	-25,41 %	31,13 %	-6,04 %	4,84 %
Consumer durables	36,39 %	-30,33 %	26,77 %	-24,38 %	-39,61 %	9,15 %	-18,71 %	4,85 %
Health	7,65 %	-13,92 %	36,89 %	12,15 %	-28,75 %	52,14 %	-7,70 %	-9,96 %
US Treasury 20 yr				1,37 %	0,09 %	3,90 %	0,61 %	-4,18 %
Silver					107,66 %	-29,63 %	20,34 %	-23,62 %
Energy						70,49 %	76,09 %	34,14 %
Real estate				-0,87 %	-7,57 %	-0,50 %	-9,71 %	5,37 %
SMB	-6,12 %	-28,95 %	-10,02 %	31,47 %	-26,84 %	-12,83 %	-7,06 %	-18,28 %
Momentum	-21,15 %	-16,95 %	12,76 %	12,43 %	24,36 %	39,49 %	20,75 %	-4,62 %

Table 16: Total returns for inflationary stagnation method 1b.

The table shows the total real return during the specific inflationary stagnation regimes defined for method 1b for multiple asset classes, as well as the total price level change during each sub regime.

	Inflationary stagnation								
Start month	Apr 1941	Oct 1970	Aug 1972	Jul 1974	Des 1976	Mar 1987	Jul 1990	Jun 2008	Mar 2021
End month	Des 1941	Sep 1971	Oct 1972	Oct 1975	Des 1981	Mar 1988	Jun 1991	Sep 2008	Jun 2021
Total price level chg	9,14 %	4,08 %	0,96 %	12,04 %	61,96 %	4,20 %	4,70 %	1,70 %	2,89 %
Length (mths)	9	12	3	16	61	13	12	4	4
Strategy									
Equities (S&P 500)	-14,89 %	19,49 %	1,98 %	-6,43 %	-2,93 %	-6,30 %	3,81 %	-13,48 %	6,15 %
Consumer durables	-25,91 %	26,71 %	-0,56 %	-2,30 %	-22,38 %	-11,05 %	-9,23 %	-26,80 %	2,14 %
Health	-9,34 %	21,82 %	1,16 %	-18,16 %	18,60 %	-13,95 %	19,68 %	-2,50 %	4,44 %
US Treasury 20 yr		1,47 %	2,81 %	-1,91 %	0,31 %	4,53 %	2,76 %	-0,59 %	-1,98 %
Silver				-19,49 %	16,32 %	6,96 %	-22,63 %	-22,19 %	3,55 %
Energy						24,42 %	52,30 %	-25,16 %	14,97 %
Real estate		1,18 %	0,23 %	-2,86 %	6,16 %	3,73 %	-6,05 %	-5,42 %	4,21 %
SMB	-12,54 %	0,45 %	-9,49 %	-1,15 %	74,73 %	-2,77 %	-3,05 %	4,29 %	-7,32 %
Momentum	0,00 %	9,18 %	-3,40 %	-6,72 %	76,16 %	-8,84 %	4,11 %	1,22 %	-5,44 %

Through the result section for part 1, there has been a general tendency of method 2 reporting higher real returns in the stagflation scenario than method 1b for equity and the equity strategies. When I examine the results in Tables 16 and 18, I find that there are especially two sub-periods for method 2, not classified as stagflation for method 1b, generating relatively high returns for the *S&P 500*. These periods are July 1981 to March 1983 and April 1989 to Dec 1989. The first regime exists only for method 2 because the method captures a larger part of the negative inflation surprises after the Iranian Revolution. A stabilizing inflation combined with a low but increasing growth in these years is good news for the stock market as the expectations about the future are brightening. *Momentum* also performs exceptionally well during this specific regime, with a 49,72% return. The second regime exists only for method 2 because it is a short-lived drop in the growth rate in the last part of Regan´s boom that does not result in a similar

increase in the unemployment rate. This drop is likely connected to the distress in the savings and loan industry ending in 1989. However, the unemployment rate lags the real growth rate and does not pass my threshold level until July 1990.

Table 17: Total returns for inflationary boom method 2.
The table shows the total real return during the specific inflationary boom regimes defined for method 2 for multiple asset classes, as well as the total price level change during each sub regime.

	Inflationary boom												
Start month	Jul 1966	Oct 1967	Jan 1971	Jan 1972	Oct 1972	Apr 1974	Jul 1975	Oct 1980	Apr 1981	Jan 1984	Jul 1987	Jan 1990	Apr 2021
End month	Sep 1966	Des 1969	Sep 1971	Mar 1972	Des 1973	Jun 1974	Jun 1979	Dec 1980	Jun 1981	Mar 1985	Mar 1989	Mar 1990	Dec 2021
Total price level chg	1,14 %	12,20 %	2,51 %	0,73 %	9,98 %	2,51 %	34,95 %	2,98 %	2,14 %	5,33 %	7,67 %	1,82 %	5,70 %
Length (mths)	3	27	9	3	15	3	48	3	3	15	21	3	9
Strategy													
Equities (S&P 500)	-9,62 %	-9,09 %	10,24 %	8,60 %	-18,07 %	-9,24 %	-2,31 %	3,91 %	-1,81 %	9,91 %	-4,43 %	-4,07 %	14,72 %
Consumer durables	-11,66 %	-21,21 %	15,70 %	7,65 %	-37,03 %	-8,37 %	12,26 %	-1,17 %	-1,77 %	-1,17 %	-10,82 %	2,16 %	30,38 %
Health	-11,68 %	17,92 %	13,68 %	9,64 %	-19,06 %	-5,56 %	-24,70 %	9,11 %	-1,49 %	11,74 %	-6,98 %	-7,46 %	6,03 %
US Treasury 20 yr	1,59 %	1,17 %	1,65 %	2,45 %	1,18 %	-2,23 %	0,88 %	-0,28 %	3,29 %	7,78 %	4,56 %	3,04 %	-3,42 %
Silver					41,32 %	-18,38 %	36,95 %	8,90 %	-12,05 %	-43,78 %	-33,25 %	-11,46 %	-21,95 %
Energy										18,45 %	47,83 %	-7,81 %	25,11 %
Real estate	-1,01 %	0,15 %	0,65 %	0,15 %	-6,39 %	-0,63 %	19,55 %	-1,29 %	-0,39 %	0,88 %	5,12 %	-1,15 %	7,67 %
SMB	-15,15 %	8,35 %	6,78 %	6,53 %	-32,29 %	-4,67 %	44,71 %	-1,42 %	6,55 %	-1,55 %	-1,11 %	0,63 %	-16,22 %
Momentum	-5,72 %	20,87 %	0,05 %	5,29 %	36,75 %	3,13 %	26,26 %	15,02 %	-2,25 %	8,59 %	-2,16 %	-2,57 %	0,21 %

Table 18: Total returns for inflationary stagnation method 2.
The table shows the total real return during the specific inflationary stagnation regimes defined for me for multiple asset classes, as well as the total price level change during each sub regime.

	Inflationary stagnation								
Start month	Jan 1970	Jan 1974	Jul 1974	Jul 1979	Jan 1981	Jul 1981	Apr 1989	Apr 1990	Jul 2008
End month	Dec 1970	Mar 1974	Jun 1975	Sep 1980	Mar 1981	Mar 1983	Dec 1989	Sep 1991	Sep 2008
Total price level chg	5,57 %	3,24 %	9,18 %	16,20 %	2,55 %	8,40 %	3,36 %	6,53 %	0,65 %
Length (mths)	12	3	12	15	3	21	9	18	3
Strategy									
Equities (S&P 500)	-2,73 %	0,26 %	-1,41 %	14,24 %	-1,55 %	16,84 %	18,29 %	12,93 %	-8,73 %
Consumer durables	8,61 %	1,96 %	-0,08 %	-5,20 %	8,66 %	37,93 %	-2,22 %	-14,47 %	-8,05 %
Health	-11,11 %	-5,61 %	-4,52 %	14,28 %	3,50 %	29,57 %	27,38 %	54,45 %	1,56 %
US Treasury 20 yr	0,92 %	-2,14 %	-2,59 %	-2,37 %	1,32 %	5,69 %	3,27 %	3,16 %	-0,72 %
Silver		80,03 %	-17,73 %	64,04 %	-38,24 %	-9,82 %	-6,04 %	-31,93 %	-23,56 %
Energy							38,12 %	47,95 %	-30,82 %
Real estate	2,48 %	-0,87 %	-3,09 %	-3,88 %	-1,14 %	-4,21 %	-0,75 %	-7,36 %	-3,48 %
SMB	-11,66 %	10,24 %	4,96 %	8,48 %	6,45 %	18,65 %	-10,03 %	-1,81 %	4,09 %
Momentum	-8,03 %	-11,20 %	-6,15 %	30,91 %	-8,18 %	49,72 %	22,32 %	21,93 %	-9,28 %

The fact that method 2 captures a larger part of negative inflation surprises, is a general trend besides the two examples above. A falling inflation rate is good news for forward-looking stock investors. In addition, unemployment does in general lag real growth, which might result in the inflation rate decreasing below the threshold before the unemployment rate starts to accelerate above the threshold. Or the opposite: the unemployment rate is still relatively high when the inflation rate starts to accelerate, even though the growth is improving. These trends might explain why the methods report different results for the asset and strategies during the stagflation scenario. Additionally, method 1b classifies a larger part of the Great Inflation in the 1970s as stagflation where the stock market, in general, has a poor performance.

5.1.7 Linear regression as a robustness check

In this section, I analyze the parameters on linear regressions of asset returns on the inflation and unemployment rate for method 1b, and the inflation proxy and real growth proxy for method 2. OLS 1 includes only the two explanatory variables, while OLS 2 includes the explanatory variables as well as an interaction term. The objective is to check how robust the reported annualized real returns are.

Table 19: Linear regressions for methods 1b and 2.
Panel A shows the parameters for two linear regressions: OLS 1, in which each asset/strategy is included in a regression controlling for the inflation and unemployment rate from method 1b, and OLS 2, in which an intersection term between the two explanatory variables is included. Panel B shows the parameters for two linear regressions: OLS 1, in which each asset/strategy is included in a regression controlling for the inflation proxy and the real growth proxy from method 2, and OLS 2, in which an intersection term between the two explanatory variables is included. The robust standard errors are reported in parenthesis, and the parameters are marked with one, two, or three asterisks, depending on whether it is statistically different from zero at a 10%, 5% or 1% probability level, respectively.

A	OLS		B	OLS	
Strategy	**1**	**2**	**Strategy**	**1**	**2**
Equities (S&P 500)			**Equities (S&P 500)**		
Inflation	-0,439** (0,200)	-0,458* (0,157)	Inflation	-1,128** (0,638)	-1,458*** (0,596)
Unemployment	0,008 (0,246)	0,062 (0,200)	Real growth	-0,766 (1,010)	-0,545 (1,016)
Inflation*Unemployment		0,055 (0,270)	Inflation*Real growth		-1,323* (0,869)
Consumer durables			**Consumer durables**		
Inflation	-0,670*** (0,251)	-0,673*** (0,259)	Inflation	-1,833** (0,897)	-1,948** (0,838)
Unemployment	0,586*** (0,252)	0,597**(0,305)	Real growth	-2,531* (1,698)	-2,454* (1,832)
Inflation*Unemployment		0,001 (0,025)	Inflation*Real growth		-0,461 (1,505)
Health			**Health**		
Inflation	-0,547*** (0,177)	-0,565*** (0,182)	Inflation	-0,890 (0,837)	-1,294* (0,851)
Unemployment	-0,082 (0,177)	-0,029 (0,215)	Real growth	-1,691** (0,842)	-1,421** (0,801)
Inflation*Unemployment		0,053(0,122)	Inflation*Real growth		-1,621** (0,714)
US Treasury 20 yr			**US Treasury 20 yr**		
Inflation	-1,462*** (0,0956)	-1,366*** (0,096)	Inflation	-2,748*** (0,420)	-2,864*** (0,387)
Unemployment	1,793*** (0,178)	1,775*** (0,175)	Real growth	0,534 (0,647)	0,612 (0,627)
Inflation*Unemployment		1,504*** (0,021)	Inflation*Real growth		-0,467 (0,565)
Silver			**Silver**		
Inflation	0,098 (0,516)	0,064 (0,512)	Inflation	-0,087 (2,212)	1,154 (1,955)
Unemployment	0,526 (1,009)	0,610 (1,002)	Real growth	0,228 (2,316)	-1,226 (1,999)
Inflation*Unemployment		-4,777*** (1,600)	Inflation*Real growth		3,942** (1,988)
Energy			**Energy**		
Inflation	2,026** (1,231)	1,028 (1,474)	Inflation	3,248 (5,393)	4,396 (5,006)
Unemployment	0,402 (1.117)	-1,223 (1,262)	Real growth	5,342* (4,030)	7,565** (4,313)
Inflation*Unemployment		-7,741** (2,873)	Inflation*Real growth		4,619 (5,367)
Real estate			**Real estate**		
Inflation	-0,122*** (0,025)	-0,116*** (0,025)	Inflation	-248*** (0,067)	-0,246*** (0,068)
Unemployment	-0,128*** (0,046)	-0,128*** (0,046)	Real growth	0,503*** (0,135)	0,502*** (0,142)
Inflation*Unemployment		0,094* (0,074)	Inflation*Real growth		0,007 (0,099)
SMB			**SMB**		
Inflation	-0,183** (0,101)	-0,155* (0,104)	Inflation	0,262 (0,415)	0,274 (0,403)
Unemployment	0,351*** (0,101)	0,269*** (0,123)	Real growth	-0,623 (0,573)	-0,631 (0,549)
Inflation*Unemployment		-0,082 (0,070)	Inflation*Real growth		0,050 (0,560)
Momentum			**Momentum**		
Inflation	-0,139 (0,152)	-0,223* (0,156)	Inflation	0,625 (0,538)	0,469 (0,505)
Unemployment	-0,419*** (0,152)	-0,187 (0,183)	Real growth	1,594 (0,936)	1,699** (0,993)
Inflation*Unemployment		0,235** (0,104)	Inflation*Real growth		-0,625 (0,936)

When I analyze the impact of the growth dimension, I consider a negative parameter for unemployment to be consistent with a positive parameter for real growth. This is because a high unemployment rate and a low real growth rate both imply low economic activity. Additionally, since the explanatory variables are standardized the coefficient explains the effect of inflation (economic activity) on the asset return when the economic activity (inflation) is on average levels.

The importance of the inflation dimension for equity returns is confirmed by the OLS 1 and 2 for both methods, as the parameters for inflation are negative and significant. The parameters for the unemployment rate and real growth proxy are on the other hand all insignificant, indicating that variations in the economic activity level do not explain the variations in equity returns. However, for method 2, the interaction term between the inflation and real growth proxy is negative and significant at a 10% level. The effect of inflation on equity returns for OLS 2, method 2 can be written:

$$5) \quad R'(I) = -1{,}458 - 1{,}323growth$$

where R is the equity return and I is the inflation proxy. This implies that the effect depends on the level of the growth rate. A Z-score larger than zero results in an even more negative effect of inflation on equity returns. Likewise, the effect of real growth on equity returns for OLS 2, method 2 can be written:

$$6) \quad R'(A) = -0{,}545 - 1{,}323inflation$$

where R is the equity return and A is the real growth proxy. This suggests that an inflation rate above average results in a larger negative impact of real growth on equity returns. This result is in line with the results in Table 5, where the inflationary boom regime is the worst environment for equity returns. Also, an inflation rate below average indicates a negative Z-score, which will turn the last term in Equation 6 positive. Therefore, the overall effect of real growth on equity returns is positive for low values of the inflation rate.

The negative parameter for real growth can seem counterintuitive. However, a possible interpretation is that during booming times, the stock market might be overvalued. This implies a high demand for stocks and a low expected return. However, during bad economic times, the

market might be undervalued, which implies a low demand and a high expected return. The real growth rate is a lagging indicator of the economic activity level, while stock prices are forward-looking and therefore a leading indicator. This mismatch might amplify the effect: during bad economic times, the stock market might already expect brighter days and start to excel into the next stage of the business cycle.

Consumer durables also benefits from a disinflationary environment. In addition, the impact of the economic activity level is also negative and significant for both methods. This is intuitive: in bad economic times, consumers do not prioritize luxury goods like new cars, TVs, furniture, and household appliances. Also, the interaction term is negative, but not significant. These results are consistent with the real annualized results in Section 5.1.1, in which *consumer durables* really shine during disinflationary booms.

Inflation is bad news also for the *health* sector. The parameters for the unemployment rate and the interaction term for method 1b are all insignificant, while for method 2, the growth proxy, as well as the interaction terms, are negative and significant at a 5% probability level. This indicates that the real growth proxy does explain some of the quarterly variations in the health portfolio. A negative interaction term implies that a Z-score for real growth larger than zero amplifies the negative effect of inflation on the *health* portfolio returns, and a Z-score for inflation larger than zero amplifies the negative impact of increasing real growth.

The impact of inflation on the real yield for the *20-year Treasury bond* is clearly negative and significant at a 1% probability level for both methods. In contrast, it is only for method 1b that the economic activity level has a significant effect on the real yield. An increasing unemployment rate is good news for the real yield. A positive interaction term suggests that: as inflation increases, the greater is the effect of real growth on the real yield, and as the growth increase, the greater is the effect of inflation on the yield.

For *silver*, none of the parameters are significant for either of the methods unless the interaction between inflation and economic activity level is controlled for. When I include the interaction in the regression, both methods agree on the parameter signs, but, only the interaction term is significant. The result implies that inflation is good news for the commodity returns, while an increasing economic activity level is bad news. A positive interaction for method 2 and a negative interaction for method 1 suggests that an increasing economic activity level amplifies

the positive effect of inflation. Meanwhile increasing inflation reduces the negative effect of real growth on *silver* returns. Method 2, Table 10, reports higher annualized real returns during disinflationary times, which is not consistent with this finding. However, the inflation parameter for *silver* is insignificant, and the standard deviation is large.

The result for *energy* is not consistent between methods 1b and 2. Both report a positive relationship between inflation and *energy* returns, however, for method 2 the parameter is not significant due to a high standard deviation. The parameter for real growth is positive and significant according to method 2. For method 1b, the interaction term is negative and significant. In general, the large standard deviations for commodities return makes it difficult to draw any clear conclusions regarding the impact of growth and inflation on returns.

In contrast, the results for *residential real estate* are clear and consistent between the two methods. Increasing inflation is bad news for *residential real estate*, while an increasing activity level is good news for returns. This should imply that booming disinflationary times are the best environment for *residential real estate* and inflationary stagnation the worst. This is the case for method 2 in Section 5.1.4.

For *SMB* method 2, none of the coefficients are significant, while method 1 reports a negative significant impact of both inflation and higher economic activity level. This is in line with the results for the annualized real return during the four regimes in Section 5.1.5, for method 1b. Nevertheless, method 2 only agrees on the negative impact of increasing economic activity. Anyhow, *SMB* generates positive annualized returns during both inflationary and disinflationary stagnations.

The two methods do not agree on the impact of inflation on *momentum*. However, the standard deviations are large and the parameters insignificant, except for OLS 2 for method 1b. Nevertheless, both reports a positive impact of a higher activity level. This is consistent with the results in Section 5.1.5 where *momentum* generates high returns during booms in disinflationary times. However, the strategy also generates relatively high returns during inflationary stagnations.

5.2 Part 2: Cost-push and demand-pull inflation

In this section, I tabulate the performance of each asset class or strategy for all periods and the cost-push and demand-pull regimes in the left part of the tables. The right part of the tables shows the hit rate and the t-statistics. I emphasize the results of the cost-push regime due to the predominance of supply-side disruptions during the current inflationary period.

5.2.1 Equity

The results in Table 20 state that inflation, independent of whether it is cost-push or demand-pull inflation, reduces the real equity returns. The annualized real return of the *S&P 500* is -9,13% during the push-inflation regime and -3,05% in the demand pull regime, which both are significantly below the average return. All of the equity portfolios perform better during demand-pull than cost-push inflation, with the exception of the *energy* portfolio. *Energy* is the only portfolio that generates positive returns during cost-push inflation. This might be associated with the fact that energy price spikes often drive the commodity basket price rise during cost-push regimes, which are often caused by energy shocks or wars that accelerate energy prices. Sectors depending on the purchasing power of individual consumers do worst during cost-push regimes, such as *retail* and *consumer durables*, as well as *technology*. For the demand-pull regime, *energy*, *consumer non-durables,* and *health* all generate positive annualized real returns, while *consumer durables* is the worst performer.

Table 19: Equity returns during cost-push and demand-pull regimes.
The first three columns show the annualized real return for the *S&P 500* and 12 equity portfolios for all periods and the cost-push and demand-pull inflationary regimes. The best (worst) performers for each regime are shown in green (pink) cells. The last four columns show the hit rate and the t-statistic for the assets for the cost-push and demand-pull regimes. The hit rate is the percentage of sub-periods within each regime with positive returns, while the t-statistic tests whether the mean return in each regime is significantly larger than the mean return for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	All periods	Cost-push	Demand-pull	Cost-push		Demand-pull	
	Average real annual returns			Hit rate	t stat	Hit rate	t stat
Equities (S&P 500)	7,24 %	-9,13 %	-3,05 %	33 %	-3,62***	33 %	-2,27**
Consumer non-durables	7,67 %	-13,22 %	3,04 %	33 %	-3,76***	67 %	-0,73
Consumer durables	7,79 %	-13,66 %	-12,37 %	33 %	-3,00**	0 %	-2,86**
Manufacturing	7,26 %	-10,49 %	-3,69 %	33 %	-2,96**	0 %	-1,63*
Energy	7,16 %	5,55 %	1,70 %	50 %	-0,21	67 %	-0,90
Chemicals	7,78 %	-8,42 %	-2,75 %	33 %	-2,63***	33 %	-1,65**
Business equipment (Tech)	7,98 %	-13,74 %	-3,89 %	33 %	-3,53***	33 %	-1,63*
Telecoms	6,18 %	-12,18 %	-1,43 %	17 %	-4,45***	33 %	-1,23
Utilities	6,00 %	-11,78 %	-1,59 %	33 %	-3,27***	33 %	-1,66**
Retail	7,71 %	-16,44 %	-1,48 %	33 %	-3,77***	33 %	-1,28*
Health	8,57 %	-6,74 %	4,44 %	17 %	-2,11**	67 %	-0,70
Financials	6,83 %	-9,94 %	-6,31 %	33 %	-2,63***	33 %	-1,79**
Other	4,96 %	-11,40 %	-4,95 %	50 %	-2,39***	0 %	-1,33*

5.2.2 Fixed income

During cost-push inflation, the real yield is significantly lower than average, independent of duration and credit ranking. Additionally, the real yield is negative during the regime for all bonds, except the *medium grade credit*, indicating that the inflation rate exceeds the bond yields. In contrast, during demand-pull inflation, the real yield is positive and significantly above average for *1-year* and *10-year Treasuries* as well as *investment grade credit*. One contribution to this large difference might be that the annualized inflation rate for the cost-push regime is on average larger. The annualized inflation rate is about 11% for the cost-push regime and 4,80% during the demand-pull regime, on average. Yields are also affected by monetary policy changes, which might be different depending on the underlying cause of inflation.

Table 20: Bond yields during cost-push and demand-pull regimes.
The first three columns show the average real yield for the US Treasuries with durations of 1-year, 10-years, and 20-years, as well as investment grade and medium grade credit for all periods and the cost-push and demand-pull inflationary regimes. The last two columns show the t-statistic for the treasury and corporate bonds, that test whether the mean yield in each regime is significantly larger than the mean yield for all periods. The t-statistic is marked with one, two, or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	All periods	Cost-push	Demand-pull	Cost-push	Demand-pull
	Average real annual returns			t stat	t stat
US Treasury 1 yr	1,15 %	-0,86 %	2,02 %	-7.42***	5,06***
US Treasury 10 yr	2,09 %	-0,76 %	2,42 %	-10,80***	1,85**
US Treasury 20 yr	2,32 %	-0,56 %	2,40 %	-11,58***	0,41
Investment grade (AAA)	2,74 %	-1,88 %	3,09 %	-11,95***	1,73**
Medium grade (BAA)	3,85 %	1,06 %	3,96 %	-12,45***	0,56

5.2.3 Commodities

In the commodity analysis for cost-push and demand-pull inflation, I only include series starting in 1970 and 1973. The commodities *energy*, *gold,* and *industrial metals* are excluded because of limited history on the return data, and therefore few observations for cost-push inflation regimes.

Table 22 confirms that inflation is good news for commodity returns in general as the return for the S&P Goldman Sachs commodity index generates a significantly larger return during inflationary times, independent of the underlying cause. During the cost-push inflation regime, *silver* is the winner with a significant average return of 42,67%, and *precious metals* and *agriculture* follows close behind. *Livestock* does not, however, generate a significantly larger than average return during this regime. In contrast, during the demand-pull regimes, *precious*

metals and *silver* do not perform well, while *agriculture* and l*ivestock* generate a positive moderate return. However, none of the specific commodity returns during demand-pull regimes are statistically significant. Considering the analyzed commodities, I conclude that cost-push inflation is a better environment for most commodity classes, besides *livestock*. Even though *energy* is not included as a commodity index I expect high *energy* returns during cost-push inflation regimes as it is often associated with energy shocks, and the *energy equity portfolio* performs well.

Table 21: Commodity returns during cost-push and demand-pull regimes.
The first three columns show the annualized real return for eight of the S&P Goldman Sachs commodity indexes for all periods and the cost-push and demand-pull inflationary regimes. The best (worst) performers for each regime are shown in green (pink) cells. The last four columns show the hit rates and the t-statistics for the assets for the cost-push and demand-pull regimes. The hit rate is the percentage of sub-periods within each regime with positive returns, while the t-statistic tests whether the mean return in each regime is significantly larger than the mean return for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	All periods	Cost-push	Demand-pull	Cost-push		Demand-pull	
	Average real annual returns			Hit rate	t stat	Hit rate	t stat
Commodities (all)	2,91 %	27,23 %	33,25 %	100 %	2,29**	100 %	2,81***
Silver	0,18 %	42,67 %	-2,45 %	67 %	2,16**	50 %	-0,31
Precious metals	2,33 %	34,03 %	1,52 %	67 %	2,11**	50 %	-0,18
Livestock	1,40 %	3,80 %	10,07 %	33 %	0,41	50 %	1,12
Agriculture	-0,52 %	35,54 %	5,08 %	100 %	2,96***	100 %	0,38

5.2.4 Residential real estate

Like most commodity classes, *residential real estate* performs better during cost-push than demand-pull inflation. The real annualized return is negative and significantly lower than average in the demand-pull regimes. In contrast, during the cost-push regimes, it is positive and larger than the average return for all periods. I, therefore, conclude that *residential real estate* is an inflation hedge during cost-push inflation regimes.

Table 22: Real estate returns during cost-push and demand-pull regimes.
The first three columns show the annualized real return for the S&P Case Shiller house price index for all periods and the cost-push and demand-pull inflationary regimes. The best (worst) environment for real estate return is highlighted in green (pink) cells. The last four columns show the hit rates and the t-statistics for the assets for the cost-push and demand-pull regimes. The hit rate is the percentage of sub-periods within each regime with positive returns, while the t-statistic tests whether the mean return in each regime is significantly larger than the mean return for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	All periods	Cost-push	Demand-pull	Cost-push		Demand-pull	
	Average real annual returns			Hit rate	t stat	Hit rate	t stat
Residential real estate	1,03 %	1,92 %	-1,88 %	67 %	1,12	0 %	-4,74***

5.2.5 Dynamic equity strategies

Table 24 reports *CMA* as the winner during cost-push inflation within the class of equity factor strategies with a real return of 3,95%. Close behind follows *momentum* and *HML* which also generates positive returns during this regime. In contrast, *SMB* and *BAB* are the worst performers with significantly lower than average returns during the cost-push scenario. For the demand-pull scenario, *momentum* and *QMJ* generates returns significantly above average, while *HML* is the worst performer. Overall, the performance of the equity factor strategies is somewhat better during demand-pull than cost-push inflation.

Table 23: Equity strategy returns during cost-push and demand-pull regimes.
The first three columns show the annualized real return for seven long/short equity strategies for all periods and the cost-push and demand-pull inflationary regimes. The best (worst) performers for each regime are shown in green (pink) cells. The last four columns show the hit rates and the t-statistics for the strategies for the cost-push and demand-pull regimes. The hit rate is the percentage of sub-periods within each regime with positive returns, while the t-statistic tests whether the mean return in each regime is significantly larger than the mean return for all periods. The t-statistic is marked with one, two or three asterisks, depending on whether it´s significant at a 10%, 5% or 1% probability level, respectively.

	All periods	Cost-push	Demand-pull	Cost-push		Demand-pull	
	Average real annual returns			Hit rate	t stat	Hit rate	t stat
SMB - 'Size'	0,04 %	-8,67 %	-0,57 %	17 %	-2,42***	33 %	-0,19
HML - 'Value'	1,76 %	1,71 %	-0,82 %	50 %	-0,04	33 %	-1,07
RMW - 'Profitability'	1,63 %	-3,01 %	3,09 %	33 %	-1,52*	100 %	0,56
CMA - 'Investment'	1,71 %	3,95 %	1,65 %	67 %	0,77	33 %	-0,03
Momentum	4,50 %	3,16 %	11,90 %	50 %	-0,42	100 %	1,36*
BAB (Bet-against-Beta)	5,80 %	-4,09 %	-0,04 %	17 %	-3,37***	33 %	-1,66**
QMJ (Quality - Junk)	2,74 %	-0,81 %	6,30 %	33 %	-1,10	100 %	1,43*

5.2.6 Return variation between regimes

In this section, I investigate whether the separation into cost-push and demand-pull inflation reduces the return variations between specific regimes reported by Neville et al. (2021) for some of the asset classes and investment strategies. Examining the return variations in Table 25, I find a general trend of larger return variations during cost-push than in demand-pull regimes. Even though there are more regimes classified as cost-push than demand-pull, I consider the reduction in return volatility to be too significant for fewer regimes to be the only explanation. For the *S&P 500*, *consumer durables,* and *health*, the variation in returns is barely reduced or not reduced at all for the cost-push regime. In contrast, the reduction is significant for all the included equities during demand-pull regimes, and especially for *durables* in which the regime span is only 9,15 percentage points. This suggests a higher equity return volatility during cost-push regimes.

The range for the difference in the average real yield between regimes is about 3,5 percentage points for both cost-push and demand-pull regimes. This span is relatively smaller than the regime variation range identified for the separation into inflationary booms and stagnations. Implying that the cost-push and demand-pull classification is a more valuable indicator of the real yield level. For *silver*, the real return variation increases considerably during the cost-push and demand-pull separation due to the extreme return of 487,34% during the Iranian revolution. Neville et al. (2021) report a real return of 210% for *silver* during the same period. The result differs due to differences in regime start date and different data sources for the commodity real return history. For the other regimes, returns do not differ in such a large extent. Anyhow, this regime drives the high average annualized return for *silver* of 42% during cost-push inflation regimes. This example highlights the limitation of commodities as inflation hedges. Even though *silver* has performed well during some inflation surges, it is still very volatile. Therefore, the assumption of high returns also during the current inflation regimes is uncertain.

The variation in returns for *residential real estate* is reduced by about 7% during cost-push regimes and about 15% for the demand-pull regime. This indicates that the difference between cost-push and demand-pull inflation can explain some of the variation in *residential real estate* returns during different inflationary surges. For the equity strategies, the return variation for *SMB* and *momentum* is not reduced for the cost-push inflation regimes. However, the general trend of lower return variations during demand-pull inflation regimes is present also for the equity factor strategies.

Table 24: Total returns for specific cost-push and demand-pull regimes.
The table shows the total real return during the specific cost-push and demand-pull inflationary regimes for multiple asset classes, as well as the total price level change during each sub regime.

	Cost-push						Demand-pull		
Start month	Apr 1941	Mar 1946	Aug 1950	Aug 1972	Des 1976	Mar 2021	Feb 1966	Mar 1987	Sep 2007
End month	May 1942	Mar 1947	Apr 1951	Nov 1974	Mar 1980	Feb 2022	Feb 1970	Oct 1990	Jul 2008
Total price level chg	14,70 %	21,57 %	7,69 %	22,91 %	37,87 %	7,91 %	19,51 %	19,32 %	5,46 %
Length (mths)	14	13	9	28	40	12	49	44	11
Strategy									
Equities (S&P 500)	-24,17 %	-27,40 %	24,18 %	-40,98 %	-11,73 %	11,29 %	-10,92 %	3,12 %	-16,78 %
Consumer durables	-16,01 %	-32,64 %	28,94 %	-59,28 %	-23,97 %	7,09 %	-26,70 %	-32,20 %	-35,85 %
Health	18,01 %	-8,52 %	30,93 %	-41,48 %	-5,75 %	-5,96 %	31,18 %	18,25 %	-6,07 %
US Treasury 20 yr				-0,17 %	-0,03 %	-3,44 %	1,41 %	3,99 %	0,41 %
Silver				92,64 %	487,34 %	-20,90 %		-32,33 %	31,93 %
Real estate				-8,42 %	12,70 %	9,81 %	-2,37 %	-0,22 %	-12,93 %
SMB	-11,39 %	-23,17 %	-6,73 %	-38,26 %	41,23 %	-24,26 %	40,20 %	-28,37 %	-5,19 %
Momentum	-14,79 %	-18,10 %	8,63 %	31,46 %	49,95 %	-9,81 %	34,28 %	53,96 %	26,98 %

6 Conclusion

My analysis confirms that equities and bonds are especially sensitive to high inflation levels. *Energy*, *health* and *consumer non-durables* are the only investment portfolios that generate positive real returns during inflationary stagnation for both methods. In contrast, most commodities are positively related to inflation, and all commodities, except *silver*, *industrial metals,* and a*griculture* generate positive returns during stagflation. *Residential real estate* is, however, not an inflation hedge, particularly not combined with bad economic times. All equity factor strategies perform well amidst inflation, especially during stagnation with *momentum* as the clear winner. I find that the results for the real annualized returns are robust for equities, bonds, and *residential real estate*, however, for *silver, energy, SMB,* and *momentum* the impact of inflation and stagnation is less clear.

Examining whether the inflation is cost-push or demand-pull driven shows that equities in general, are considerably worse off during cost-push regimes. All the equity portfolios generate negative returns during cost-push inflation, except the *energy* portfolio. For fixed income securities, I find the same pattern. All real yields are negative, except the *medium-grade credit*. In contrast, *silver*, *precious metals*, and *agriculture* generate positive, significantly above average real returns during cost-push inflationary regimes. Additionally, *residential real estate* generates somewhat positive real returns. The equity factor strategies do in general not perform well and only *CMA*, *momentum* and *HML generate* positive real returns during the cost-push regimes.

To summarize: *energy, precious metals, HML*, *CMA* and *momentum* generates positive real returns during the cost-push inflationary regime as well as during inflationary stagnation for both method 1b and 2. Commodities clearly generate the highest real returns during inflationary regimes. However, the finding of relatively high return variations between specific inflationary regimes creates uncertainty and limits the asset hedging ability. The *energy* portfolio and equity factor strategies have a lower return variability, which might make them more attractive inflation hedges.

6.1 Limitations and extensions

Investors are more sensitive to permanent than temporary inflation shocks. Using the change in the rate of inflation as a measure for unexpected inflation has a limitation: it does not separate

temporary from permanent inflation spikes. Additionally, I consider asset returns from short-term holding periods, which may differ from the long-term return. Furthermore, my asset return calculations do not account for the fact that returns may vary within each defined regime and across time due to structural changes in the economy. For instance, the green shift predicts increased regulation of the energy sector, which may reduce its future profitability. Future uncertainty implies that realized returns are not a perfect proxy for expected returns. My analysis can be extended by considering asset returns from longer holding periods as well as ex-ante indicators, which are forward-looking.

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Appendix

The 12 Industry Portfolios

The following definitions of the industry portfolios are described on the Kenneth R. French's website: *consumer nondurables*; food, tobacco, textiles, apparel, leather and toys, *consumer durables;* Cars, TVs, furniture and household appliances, *manufacturing*; machinery, trucks, planes, off furn, paper and com printing, *energy;* oil, gas, and coal extraction and products, *business equipment (tech)*; computers, software, and electronic equipment, *telecoms;* telephone and television transmission, *retail;* wholesale and some services (laundries, repair shops), *health;* healthcare, medical equipment and drugs, *others;* mines, construction, hotels, bus service, entertainment, trans and BldMt. *chemicals* and allied products, *finance* and *utilities*, are not further defined.

The equity factor strategies

The Fama/French factors are described on the Kenneth R. French website, and constructed using different combinations of 18 value-weighted portfolios. The first 6 are formed on size and book-to-market, the next 6 are formed on size and operating profitability, and the last 6 are formed on size and investment. The *SMB* factor represents the average return on the nine small stock portfolios minus the average return on the nine big stock portfolios, while the *HML* factor is the average return on the two value portfolios minus the average return on the two growth portfolios. The *RMW* strategy goes long the two robust operating profitability portfolios and short the two weak operating profitability portfolios, while *CMA* goes long the two conservative investment portfolios and short the two aggressive investment portfolios. *Momentum* is constructed using 6 value-weighted portfolios formed on size and prior (2-12) returns. It is the average return on the two high prior return portfolios minus the average return on the two low prior return portfolios.

The *QMJ* factor is constructed at the intersection of six value-weighted portfolios formed on size and quality. The strategy goes long high-quality stocks and short low-quality stocks, in which quality is based on measures of profitability, growth, safety and payout (Asness et la. 2019). The *BAB* strategy represents holding low-beta assets, leveraged to a beta of one, while shorting high-beta assets, de-leveraged to a beta of one (Frazzini & Pedersen, 2014).

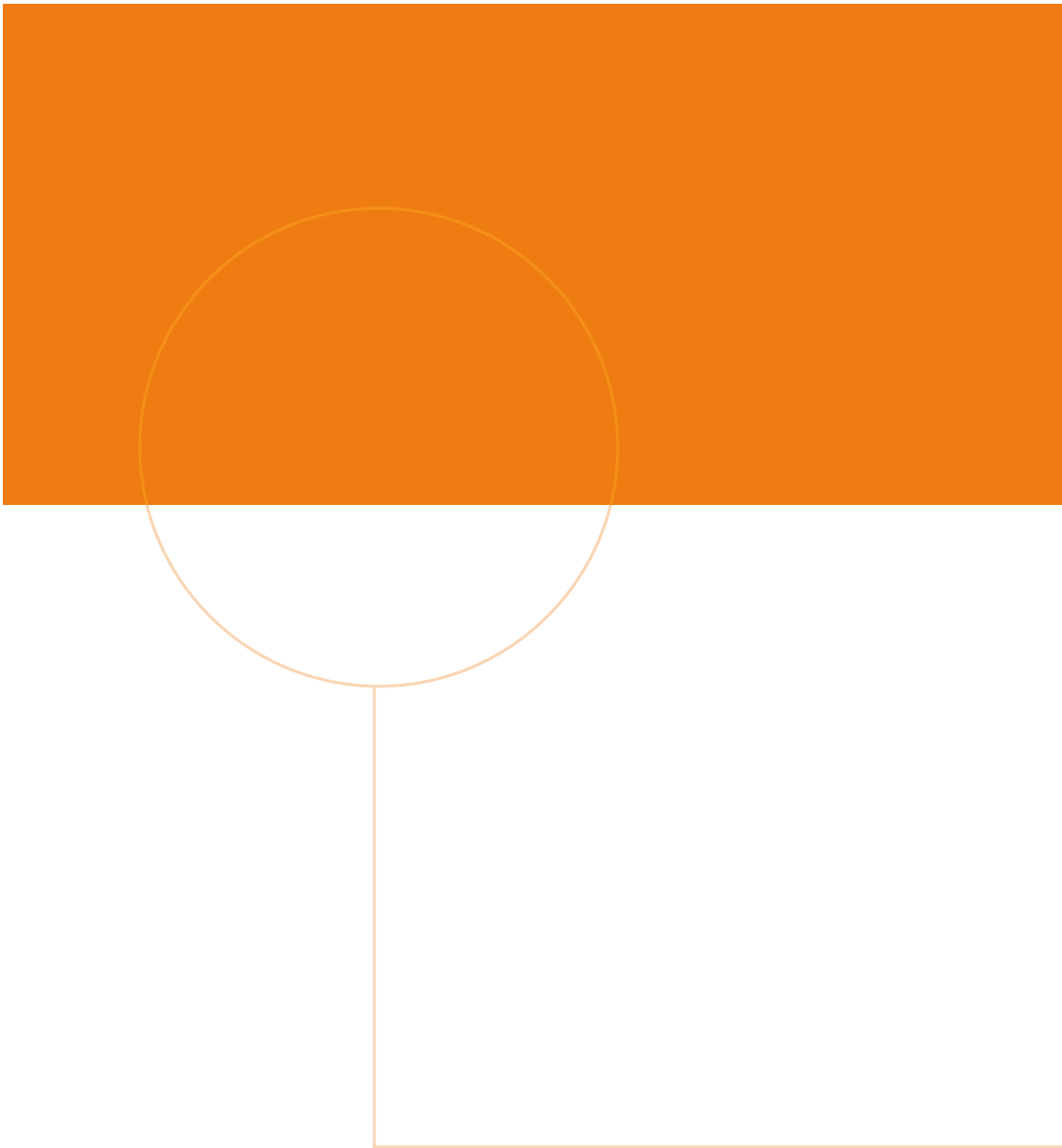
Tables

I use the critical value of Student´s t-distribution for a 1%, 5% and 10% probability level and a large sample size, which are equal to 1,28, 1,65 and 2,33, respectively (Brooks, 2019 s. 802). T-statistics larger than 1,28 in absolute value are considered statistically significant and marked with *, ** or *** in the tables, depending on which level the parameter is significant.

The reported t statistics is the heteroscedasticity-consistent t statistic on a regression of monthly returns to the asset on a constant plus a dummy variable which switches between 1 to indicate when we are in a specific regime, for instance, inflationary boom, and 0 when we are not. This is done independently for each regime.

When I calculate the t-statistic for each regime I add the constant to the parameter value to find the average return during the specific regime, then I subtract the average return for the entire period. This, to find out whether the return is significantly larger/smaller than the average value. I use robust standard errors to make it heteroscedasticity consistent. The following formula is used to calculate the t-statistics for each of the four regimes for all of the asset classes.

$$t_i = \frac{(constant_i + paramter_i) - average_i}{robust\ std.err._i} \qquad i = 1,2,3,4$$



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