Investing in deflation, inflation, and stagflation regimes[1]

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Abstract

We examine asset class and factor premiums across inflationary regimes. As periods of high inflation and deflation are relatively uncommon in recent history, we use a deep sample starting in 1875. Moderate inflation scenarios provide the highest returns across asset class and factor premiums. During deflationary periods, nominal returns are low, but real returns are attractive. By contrast, real equity and bond returns are negative during a high inflation regime, and especially so during times of stagflation. During these 'bad times' factor premiums are positive, which helps to offset part of the real capital losses.

Keywords: Inflation, deflation, stagflation, equity returns, bond returns, factor premiums.

JEL Classification: G11, G12, G15, E31, E32

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1. Introduction

High inflation has always been a worry for investors, but inflation has been very stable around 2% and never exceeded 4% during the past 30 years. Investors have become accustomed to low and stable inflation in which real returns are close to nominal returns. However, the strong global spike in consumer price inflation after the Corona crisis of 2020 and the following fears of stagflation has substantially increased questions about the impact of inflation on risk premiums and investment strategies. Related, deflation commonly follows periods of high inflation. An important question, hence, is how risk premiums and investment strategies behave across inflationary regimes like periods of high inflation, deflation, or stagflation. In this paper we examine such relationships robustly utilizing the deepest sample available for a relatively broad cross-section of asset class and factor portfolio starting in 1875.

There are two key challenges when it comes to examining the inflation sensitivity of investment returns. First, there have been few periods of elevated inflation rates in the past 50 years. Most evidence is derived from the inflationary period following the oil price shocks in the 1970s, a period that spans relatively little independent observations. This holds especially for regimes that combine inflation and macroeconomic growth, such as stagflation with less than a handful of annual observations since the 1970s. In a similar spirit, deflation could be as much as a risk for investors as inflation, but deflation has been virtually absent the past 50 years. Second, limiting the menu of assets to long-only investments in conventional asset classes and ignoring factor premiums does not show the full potential of asset allocation to deal with large economic shocks; see for example Ilmanen and Kizer (2012).[2]

To overcome these challenges, we start by building an extensive historical database that includes a wide range of inflationary regimes while still having high quality data on asset class and factor returns. For asset class premiums we combine several global datasets on equities, bonds, and cash returns. For factor premiums we use data from three key studies that construct equity, bond, and global factor premiums back to the 19th century, which we update to the end of 2021.[3] We consider four investment factor premiums: Value, Momentum, Low-risk, Quality or Carry applied in three

[2] Several authors have examined the inflation-hedging characteristics of a variety of asset classes over different investment horizons; see, e.g., Froot (1995), Schotman and Schweitzer (2000), Martin (2010), Crawford, Liew, and Marks (2013), and Podkaminer, Tollette, and Siegel (2022). These studies typically focus on the U.S. instead of global markets and examine considerably shorter sample periods than we do.

[3] For equity factors, we use the dataset on U.S. equity factors compiled by Baltussen, Van Vliet, and Van Vliet (2022), combined with data from Wahal (2019). For bond market factors, we use data from Baltussen, Martens, and Penninga (2022) on global government bond factor premiums. For global ('cross-asset') factor premium we use the dataset compiled by Baltussen, Swinkels, and Van Vliet (2021).

markets: equities, bonds and across global markets. Some of these 12 factor-return series start as early as 1800, but the availability of monthly global inflation series limits the start of our sample to 1875. Using this 147-year sample provides the most testing power and robustness to examine the performance of asset classes and factors premiums during various inflationary regimes.

We start our analysis by examining asset class (equities, bonds, and cash) returns and factor returns within and across asset classes over our deep sample. We show the global equity return has been on average 8.4% (in arithmetic terms) between 1875 and 2021, while the global bond market return (currency risk hedged) has been 4.5%. For comparison, global inflation has been on average 3.2% per annum over the same period. Value, Momentum, Low risk or Quality/Carry factors also returned attractive and significant returns above 4%, providing substantial alpha over traditional asset classes. The average multi-factor factor combination delivers significant alphas on top of asset returns with t-values above 7.9 over this full sample period. In other words, asset class and factor returns are strong and consistent 'empirical facts', with factor premiums offer materially value added to asset class premiums.

Next, we consider annual investment performance over various inflationary regimes. In our core analyses we divide our sample in various ex-post inflation regimes and examine the average returns during each regime. As our base-case we divide our sample in four economically motivated global inflation regimes: (1) below 0%, or deflation, (2) between 0% and the current central bank target of 2%, (3) a mild inflation overshoot, between 2% and 4%, and (4) high inflation, above 4%. Note that this is more granular than the high/low inflation regime with an entry threshold of 5% as used in Neville, Draaisma, Funnell, Harvey, and Van Hemert (2021).[4] Each of our four regimes constitutes about 20% to 30% of the observations.

Our findings show asset class premiums vary significantly across these inflationary regimes in both nominal and real terms. Equities and bonds on average yield lower nominal returns during periods of high inflation, causing *negative* real returns. Further, equity returns tend to be relatively low in nominal terms in periods of deflation, but average in real terms. By contrast, equity, bonds, and global factor premiums are generally consistently positive across inflationary regimes, displaying generally no significant variation across, while they enhance nominal and real asset class returns in (approximated) long-only asset class implementations. We show these results are robust across different definitions of inflationary regimes, including a 3% or 5% (instead of 4%)

[4] More specifically, Neville et al. (2021) roughly define inflationary times as those periods when YoY realized inflation rises above 5% or has not fallen back below 50% of its peak over a rolling 24-months window.

high inflation cutoff, the use of annual changes in inflation (or unexpected inflation), the use of only U.S. (instead of global) inflation, or the use of 3-years (instead of 1-year) horizons.

We continue by dividing inflationary regimes in several sub-regimes based on macroeconomic or market performance and inflation dynamics, most notably for high inflation. This includes stagflationary episodes with both high inflation and economic downturns (i.e., recessions). We find that especially the periods of stagflation are truly bad times, as for example nominal equity returns average -7.1% per annum, yielding double digit negative returns in real terms. During the bad times, equity, bond, and global factor premiums remain consistently positive. As such, factors help to offset some, but not all, of the negative impact of high inflation in recessionary times. We consider a variety of 'stagflationary' sub-regimes definitions, including recessions, falling earnings growth, or falling equity markets, and find mostly consistent results across these times. Further, we examine sub-regimes based on increasing and decreasing long-term interest rates or increasing and decreasing inflation rates. Overall, stagflationary episodes, inflationary bear markets or rising inflationary times, and to a lesser extent deflationary bear markets are bad times for investors and factor premiums alleviate some of the pain during these regimes.

The remainder of this paper is organized as follows. Section 2 describes our inflation sample and dynamics over time. Section 3 outlines our investment sample and examines the long-run evidence on asset class and factor premiums. In Section 4, we examine the performance of asset classes and factor premiums over inflationary regimes, while in Section 5 we distinguish business cycle as well as other sub-regimes. Finally, Section 6 concludes.

2. A long history of inflationary and deflationary times

In this section we examine inflation dynamics and regimes over time, starting in 1875 and ending in 2021. To measure inflation, we primarily use year-on-year changes in Consumer Price Indices (CPI).[5] The primary source of inflation data is Datastream, which we backfill with inflation data from Global Financial Data (GFD) and MacroHistory before availability in Datastream. The monthly inflation data series starts in January 1875 for each of the following countries that we consider: United States, United Kingdom, Germany, France, and Japan. Following Cagan (1956) and Baltussen, Swinkels and Van Vliet (2021), we exclude hyperinflation periods from our sample

[5] We choose to focus on CPI as core measure of inflation instead of GDP deflators, as the former measures inflation average prices of the typical expenditure basket of an urban consumer and is typically considered as the headline number by investors, while GDP deflators focus on average prices of domestically produced final goods and services within an economy.

by excluding periods for which the annual inflation number is above 50% and start including again 12 months after the hyperinflation period has ended. Note that this screen is based on real-time available information. We choose to exclude these hyperinflation periods as they are very rare and special episodes that come with large measurement noise and risks for investors that they typically choose to exclude. This affects especially Germany during the post-World War I period 1920-1926 and Japan during the post-World War II period 1946-1950. From the resulting series we construct a global inflation measure by equally weighting across markets (but later verify robustness to using only U.S. inflation numbers).

[INSERT FIGURE 1 HERE]

Figure 1A shows the U.S. and global inflation series over the sample period from January 1875 to December 2021 together with NBER recession periods. Several observations are noteworthy. First, U.S. and global inflation behave very much alike. Second, inflation varies substantially over time, with several periods of high inflation – like during the 1880s, after World War I, around World War II, during the 1970s, and more recently – but also periods of deflation – typically after periods of high inflation (especially before World War II). Third, inflation is more volatile in the period before the 1970s, which for a large part was dominated by currencies that were tied to gold or silver. Inflationary episodes in times of the gold standard generally correspond to times during which convertibility to gold was suspended to meet demand for additional government revenue, after which convertibility was reinstated and prices deflated to initial levels. For the U.S., the period until 1900 shows one short-lived inflation peak up to 10% but was on average deflationary. The following period until World War I showed mild positive inflation around 3%.[6] The period in between both World Wars was deflationary. After World War II, the 1970s and early 1980s are further periods with high and persistent inflation.

It is unlikely that investors care about transitory spikes in inflation that are expected to reverse in the next year when they price assets with long-term cash flows such as equities and bonds. Therefore, Figure 1B shows the rolling three-year global inflation rate in addition to the annual global inflation rate. This figure again shows that before World War I, inflation was noisier and averaging over longer periods of time reduces the volatility of inflation substantially. However, after World War I, averaging has limited effect, as inflation and deflation spikes tend to be more persistent.

[6] Barsky and De Long (1991) investigate U.S. inflation expectations in the period before World War I and conclude that they may have been related to increased gold production.

Table 1 summarizes the distribution of inflation over our sample. Panel A buckets global inflation into four inflation regimes: (1) below 0%, or deflation, (2) between 0% and the current central bank target of 2%, (3) a mild inflation overshoot, between 2% and 4%, and (4) high inflation, above 4%, and reports the number of years of inflation observations in each bucket. The midpoint between (2) and (3) was chosen because 2% is the current target of many central banks in major developed markets. As such, we focus on periods of negative inflation, inflation that realizes low relative to 'target' (0-2%), inflation that overshoots the target (2-4%) – in 2021 an inflation level of 3% was seen by several investors as a material worry[7] – and inflation that is substantial (>4%).

Over the entire sample period (1875-2021), there have been 23.1 years of deflation and 46.1 years with inflation above 4%. The subperiod analysis also shows that examining the most recent 30 years does not yield much information about deflationary or inflationary periods, as inflation has almost always been in the range of 0% to 4%. Including the 1970s gives a period of high inflation, but one needs to include the 1930s to also have a substantial number of deflationary periods. Extending the sample to 1875 increases both the number of years with high inflation during and after World War II, and with deflation at the end of the 19th century. Hence, extending the period to 1875 gives a more reliable assessment of what investors can expect during periods of deflation or high inflation. Panel B confirms these insights for U.S. inflation. Panel C contains more information about the distribution of inflation. The median value of annual inflation equals 2.3% for global and 2.2% for U.S. inflation. At the 10th percentile, there is a -1.4% and -2.4% deflation, respectively. At the other end, the 90th percentile is an inflation of 8.9% and 7.2%, respectively. Further, between 19% (deflation) and 29% (0-2% inflation) of observations fall within each inflation regime.

[INSERT TABLE 1 HERE]

Central banks existed for most of our sample period. The U.S. Federal Reserve was founded in 1913, the Bank of England in 1694, the German Bundesbank in 1957 (its predecessor in 1948, and before World War II the Reichsbank in 1876), and the Bank of Japan in 1882. Their mandate to curb inflation to a pre-determined level is a relatively recent phenomenon, mostly introduced after the inflation shocks in the 1970s. Explicit inflation targeting was only started in the 1990s; see Svensson (2011). Hence, we have to leave the impact of inflation targeting policies on the relationship between inflation and asset returns open. The lack of inflation targeting by central banks does not mean that investors did not care about deflation or inflation when judging stock

[7] See, for example, The Guardian (24 June 2021) "Recovery likely to push inflation above 3% by end of year, says Bank".

and bond markets. This follows from a simple count of words measure of inflation- and deflation-related words as mentioned in the Abreast of the Market columns of the Wall Street Journal and related market commentary columns in the New York Times as used by Garcia (2013), which we acquire between 1899 and 2021. Figure 2 shows the relative importance of inflationary minus deflationary words per rolling annual window, computed by the standardized relative word frequencies.[8] A value of 1 (-1) indicates inflation (deflation) words were commonly mentioned during that year in the market commentaries (i.e., they were 'topical'), while a value of 0 indicates less investor consideration of inflation. This figure shows that also before the inflation spikes in the 1970s, inflation was an important finance topic during periods with elevated inflation, and deflation was topical in deflationary periods. When regressed on U.S. inflation the R^2 equals 51%. This evidence indicates that market participants were indeed aware of increases and decreases of consumer prices and linked it to asset prices.

[INSERT FIGURE 2 HERE]

3. Long run evidence on asset class and factor premiums: 1875-2021

In this section, we examine asset class returns and factor returns within and across asset classes over our deep sample. Our dataset is at the monthly frequency and includes global and local equities, bonds, and cash returns, equity factor returns (Value, Momentum, Low risk, and Quality), government bond factor returns (Value, Momentum, Low risk, and Carry), and global factor returns (Value, (Time-Series) Momentum, Low risk, and Carry) all expressed in USD. Our sample of returns and inflation numbers starts in January 1875, the first year we have global inflation series, and ends in December 2021.

Equity and bond market returns are sourced from Datastream or Bloomberg, spliced with GFD, as in Baltussen, Swinkels and Van Vliet (2021). We use global equity market returns expressed in USD from MSCI World, and before existence use global value-weighted equity market returns from GFD (ticker TRWLDM) and in case not available, weighted market returns across key developed markets. For the global government bond returns we use returns on the Bloomberg

[8] More specifically, we employ a bag of words approach by counting the relative frequency of words each day related to inflation (including inflation, inflationary, and stagflation) and deflation (i.e., including deflation, deflationary, disinflation, anti-inflationary, and noninflationary), see Garcia (2013) for more specifics about the bag of words approach and information about the New York times columns. We utilize the approach of Garcia (2013) but apply it to inflation or deflation by taking all inflation-related words in the TIAA-CREF financial glossary and the General Inquirer dictionary. Further, in line with an annual inflation horizon we compute an annual average and compute its rolling 10-year standardized Z-score. We assign a resulting value of 1 (-1) when the Z-score exceeds 1 (falls below -1).

Barclays Global Treasury index, which we splice inception before with GDP-weighted bond returns across U.S., U.K. German, France, and Japanese bond markets. Bond return data is from Bloomberg and GFD, while GDP data is from the Maddison Project Database (Maddison, 2006). All bond returns are hedged to USD, as common in practice as currency risk is a very substantial driver of relative risk in bond portfolios. Cash returns are returns on short-dated U.S. Treasury Bills obtained from Kenneth French website and before its inception from Jeremy Siegel.[9]

We include data on long/short Value, Momentum, Low risk, and Quality equity factors in the cross-section of U.S. stocks. These factors are the common factors employed in the industry, being the key motivation of our choice.[10] Further, we consider U.S. stocks, as data on equity factors across the globe only starts towards the end of the 1980s. The equity factors are constructed as follows:

- Value:
  - 1875-1926: Dividend yield. Source: Baltussen, Van Vliet, and Van Vliet (2022).
  - 1927-2021: Book-to-market (HML). Source. Kenneth French on-line data library.
- Momentum:
  - 1875-1926: Past 12-1 month total return. Source: Baltussen, Van Vliet, and Van Vliet (2022).
  - 1927-2021: Past 12-1 month total return (MOM). Source. Kenneth French on-line data library.
- Low risk:
  - 1875-1926: Past 36-month beta. Beta neutral long-short portfolio. Source: Source: Baltussen, Van Vliet, and Van Vliet (2022).
  - 1927-2021: Past 36-month volatility. Volatility neutral long-short portfolio.[11] Source. www.paradoxinvestor.com
- Quality (50% Profitability & 50% Investment):

[9] In this study, we choose to not include other asset classes like aggregate returns on global real estate, commodities, or credit markets due to a lack of index data in the beginning of our sample. Commodities futures data is available as of 1877 (see Baltussen, Swinkels and Van Vliet, 2021), but only includes agricultural commodities for a large part of our sample, making it in our view less suited as an aggregate commodity market proxy. Further, we do not include Treasury Inflation-Protected Securities (TIPS), assets who are designed to protect the investor against inflation shocks. Investing in them sometimes requires locking in negative real yields, for example since the beginning of 2020 (see Podkaminer, Tollette, and Siegel, 2022).

[10] We do not include the size factor. Baltussen, Van Vliet, and Van Vliet (2022) show that there is no long-run evidence for an alpha relative to the Capital Asset Pricing Model in the United States, confirming the observation of Blitz and Hanauer (2021) that size is a weak stand-alone factor in international equity markets. In (unreported) robustness results we have verified that conclusions on size across inflationary regimes are not materially different from other equity factors.

[11] Note that we choose to focus on 2x3 sorted portfolios to circumvent issues of high tilts to smaller caps and illiquid stocks, as is the case in the Betting-Against-Beta factor in stocks.

- 1875-1939: Not available, because companies did not have (standardized) accounting data, see Wahal (2019) and Baltussen, Van Vliet, and Van Vliet (2022).
- 1940-1962: Operating profitability, defined as revenues minus cost of goods sold, minus selling, general, and administrative expenses, minus interest expense, scaled by book equity. Investments, defined as the change in total assets from the fiscal year ending in year t-2 to the fiscal year ending in t-1, divided by t-2 total assets. Source: Wahal (2019).
- 1963-2021: Operating profitability (RMW) and Investments (CMA), defined the same as above. Source. Kenneth French on-line data library.

For global government bond market factors, we use data from Baltussen, Martens, and Penninga (2022) on Value, Momentum, Low risk and Carry factors, which we update till the end of December 2021. Their factors are constructed as follows:

- Value: Real yield (bond yield minus inflation). Available 1875-2021.
- Momentum: Past 12-1 month total return. Available 1875-2021.
- Low risk: 36-month beta. Beta neutral long-short portfolio on the U.S. bond curve. Available 1922-2021.
- Carry: Term spread (bond yield minus short-term interest rate). Available 1875-2021.

Finally, global ('cross-asset') factor returns on value, Momentum, Low risk and Carry are taken from Baltussen, Swinkels, and Van Vliet (2021), which we also update till the end of 2021.[12] They construct global factor premiums using bond, equity, currency, and commodity market data at the country level, so no individual stocks. The factors in their dataset are constructed as follows:

- Value: Various definitions depending on the asset class
- Momentum/Trend: Time-series Momentum that takes a long (short) position if the 12-1 month return is positive (negative).
- Low risk: Past 36-month beta with respect to asset class. Beta neutral long-short portfolio.
- Carry: Various definitions depending on the asset class.

For more details on the factor construction, we refer to the corresponding papers.

We start our analysis by examining the long-run evidence on global asset class and factor returns. Table 2 contains the average returns on each of these asset classes and factor premiums over the

[12] The time-series we use are updated versions of the data that has been made on-line available at https://doi.org/10.25397/eur.14237024.v1. We do not include cross-sectional momentum, as its returns are highly correlated with those of time-series momentum (also known as Trend). We also do not include the monthly seasonal factor, which is difficult to line up with our annual inflation measure.

long-run sample from 1875 to 2021, as well as several subsamples that start later. The reason to include these shorter subsamples is that they are often employed in earlier studies, thereby proving a form of 'in-sample' evidence, while the longer run evidence reveals the 'out-of-sample' robustness of the asset class and factor premiums (although we leave a full out-of-sample study to the original papers with deep history). Moreover, those who find that the recent history is more representative of the future may be interested in more recent subsamples, even while these contain less powerful information about inflationary regimes.

[INSERT TABLE 2 HERE]

Panel A contains the returns on the conventional long-only asset classes equities, government bonds, and cash, and a multi-asset portfolio that consists of 60% equities and 40% government bonds.[13] Long-term nominal average returns for global equity investors have been on average 8.4% per annum, a number that is highly significant (t-value = 7.4).[14] Hence, equities offered an attractive return over 147 years. For sample periods that start later, average returns are also consistently positive ranging from 8.9% (1992-2021) to 12.1% (1950-2021) per annum.

Global (currency risk hedged) government bond returns have been substantially below global equity market returns with 4.5% per annum, but still significantly above zero (t-value 14.0). This compares to an average return on Cash of 3.4% per annum, while global inflation has been on average 3.2% per annum over the same period (see Table 1).[15] Hence, the global term premium is 1.1% per annum. Although this may appear to be modest, this may be partially due to the lack of a good proxy for the short-term risk-free rate over the long historical period, which may overstate the cash returns. For example, US Treasury bills were not regularly issued until December 1929, when the auctioning of 13-week bills started. Most studies use commercial paper with 2 to 3 months maturity to proxy the short-term interest rate before the issuance of Treasury bills or certificates, but these contain a small credit premium relative to government issued securities.[16]

[13] Equities and bonds have historically been the most important asset classes making up the invested market portfolio; see Doeswijk, Lam, and Swinkels (2020). Unfortunately, a good historical database on the returns of investing in corporate bonds going back to 1875 is to the best of our knowledge not available.

[14] This is fairly similar to the arithmetic (geometric) average of 10.65% (8.45%) reported in Jordá et al. (2019) over the period 1870-2015.

[15] Jordá et al. (2019) report an arithmetic (geometric) 6.06% (5.71%) return for government bonds and a 4.58% (4.53%) return for cash over the period 1870-2015.

[16] Related, Garbade (2008) explains that from 1920 onwards Treasury certificates had been brought to the market for a fixed price. This resulted in massive oversubscriptions because the fixed issue price was lower than their market value after issuance. Snowden (1990) argues that it seems more important to include a short-term instrument that carries some default risk rather than not using one at all. Moreover, it is not the case that data on default-free securities are not available, but rather that commercial paper was the closest to default-free present in financial markets. Siegel (1992) attempts to remove this default premium from U.S. commercial paper rates by using the term structure observed in the U.K., which was more likely the global risk-free rate of the time; see Friedman and Schwartz (1982). Similar issues may also be at play for the other government bond markets outside the U.S. in our sample, leading to term premia that are

Consequently, we choose to focus our analysis on total asset class returns (instead of excess returns over cash).

In Panel B, the four equity factors show strong and statistically significant performance over the long-run sample, with average returns ranging between 2.5% (Quality) to 6.9% (Momentum). Low risk has the highest t-stat (6.7). The overall multi-factor equity ('MFE') strategy, constructed as a 1/N combination of the individual factors available each period, gives a robust and significant outperformance over each sample period. The average return since 1875 equals a statistically significant 5.1% with a high t-value of 7.4. The average return is economically and statistically significant in all sub-samples and is 4.1% over the most recent 30 years. During this more recent period the Quality factor is somewhat stronger with 3.2% per annum versus 2.5% in the longest sample, that for Quality goes back to 1940 because no reliable accounting data is available before that time. Furthermore, the combination of value and momentum gives more consistent results than the individual strategies profiting from negative correlation between these two factors.[17] When we correct for asset class risks, all equity factors remain significant in economic and statistical terms. Momentum and Low risk have the highest alphas of 8.5% and 5.0% per annum, respectively, while Value and Quality have alphas exceeding 3%. The combined MFE alpha equals 5.5%, with a high t-value of 7.9. In other words, equity factors are economically sizable and statistically robust phenomena over the last 147 years.

Panel C shows that results for bond factor premiums are similar. Value yields a statistically significant 2.4% per annum return (t-value 2.5), while Carry is the strongest factor with an average return of 7.4% per annum (t-value 7.9). Further, the individual bond factors are generally sizable and statistically significant over most subsamples. The major exception is the most recent subperiod, in which Carry factor is the strongest factor with 5.5% return per annum, while the three other factors are positive, but statistically indistinguishable from zero. However, due to diversification benefits across factors, the equally weighted Multi-Factor Bond ('MFB') strategy is statistically significant with a return of 2.4% over the most recent 30 years. Over the full sample period the MFB strategy returns a sizable 4.6% return, with again a high t-value of 9.4, highlighting its robustness and statistical significance. As for equity factors, market risk adjustments in the final columns indicate that market risk is unable to explain any of the factors

lower than we have observed in more recent markets where an entire term-structure of (near) default-free government securities can be traded.

[17] Also see for example Asness, Moskowitz and Pedersen (2013) for evidence that a combination of value and momentum is significant.

to a meaningful extent, and alpha remain generally sizable and highly significant for the MFB combination (4.9% per annum with a t-value of 9.2).

Finally, global factor premiums are also sizable and highly significant as shown in panel D. The Low risk factor is the weakest among the factors, but still shows an economically and statistically significant premium of 1.6% per annum (t-value = 4.3).[18] Momentum is the strongest over the sample since 1875 with 7.4% average return per annum (t-value = 13.8). The equally weighted multi-factor Global Factor Premium ('GFP') strategy returns 4.2% per annum, with an extremely high t-value of 17.7. The four Global Factor Premiums combined are economically and statistically significant over the various subsamples highlighting their robustness. Asset class risks cannot explain the global factor returns, witnessing alphas between 1.4% (Low risk) and 7.6% (Momentum) and t-values between 3.5 and 12.6. As for equity and bond factor premiums, market risk is not able to explain any of these global factor premiums, with an average alpha of 4.2% per annum (t-value = 15.7) between 1875 and 2021.

[INSERT FIGURE 3 HERE]

Figure 3 summarizes these insights by plotting cumulative returns. Panel A contains the returns on conventional global bond and stock markets, as well as the 60/40 multi-asset portfolio. Panel B contains the multi-factor return series for equities (MFE), government bonds (MFB) and global factor premiums (GFP). While equity and bond markets experience severe drawdowns in nominal terms, particularly around war times, factor returns tend to be smoother, even though occasional crashes occur. In sum, asset class (i.e., equities and bonds), and equity, bond, and global factor premiums are economically sizable and statistically significant and robust phenomena over the last 147 years.

4. Investment returns during deflationary and inflationary periods

In this section, we examine the performance of asset classes and factor premiums over inflationary regimes. Our key focus is on the four inflationary regimes (<0%, 0-2%, 2-4%, and >4%) defined previously, but we like to stress that we consider robustness to other regime classifications as well. The first question to answer is the impact of inflation on returns of the three major asset classes (equities, bonds, and cash). Panels A1 and A2 of Table 3 contains the nominal and real returns of

[18] As discussed in Baltussen, Swinkels, and Van Vliet (2021) the Low risk factor works better within asset classes than across markets, which is confirmed by the fact that Low risk is the strongest factor in equities (Panel B), the second strongest in bonds (Panel C), but the weakest factor in global markets (Panel D).

these asset classes over the full period, as well as during the four inflation regimes defined above. We also include a multi-asset portfolio that consists of 60% equities and 40% bonds. This global portfolio returned 6.8% per annum in nominal terms (see also the previous section) and in 3.5% in real terms over the full sample period 1875 to 2021.

[INSERT TABLE 3 HERE]

Deflationary periods, where inflation is below 0%, coincide with relatively low nominal returns for equities of 2.4% per annum, well below the 8.4% unconditional average return. Bonds and cash show a 5.2% and 2.8% per annum nominal return during deflationary periods, which is slightly above the unconditional average of 4.5% and 3.4%. Consequently, a multi-asset 60/40 investor achieved a 3.5% nominal return during deflationary periods. However, an investor that does not suffer from money illusion realizes that even though the *nominal* return is low, the *real* return is decent because of the deflation. Adjusted for purchasing power, the multi-asset investor earns 6.7% per annum during deflationary periods.

Inflationary periods, where inflation is above 4%, show a positive nominal returns for equities (6.9%) and bonds (3.9%). At face value, it may seem that the multi-asset investor does quite well with a 5.7% nominal return. However, the real return is substantially negative at -2.9% per annum, leading to a severe reduction in purchasing power.[19]

The two periods in between, with a positive inflation just below current central bank targets of 2%, and a mild overshoot of those targets to 4%, are both good for equities and bonds, with nominal returns on equities of 11.0%, well above their unconditional average, and nominal returns on bonds in line with their unconditional average. In real terms, returns on these asset classes are also good, with the undershoot scenario being even somewhat better with a 9.8% real return for equities and 3.4% for bonds. The real return on the 60/40 multi-asset portfolio is 7.2% and 5.6% per annum for the 0-2% and 2%-4% inflation buckets. In other words, positive but low consumer price increases are good for nominal investment returns, as well as those adjusted for purchasing power.

The last column summarizes the results of a Wald test (adjusted for serial correlation due to the use of 12-months overlapping observations) that tests whether the variation of returns across

[19] Several studies argue that the asset class commodities tend to be a good hedge against inflation risk. Zaremba et al. (2021) provide evidence of the positive link between commodities and inflation over as much as seven centuries. Levine et al. (2018) show this for a sample 1877-2015. Consequently, including commodities into a multi-asset portfolio may provide attractive diversification benefits for inflationary times. Doeswijk, Lam, and Swinkels (2020) claim that commodity investments were only 2.2% of the invested market portfolio over the period 1960-2017, indicating that commodity investments have not been able to protect investor portfolios against inflation in aggregate.

inflation scenarios is statistically significant. Nominal equity, cash, and multi-asset returns vary significantly across inflationary regimes, while the variation in nominal bond returns is not significant. Because of the huge differential of average inflation during the inflation scenarios, the variation in real returns is significant for all asset classes.

Figure 4 summarizes these important insights by depicting the average nominal and real annual return on the multi-asset portfolio across the inflationary regimes. Inflation just below or above the inflation target of 2% is good for investors in both nominal and real terms. Deflation is relatively bad for nominal returns, but good in real terms. Nominal returns during inflationary periods seem okay, but in real terms are dramatically negative.

[INSERT FIGURE 4 HERE]

As outlined in the previous section, factor premiums offer significant and diversifying returns over asset class premiums. Many investors distinguish factor premiums in their strategic asset allocation, and it therefore is of interest to examine the variation in factor premiums across inflationary regimes. Panels C, D and E in Table 3 show the factor return for each of the four inflation buckets. Interestingly, the factor performances do not seem to depend much on the level of inflation, in contrast to the asset class returns. Indeed, the multi-factor portfolio performs 5.9% in deflation, 5.3% in inflationary periods, and 5.1% and 4.5% when inflation is just below or above the central bank targets. Variations across inflation buckets at the individual factor level are somewhat higher but remain quite close to their unconditional averages. The Wald-tests indicate that the observed variation across inflation scenarios is not statistically significant, even not for some factors sometimes believed to vary with inflation like Momentum and Value. These findings for Value, Momentum and Quality generally align with the findings of Neville et al. (2021) over a shorter sample and with a different inflation definition.[20]

Bond factors also deliver positive returns across all four inflationary regimes, although they generally perform more mixed across the regimes. Value in bonds is performing well when inflation is high (4.8%), but not in deflationary periods (0.8%). That said, its return variations across regimes are insignificant as reflected in the Wald test. Momentum in bonds on the other hand is performing well in each period (5.6%, 5.0%, and 6.0%) except when inflation is high (0.4%), and its variation across inflationary regimes is significant. The low risk factor performs especially

[20] Note that Cohen, Polk and Vuolteenaho (2005) find that the risk-return relation becomes inverse during inflationary times, indicating a larger Low risk premium in equities. By contrast Neville et al. (2021) find that Betting-Against-Beta (BAB) is significantly weaker during times of inflation. With this extended series based 2x3 sorted portfolios with value weighting (which prevent an extreme size bias or large exposure to illiquid stocks), we do not find a clear relation between Low risk equities and inflation.

well in times of deflation (10.3%, compared to a 4.4% unconditional average) and inflation (5.8%), but again return variations across regimes are not significant. Further, the Carry factor is not much affected by inflation regimes. As for equities, the multi-factor bond portfolio performs consistently high across inflation regimes, delivering well positive returns in each inflationary regime.

The global factor premiums also deliver positive and consistent returns across all four inflationary regimes. Seemingly, Value performs a little worse during deflationary periods with 1.2% per annum, but the Wald test fails to reject the null hypothesis of no significant return variations across the four inflationary regimes. (Time-series) Momentum varies significantly across the regimes as it does best during inflationary periods (8.9% per annum), which is consistent with the findings of Neville et al. (2021) who examine the post-1926 period. However, it delivers positive returns on average across all four regimes. Low risk performs above average when inflation is above 2% but does not display significant return variation across regimes. Carry also delivers positive and fairly similar average returns across the regimes. Similar to the equity and bond factors, the multi-factor strategy in the multi-asset universe is virtually immune to inflation or deflation shocks, at least on average, with excess returns ranging from 3.4% to 4.4% per annum.

The factor returns are the return differential between a long portfolio with the highest factor exposures and a short portfolio with the lowest factor exposures. The excess returns on these 'zero investment' portfolios are therefore the same in nominal and real terms. In practice, an investor would need to hold either a cash position to fund these long-short strategies, for example as a derivatives-based overlay on top of the conventional asset allocation or replace the conventional asset allocations to equities and bonds with the long-side of each factor. It depends on the nature of the factor, the trading costs involved with different instruments, and the investor's willingness and ability to deal with derivatives what an optimal implementation in practice would be.

Panel E considers these factor implementations. For equities we replace its 'passive' allocation with an approximate long-only allocation to the multi-factor equity strategy. Similarly, for bonds we replace its 'passive' allocation with an approximate long-only allocation to the multi-factor bond strategy.[21] We add the GFP strategy, which represents a long-short strategy in derivatives across the major global markets, to the cash portfolio to generate a factor-based absolute return macro strategy. We see that the multi-factor long-only equity investor can increase her full sample real return from 5.1% to 7.7% per annum, the long-only bond investor from 1.2% to 3.5%, and the cash investor from 0.1% to 4.3%, and the 60/40 multi-asset portfolio from 3.5% to 6.9% per annum,

[21] We proxy a long-only investment with a 50% allocation to the market, and a 50% allocation to the long-short multi-factor premium strategy in that asset class.

assuming that the GFP is added via an overlay on 20% of the portfolio's value. Further, the long-only factor strategies consistently add across inflationary regimes, with for example the factor-enhanced equity (multi-asset) allocation managing to make up for the losses of the conventional portfolio in the inflationary regime, as its average real return equals 1.0% (0.4%).

[INSERT FIGURE 5 HERE]

The factor premiums averaged across equity, government bonds, and the global factor premiums for each of the four inflationary regimes are displayed in Figure 5. The Value factor is the weakest stand-alone (while diversifying well to the other factors, see for example Baltussen, Swinkels and Van Vliet, 2021), but performs relatively well during inflationary periods when conventional asset classes do poorly. On the other hand, Quality/Carry perform slightly worse during inflationary times, but better in each of the other inflationary regimes. Low risk performs well especially in the extremes, i.e., deflationary, or inflationary regimes, and is weaker in the middle two that are goldilocks scenarios for equities and bonds. Finally, Momentum performs consistent and well across the inflationary regimes.

In the Appendix we show these results are robust across different definitions of inflationary regimes, including a 3% or 5% (instead of 4%) high inflation cutoff, these use of annual changes in inflation rates (as measure of unexpected inflation), the use of only U.S. (instead of global) inflation, or the use of 3-years (instead of 1-year) horizons. Noteworthy observations include poorer nominal and real global equity returns the higher the high inflation cut-off, and stronger returns on equity factors during times of falling inflation (especially Momentum and Low risk) and times of strongly rising inflation (especially Momentum).

In sum, our findings show asset class premiums vary significantly across the inflationary regimes in nominal and especially real terms. Equities and bond on average yield lower nominal returns during periods of high inflation, causing *negative* real returns. By contrast, equity, bond, and global factor premiums are generally consistent across inflationary regimes, displaying generally no significant variation across, while they enhance nominal and real asset class returns in (approximated) long-only asset class implementations.

5. Dissecting inflationary regimes – stagflation hurts

In the previous section, we observed that real returns during inflationary periods are negative for investors in stocks and bonds, but that equity, bond and global factor premiums are mostly

resilient during different inflation scenarios. In this section, we further split up the 'bad times' of high inflationary episodes, as well as deflationary periods based on other economic or financial market circumstances. Not all inflationary regimes are alike, and hence the question is how investment returns behave over various sub-regimes within inflationary and deflationary regimes.

To this end, we divide the periods based on five different characteristics: (1) recession or expansion, (2) falling or rising earnings growth, (3) bear or bull equity markets, and (4) increasing or decreasing interest rates, and (5) increasing or decreasing inflation. This hence includes stagflationary episodes with both high inflation and recessions. We date recessions based on business cycle data from the National Bureau of Economic Research[22] by requiring that at least six of the months in a rolling 12-months window are classified as recession.[23] In total, there have been 30 recessions over the period 1875 to 2021 with an average duration of 17 months. We define increasing or decreasing interest rates based on the sign of the 12-months change in global government bond rates, and a bull (bear) equity market based on the sign of global equity returns.

[INSERT TABLE 4 HERE]

The average returns per inflationary sub-regime are displayed in Table 4. Panel A1 (A2) of Table 4 shows that nominal (real) returns on equities are particularly bad during recessions with high inflation, or stagflationary episodes. The nominal (real) return on the multi-asset portfolio is -2.2% (-11.7%) per annum, compared to 8.2% (-0.1%) during expansionary periods with high inflation. Recessions likely lead to lower expected corporate cash flows, which dominate a decrease in the discount rate, leading even to negative nominal stock returns of -7.1% per annum (see Table 4, Panel A1). Recessionary periods are somewhat better for nominal bonds than expansionary periods with nominal returns of 5.1% versus 3.6% per annum (see Table 4, Panel A1). Decreasing interest rates lead to positive marked-to-market gains. The negative real return for equities of -16.6% suggests that equities are a particularly bad inflation hedge during stagflationary periods. While expansionary periods in general tend to be good for investors, this does not hold when inflation is high. Real returns on stocks are marginally positive (2.9% p.a.) and real returns on

[22] See https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions.
[23] We have verified results are similar when using the Global Recession Indicator from the OECD when available (and before availability backfilled with NBER data), which however dates back to the 1960s, motivating our choice of NBER dates. Historical business cycle dating exercises for other countries stretching back to the 19th century are not readily available. As alternative we have also evaluated the sign of the annual changes in nominal GDP across the U.S., U.K. Germany, France, and Japan, finding again similar results (for example the nominal equity return (60/40) during stagflationary episodes equals -14.9% (-8.9%), and factors materially improve this number).

bonds are deeply negative (-4.7%). Even though the economy is doing well, times of high inflation are generally not good for investors.

Panels C, D, and E contain the result of the factor premiums and give a completely different picture. The multi-factor equity portfolio has a return of 5.4%, the multi-factor bond portfolio 4.7%, and the global factor premium portfolio a return of 4.1% during stagflation periods. If anything, the stagflation performances for factor premiums in equities and bonds are even better than during expansions in inflationary periods, albeit not statistically significantly different (unreported). All factor premiums performing well during stagflations except for Momentum in bonds, which returns -2.4% on average. Similarly, global factor premiums perform well, with only Low risk returning zero and all other factors returning positively.

Panel E of Table 4 also show that investors who are, for example, worried about achieving negative real returns during stagflation periods may improve their asset allocation by including factors across asset classes. This would help their portfolio to a certain extent from these adversary business cycle conditions. Even though -8.3% per annum in real terms can hardly be called a success, it is substantially better than the alternative of -11.7% per annum. Note that the factor series are all long-short factors that do not include trading costs, and investors need to construct efficient ways to exploit these factor strategies in practice.

The NBER definition of a recession is based on negative GDP growth, but we also examine declining (annual) earnings of the stock market (based on data from Shiller's' website), as that part of the economy may be more relevant for equity investors. Real returns on the multi-asset portfolio remain poor, although better than during NBER stagflations, with -5.8% versus -11.7%. The MFB premiums are positive, but relatively low with 2.5%, because Momentum and Carry have relatively low returns. MFE and GFP show average returns, leading to a -3.2 real return on a multi-asset portfolio that includes factors.

Decreasing equity markets in inflationary periods are especially disastrous with an annualized real return of -28.8%. At the same time bonds suffer in real terms during high inflation and falling equity market episodes with -9.0% p.a. negative real returns, yielding a -20.9% real return on the multi-asset portfolio. For both bear and bull equity markets in times of inflation, a diversified portfolio of factor premiums yields robust performance enhancements, thereby alleviating the pain of high inflation. Again, all factor premiums yield positive returns, except for Momentum in bonds and Low risk across assets during high inflation bear markets.

When we sub-condition on changes in interest rates it becomes clear that increasing interest rates cause more pain (real -6.8% p.a.) to a conventional multi-asset portfolio than decreasing interest rates (real 2.2% p.a.), as both equities and bonds suffer in real terms (-6.0% and -8.0% p.a., respectively). By contrast, during decreasing rates periods equities and bonds experience materially better real returns (3.9% and -0.3% p.a.). Average returns on factor premiums are again good across sub-regimes, but generally a bit better during when rates increase. Especially Momentum in equities and Trend following stand out during these episodes, while Low risk in equities and Value in bonds benefit more from declining rates in times of inflation. Again, factor premiums materially help to soften to burden of high inflation for traditional portfolios.

The final sub-regime is that of increasing inflation during periods in which inflation is above 4%. This happens in 12.8 out of 46.1 years. Nominal and real equity and bond returns are worse than during the average year in a high inflationary regime. Consequently, real returns on the multi-asset portfolio are -5.0%, worse than with decreasing inflation, but not as bad as during stagflation periods. Again, factor premiums perform consistent and well, with government bond factor premiums being particularly high, mostly due to Low risk and Carry outperforming. As before, a diversified portfolio of factor premiums yields robust performance enhancements, thereby alleviating the pain of high inflation. The robust results on factor investing do not mean that investing in factor premiums is without risk. For example, Blitz (2021) suggest that quant equity factors follow their own 'quant cycle', which is unrelated to business cycle variables that we examine here.

[INSERT TABLE 5 HERE]

Next, we examine performances over deflationary sub-regimes, as shown in Table 5. The total deflationary period is 23.1 years, about half of the 46.1 years that have inflation above 4%. This means that the sub-regimes are sometimes small, with several of them below 10 years of observations, reducing the accuracy of the displayed averages. Deflationary expansions are relatively good for investors, with a 10.4% real return per annum for the 60/40 portfolio, while deflationary recessions are slightly positive (1.6%) in nominal terms, but better in real terms (4.9%). For the multi-asset investor, interest rate increases are worse than decreases (with equities returning negatively), and equity market bear markets worse than bull markets. Most troubling are deflationary episodes that coincide with equity bear markets. The equity, bond, and global factors multi-factor combinations do well for each of the sub-regimes during deflationary periods, especially equity and bond factors during the states with poor equity or bond returns – deflationary recession or bear markets. Further, individual factor performances vary, although we

have to be cautious as some samples are fairly small. For example, equity Value does rather poorly during deflationary expansion periods (-4.5%) when equity Low risk does particularly well (16.1%). The same holds for bond Value, and to a lesser extent for Value across assets. The GFP portfolio does not vary a lot across sub-regimes, ranging between 2.3% to 4.1%. Overall, we observe that especially equity and bond factors perform tend to do well during the bad times in deflationary cycles, but that these bad times are much milder than during stagflations.

[INSERT FIGURE 6 HERE]

Figure 6, Panel A summarizes the results of the inflationary bad times presented in Table 4. Clearly, for the multi-asset investor stagflationary and other bad times episodes are challenging, while the same asset allocation including factor premiums perform better in each of these sub-regimes. Figure 6, Panel B summarizes the results during deflationary bad times. Although returns on traditional portfolios are substantially better than during inflationary bad times, deflationary bear markets also present a challenge for investors. Again, factor premiums consistently improve upon traditional portfolios. Overall, we can conclude that the most severe bad times for investors in traditional asset classes are times of high inflation with either economic or earnings downturns, rising rates, falling equity markets, or rising inflation, or deflationary bear markets, and factor premiums on average help to alleviate the pain during these periods.

6. Concluding remarks

Inflation and deflation have been a worry for investors and inflation indeed varied across time, especially prior to the 1990s. We examine asset class and equity, bond, and global factor premiums, focusing on premiums across inflationary regimes. As more extreme inflation regimes – like high inflation, stagflation, and deflation – are relatively uncommon, we utilize a deep sample of inflation and investment returns between 1875 and 2021. Our findings reveal that asset class and factor premiums are strong and consistent 'empirical facts', with attractive significant average returns over time. However, asset class premiums vary substantially across inflationary regimes. Deflationary and moderate inflation scenarios generally provide positive nominal and real equity and bond returns, while especially real returns suffer during times of high inflation. Splitting up inflationary regimes into sub-regimes reveals that stagflationary episodes, inflationary bear markets or rising inflationary times, and to a lesser extent deflationary bear markets, are bad times for investors. During these 'bad times', equity, bond, and global factor premiums are consistent

and attractive, as they are across inflationary regimes. As such factors help to alleviate the pain during bad times, offsetting some of the negative impact of high inflation.

These results have three implications. First, for investors times of high inflation, and especially stagflation and inflationary bear markets are challenging, which suggests asset class returns may partly provide a compensation for bearing risks during these bad times. Second, as equity, bond, and global factor premiums are generally consistent across inflationary regimes, they provide consistent value add for traditional portfolios. These premiums provide diversification, but at the same time are also not a perfect hedge against inflation, as their returns do not substantially increase during the worst times. Finally, our results suggest factor premiums in equities, bonds, and across asset classes are not a compensation for bearing inflationary risks.

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Figures and Tables

Figure 1A: Annual Consumer Price Inflation

The figure shows the historical timeseries behavior of Global and US YoY inflation (Panel A) or Global YoY versus 3-year (annualized) inflation (Panel B). Periods highlighted in grey represent NBER recessions. The sample period is 1875-2021.

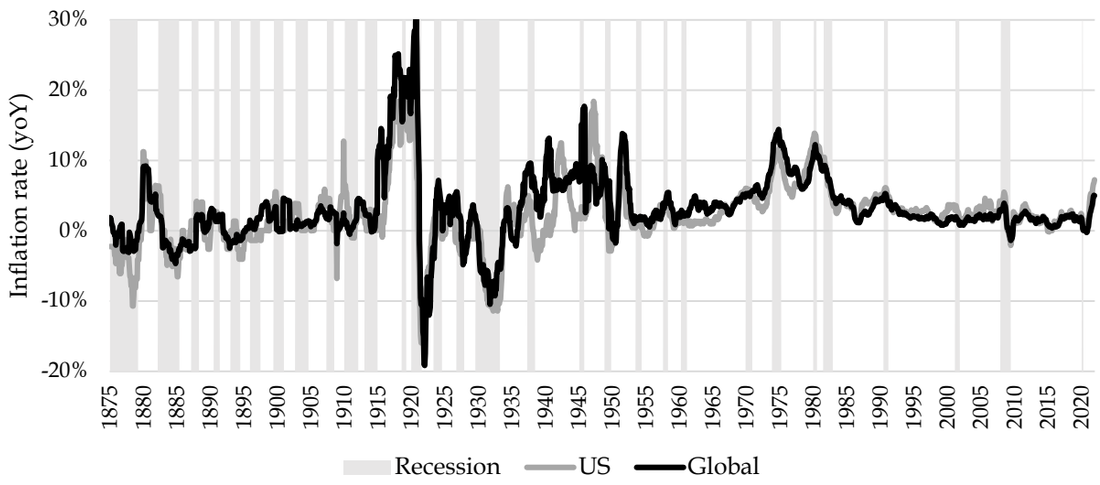


Figure 1B: Tri-annual Global Consumer Price Inflation

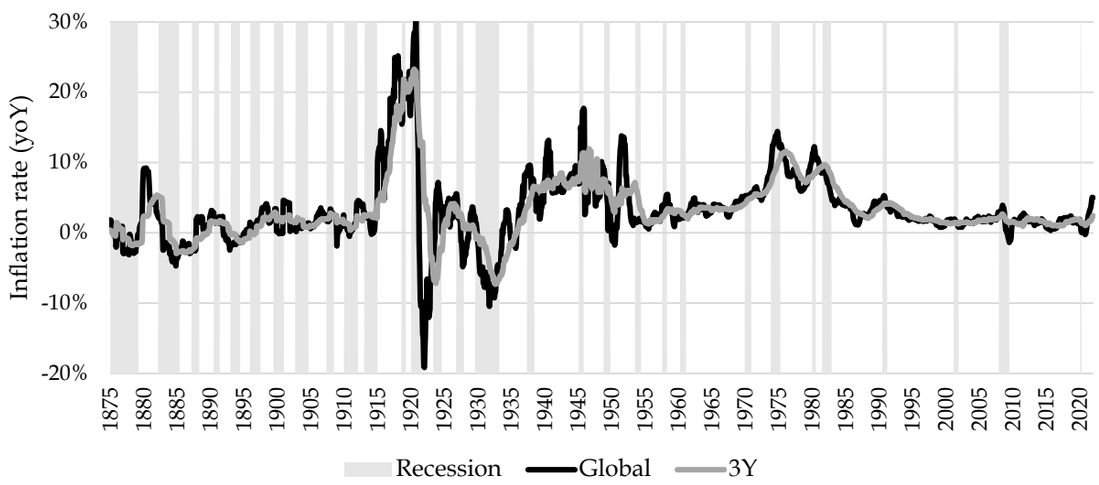


Figure 2: Inflation Topicality

The figure shows the historical timeseries behavior of inflation topicality (the relative mentioning of inflation verses deflation words in the market columns in the Wall Street Journal and/or New York Times) versus US YoY inflation. The sample period is 1899-2021.

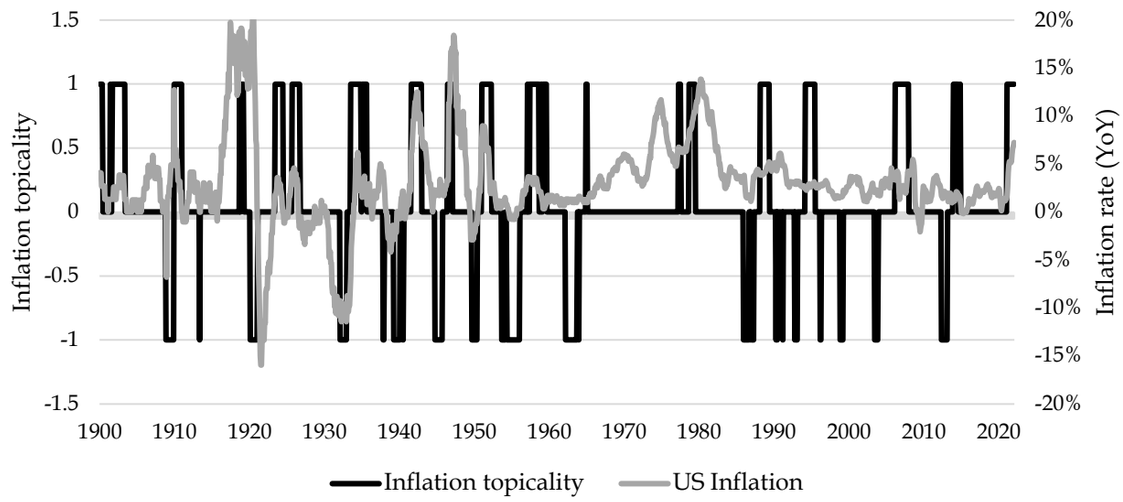
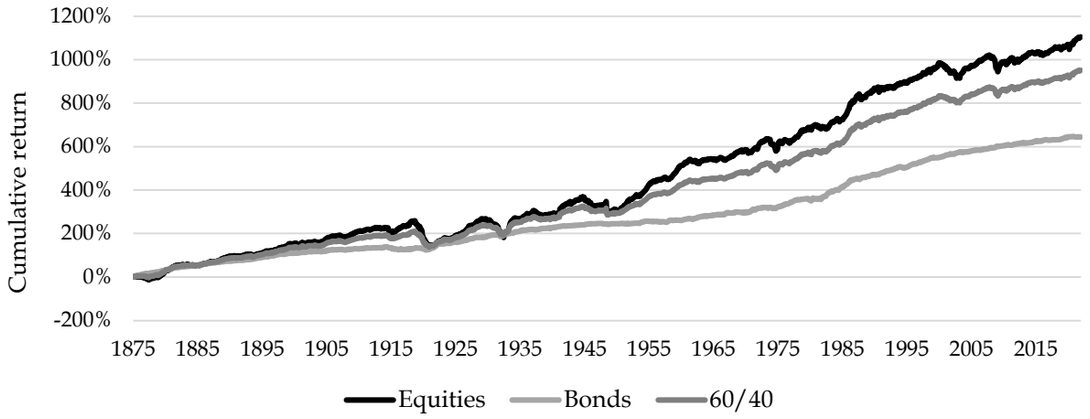


Figure 3: Long run returns on investment strategies

The figure shows the historical cumulative return (on log-scale) of investing $1 in 1875 in asset classes or factor premiums. Asset class returns are based on global portfolios and factor premiums as described in the text. The sample period is 1875-2021.

Panel A: Global asset class returns



Panel B: Factor returns

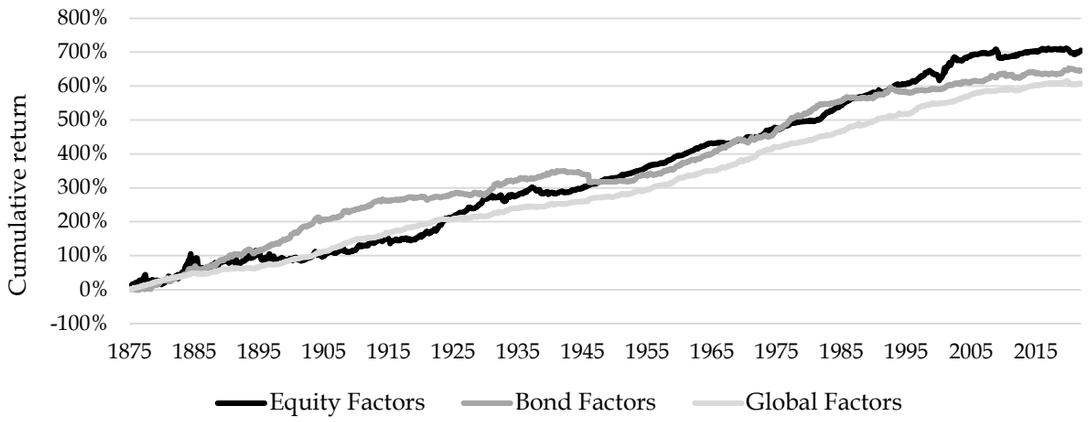


Figure 4: Nominal and real 60/40 returns across inflation regimes, 1875-2021

The figure shows the historical average nominal return (grey bars) and real return (black bars) on the 60/40 global equity/bond portfolio across inflationary regimes. The sample period is 1875-2021.

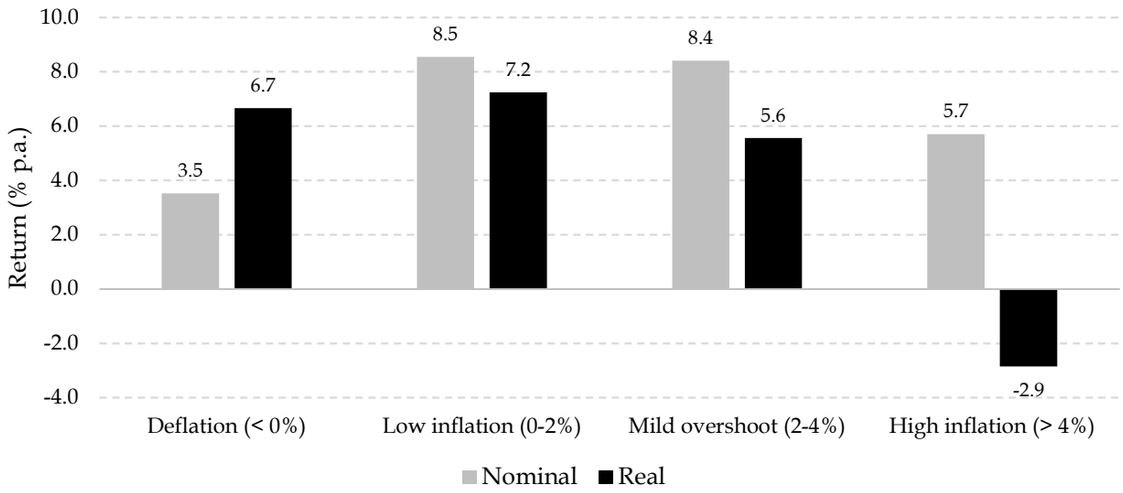


Figure 5: Factor premiums across inflation regimes, 1875-2021

The figure shows the historical average return on Value, Momentum, Low risk and Quality/Carry factor premiums across inflationary regimes. Factor premiums are computed as the equally weighted average of equity, government bond, and global factor premiums. The sample period is 1875-2021.

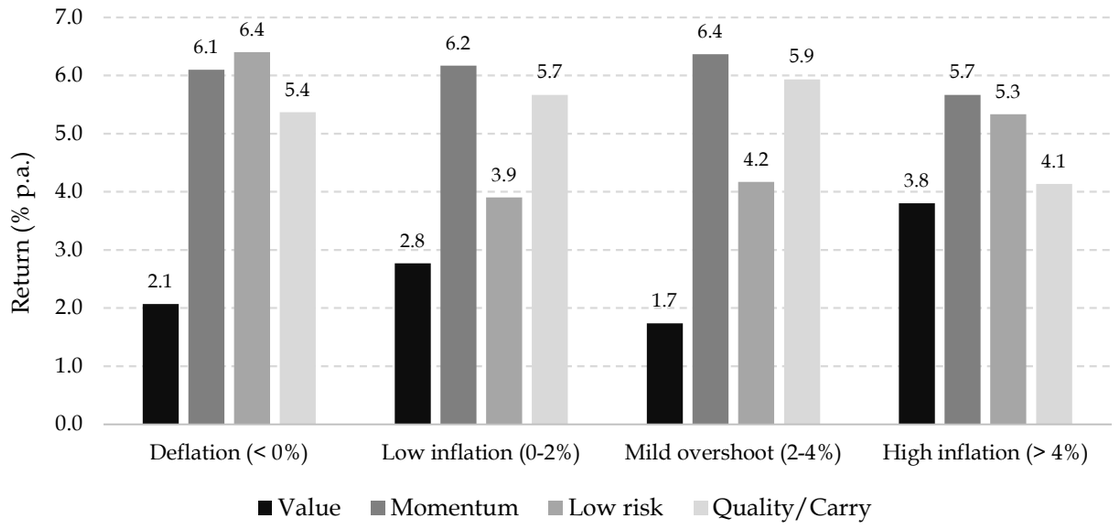
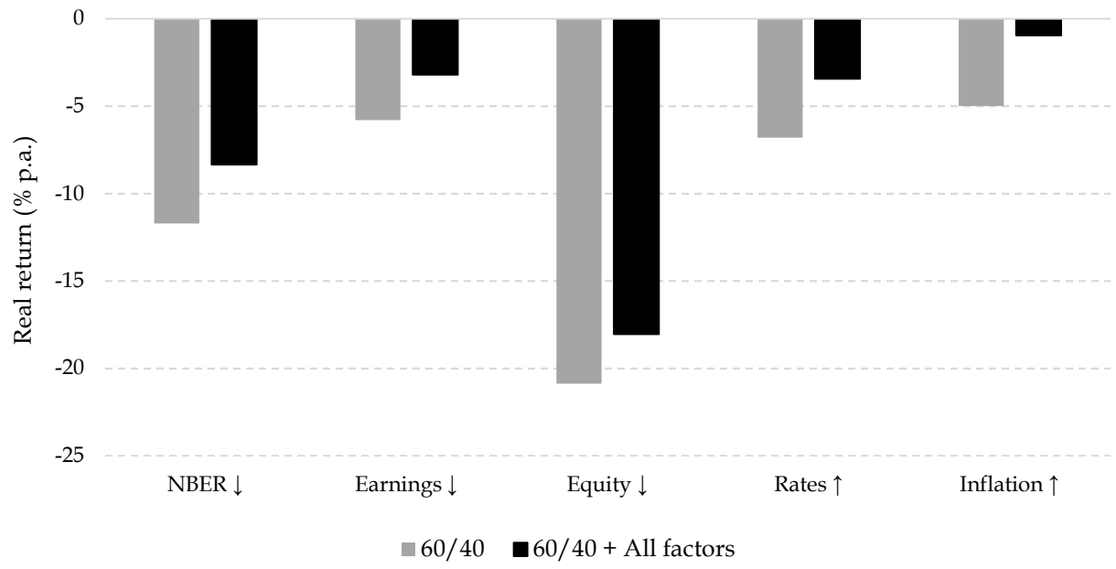


Figure 6: Stagflationary times and investment returns, 1875-2021

The figure shows the historical average return on (i) the 60/40 global equity/bond portfolio, and (ii) the 60/40 portfolio augmented with equity, bond, and global factor premiums across inflationary 'bad time' regimes (Panel A) or deflationary bad times (Panel B). Inflationary (deflationary) times and defined as high (>4%) (low <0%) inflation periods in combination with an economic recession (NBER), falling corporate earnings, falling equities, rising rates, or inflation (changes over 12-month period). The sample period is 1875-2021.

Panel A: Inflationary 'bad times'



Panel B: Deflationary 'bad times'

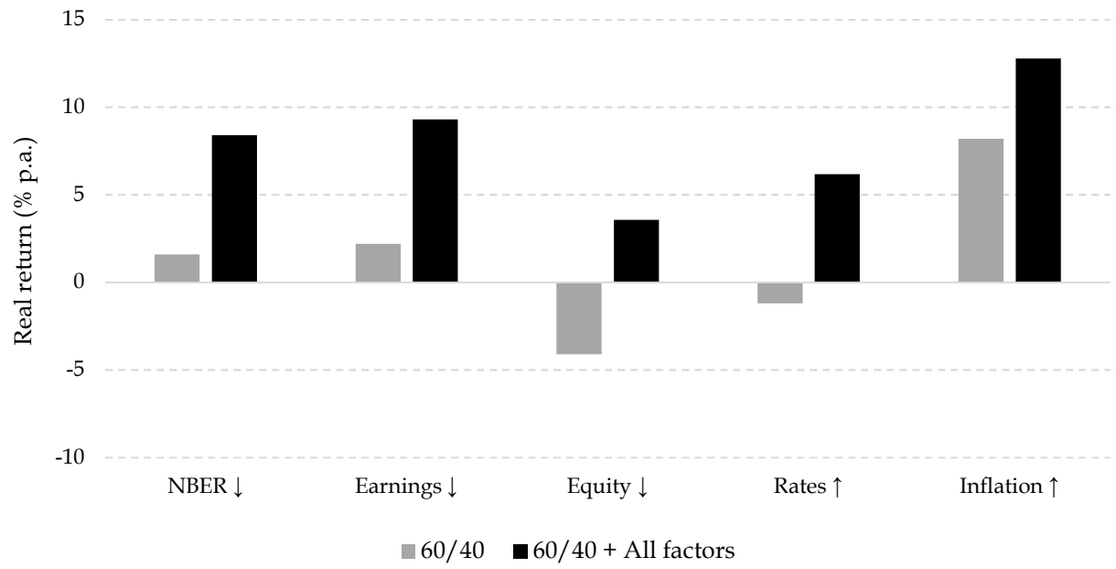


Table 1: Inflation frequencies

The table represents the historical distribution of inflation. Panel A (B) show the average number of annual observations over different sample periods falling in each YoY inflation level bucket based on Global (US) inflation. Panel C contains the distribution of Global and US inflation over the full sample 1875-2021.

Panel A: Global inflation episodes

Inflation bucket	1992-2021	1950-2021	1926-2021	**1875-2021**
<0%	0.9	1.6	7.7	**23.1**
0-2%	20.3	25.5	27.6	**42.9**
2-4%	8.6	22.7	25.9	**34.9**
>4%	0.3	22.3	34.8	**46.1**
All	30.0	72.0	96.0	**147.0**

Panel B: US inflation episodes

Inflation bucket	1992-2021	1950-2021	1926-2021	**1875-2021**
<0%	1.2	2.7	11.2	**27.6**
0-2%	10.3	21.5	26.3	**42.0**
2-4%	16.8	27.5	32.3	**40.3**
>4%	1.8	20.3	26.3	**37.2**
All	30.0	72.0	96.0	**147.0**

Panel C: Inflation distribution

Inflation (YoY)	**Percentile**								
	0.05	0.10	0.25	0.33	0.50	0.67	0.75	0.90	0.95
Global	-3.0%	-1.4%	1.0%	1.5%	2.3%	3.8%	4.6%	8.9%	12.1%
US	-4.1%	-2.4%	0.2%	1.2%	2.2%	3.2%	4.1%	7.2%	11.2%

Table 2: The long run evidence on asset class and factor premiums

The table shows historical returns on asset class and factor premium portfolios over various sample periods. Equity and bond returns are based on global portfolios, cash on short-dated US cash investments. 60/40 represents a 60% equity, 40% bond portfolio. Equity factors: Quality starts in 1940, all other series in 1875. MFE takes an equally weighted combination of the equity factor premiums. Bond factors: Low risk starts in 1922, all other series in 1875. MFB takes an equally weighted combination of the bond factor premiums. Global factors: All series start in 1875, composed of equally volatility weighted combinations of the factor premiums in equity indices, government bonds, currencies, and commodity futures. GFP takes an equally weighted combination of the global factor premiums. Alphas are relative to equity and bond asset class returns. Significant average returns at the 10% significance level are denoted in italics and at the 5% significance level with a *. Numbers within parentheses represent t-values. Standard errors are computed using the Newey-West procedure.

	1992 2021	**1950 2021**	**1926 2021**	**1875 2021**	**t-value**	**Alpha**	**t-value**
Panel A: Asset classes							
Equities	*8.9**	*12.1**	*10.6**	*8.4**	*7.4*	-	-
Bonds	*5.4**	*5.6**	*5.1**	*4.5**	*14.0*	-	-
Cash	*2.3**	*4.0**	*3.2**	*3.4**	*40.4*	-	-
60/40	*7.5**	*9.5**	*8.4**	*6.8**	*9.5*	-	-
Panel B: Equity factors							
Value	1.6	*3.3**	*4.0**	*3.5**	*3.0*	*3.9**	*3.3*
Momentum	5.4	*8.2**	*7.7**	*6.9**	*4.8*	*8.5**	*6.0*
Low risk	*6.4**	*6.9**	*6.0**	*6.5**	*6.7*	*5.0**	*4.9*
Quality	*3.2**	*2.9**	*2.5**	*2.5**	*4.9*	*3.2**	*6.0*
MFE	*4.1**	*5.3**	*5.2**	*5.1**	*7.4*	*5.5**	*7.9*
Panel C: Bond factors							
Value	0.8	*4.0**	*3.4**	*2.4**	*2.5*	*2.1*	*1.8*
Momentum	2.4	*2.6**	1.7	*3.9**	*3.9*	*4.2**	*3.6*
Low risk	0.9	*4.3**	*4.5**	*4.4**	*4.0*	*6.1**	*5.0*
Carry	*5.5**	*7.9**	*6.6**	*7.4**	*7.9*	*7.4**	*6.8*
MFB	*2.4**	*4.7**	*3.9**	*4.6**	*9.4*	*4.9**	*9.2*
Panel D: Global factors							
Value	*2.6**	*2.7**	*2.4**	*2.3**	*4.8*	*2.6**	*4.8*
Momentum/Trend	*4.8**	*7.3**	*7.4**	*7.4**	*13.8*	*7.6**	*12.6*
Low risk	0.7	*2.2**	*2.1**	*1.6**	*4.3*	*1.4**	*3.5*
Carry	*5.5**	*6.5**	*4.9**	*5.5**	*11.4*	*5.3**	*9.7*
GFP	*3.4**	*4.7**	*4.2**	*4.2**	*17.7*	*4.2**	*15.7*

Table 3: Investment returns by inflation regime

The table shows historical returns on asset classes and factor premiums bucketed by four contemporaneous global inflation categories (from deflation; <0%, to high inflation; >4%). The sample period is 1875-2021. Returns are in percentages per annum. Significance at the 10% significance level is denoted in italics and at the 5% significance level with a *. A Wald F-test is used to test for significant average return differences across the different inflationary states. All standard errors are computed using the Newey-West procedure.

		Inflation bucket				
	All	< 0%	0-2%	2-4%	> 4%	Wald
Years	147	23.1	42.9	34.9	46.1	-
Likelihood (%)	100	15.7	29.2	23.7	31.4	-
Inflation (%)	3.2	-3.1	1.2	2.8	8.5	-
Panel A1: Asset classes – nominal return						
Equities	8.4	2.4	11.1	11.0	6.9	*3.9**
Bonds	4.5	5.2	4.7	4.5	3.9	0.6
Cash	3.4	2.8	2.7	3.4	4.2	*3.5**
60/40	6.8	3.5	8.5	8.4	5.7	*3.0**
Panel A2: Asset classes - real return						
Equities	5.1	5.5	9.8	8.2	-1.7	*4.2**
Bonds	1.2	8.4	3.4	1.6	-4.6	*24.9**
Cash	0.1	5.9	1.5	0.5	-4.3	*37.0**
60/40	3.5	6.7	7.2	5.6	-2.9	*6.5**
Panel B: Equity factors						
Value	3.5	4.2	3.0	2.4	4.5	0.5
Momentum	6.9	5.9	6.1	7.4	7.7	0.3
Low risk	6.5	7.0	7.4	5.3	6.2	0.3
Quality	2.5	3.6	3.3	2.2	2.0	0.5
MFE	5.1	5.9	5.1	4.5	5.3	0.4
Panel C: Bond factors						
Value	2.4	0.8	2.0	0.9	4.8	1.7
Momentum	3.9	5.6	5.0	6.0	0.4	*2.7**
Low risk	4.4	10.3	2.2	3.0	5.8	*2.2*
Carry	7.4	7.8	7.7	8.5	6.1	0.5
MFB	4.6	5.3	4.7	4.9	4.0	0.4
Panel D: Global factors						
Value	2.3	1.2	3.3	1.9	2.1	1.8
Momentum/Trend	7.4	6.8	7.4	5.7	8.9	*2.9**
Low risk	1.6	1.9	2.1	4.2	4.0	1.2
Carry	5.5	4.7	6.0	7.1	4.3	*2.4*
GFP	4.2	3.4	4.4	4.2	4.3	1.3
Panel E: Assets + Factors – real return						
Equities + MFE	7.7	8.5	12.4	10.4	1.0	*4.1**
Bonds + MFB	3.5	11.0	5.7	4.1	-2.6	*21.3**
Cash + GFP	4.3	9.3	5.9	4.7	0.0	*24.5**
60/40 + All factors	6.9	10.2	10.6	8.7	0.4	*6.3**

Table 4: A deeper look at returns during inflationary periods

The table shows historical returns on asset classes and factor premiums during high inflation regimes, sub-bucketed based on recessions or expansion, increasing or decreasing corporate earnings, equity bull or bear markets, increases or decreases in long-term rates, or increases or decreases in one-year inflation rates. The sample period is 1875-2021. Returns are in percentages per annum.

	High inflation (>4%)									
	NBER		Earnings		Equity		Rates		Inflation	
	↓	↑	↓	↑	↓	↑	↑	↓	↑	↓
Years	10.9	35.3	16.8	29.3	12.8	33.4	25.9	20.1	28.5	17.6
Likelihood	23.4	76.6	36.5	63.5	27.8	72.2	56.2	43.8	61.8	38.2
Inflation (%)	9.5	8.3	9.8	7.8	10.8	7.7	9.0	8.0	9.1	7.6
Panel A1: Asset classes – nominal return										
Equities	-7.1	11.2	3.2	9.0	-18.0	16.4	3.0	11.9	5.6	9.0
Bonds	5.1	3.6	5.0	3.3	1.8	4.7	1.0	7.7	2.4	6.4
Cash	5.4	3.8	4.6	4.0	4.3	4.2	4.7	3.6	3.8	4.8
60/40	-2.2	8.2	4.0	6.2	-10.1	11.7	2.2	10.2	4.1	7.5
Panel A2: Asset classes – real return										
Equities	-16.6	2.9	-6.7	1.2	-28.8	8.7	-6.0	3.9	-3.5	1.4
Bonds	-4.4	-4.7	-4.8	-4.5	-9.0	-3.0	-8.0	-0.3	-6.8	-1.1
Cash	-4.1	-4.4	-5.2	-3.8	-6.5	-3.5	-4.3	-4.4	-5.3	-2.8
60/40	-11.7	-0.1	-5.8	-1.6	-20.9	4.0	-6.8	2.2	-5.0	0.0
Panel B: Equity factors										
Value	3.0	4.9	3.0	5.3	6.2	3.8	3.4	5.8	4.3	4.8
Momentum	7.2	7.9	7.3	8.0	8.0	7.6	10.0	4.8	8.7	6.1
Low risk	7.6	5.8	6.1	6.4	5.6	6.5	4.9	8.0	4.7	8.8
Quality	4.6	1.4	2.7	1.6	3.1	1.6	2.5	1.4	1.9	2.2
MFE	5.4	5.2	4.8	5.5	5.7	5.1	5.3	5.1	5.1	5.5
Panel C: Bond factors										
Value	5.8	4.5	6.1	4.1	5.9	4.4	2.8	7.4	1.9	9.6
Momentum	-2.4	1.3	-3.8	2.9	-5.9	2.8	1.0	-0.2	1.7	-1.7
Low risk	14.3	3.3	10.2	3.5	1.4	7.8	7.0	4.9	6.1	5.3
Carry	5.5	6.2	1.4	8.8	9.5	4.4	7.0	4.3	7.4	3.9
MFB	4.7	3.7	2.5	4.8	1.6	4.9	4.2	3.7	4.1	3.7
Panel D: Global factors										
Value	3.9	1.6	3.7	1.2	4.0	1.4	1.4	3.1	1.4	3.3
Momentum/Trend	7.3	9.4	8.0	9.4	9.6	8.6	10.4	6.9	9.1	8.5
Low risk	0.0	3.3	1.4	2.3	-0.3	2.8	1.9	2.1	1.7	2.5
Carry	5.2	4.1	3.1	5.0	2.8	4.9	5.0	3.5	5.2	3.0
GFP	4.1	4.6	4.0	4.5	4.0	4.4	4.7	3.9	4.3	4.3
Panel E: Assets and Factors – real return										
Equities + MFE	-13.9	5.5	-4.3	4.0	-26.0	11.3	-3.4	6.5	-1.0	4.2
Bonds + MFB	-2.1	-2.9	-3.6	-2.1	-8.2	-0.6	-5.9	1.6	-4.8	0.8
Cash + GFP	0.0	0.2	-1.2	0.7	-2.5	0.9	0.4	-0.5	-1.0	1.5
60/40 + All factors	-8.3	3.1	-3.2	2.4	-18.1	7.4	-3.4	5.3	-1.6	3.7

Table 5: A deeper look at returns during deflationary periods

The table shows historical returns on asset classes and factor premiums during high inflation regimes, sub-bucketed based on recessions or expansion, increasing or decreasing corporate earnings, equity bull or bear markets, increases or decreases in long-term rates, or increases or decreases in one-year inflation rates. The sample period is 1875-2021. Returns are in percentages per annum.

	Deflation									
	NBER		Earnings		Equity		Rates		Inflation	
	↓	↑	↓	↑	↓	↑	↑	↓	↑	↓
Years	15.8	7.3	14.6	8.5	8.2	14.9	6.4	16.7	6.1	17.0
Likelihood (%)	68.2	31.8	63.2	36.8	35.4	64.6	27.8	72.2	26.4	73.6
Inflation (%)	-3.3	-2.7	-3.7	-2.2	-3.9	-2.6	-2.7	-3.3	-2.7	-3.2
Panel A1: Asset classes – nominal return										
Equities	-1.3	10.2	-0.6	7.5	-12.1	10.3	-4.3	4.9	11.1	-0.7
Bonds	4.9	5.9	5.5	4.8	4.1	5.9	1.7	6.6	5.9	5.0
Cash	3.0	2.6	2.9	2.8	2.9	2.8	2.8	2.8	2.6	2.9
60/40	1.6	7.7	2.2	6.0	-4.1	7.8	-1.2	5.4	8.2	1.9
Panel A2: Asset classes – real return										
Equities	2.0	13.0	3.0	9.7	-8.2	13.0	-1.6	8.2	13.8	2.5
Bonds	8.2	8.6	9.1	7.0	8.1	8.5	4.4	9.9	8.6	8.2
Cash	6.3	5.3	6.5	4.9	6.9	5.4	5.5	6.1	5.3	6.2
60/40	4.9	10.4	5.8	8.1	-0.2	10.4	1.5	8.7	10.9	5.2
Panel B: Equity factors										
Value	8.3	-4.5	7.8	-2.0	8.0	2.1	14.1	0.4	7.1	3.2
Momentum	7.9	1.5	7.2	3.7	19.1	-1.4	13.1	3.1	-14.2	13.1
Low risk	2.6	16.1	3.7	12.6	0.8	10.6	6.3	7.2	7.8	6.6
Quality	5.3	-0.1	3.0	4.2	6.6	2.4	4.4	3.0	-	3.6
MFE	6.7	4.3	6.7	4.6	9.7	3.9	11.2	3.9	0.2	8.0
Panel C: Bond factors										
Value	1.3	-0.3	1.9	-1.2	4.8	-1.4	2.2	0.3	-2.7	2.0
Momentum	5.6	5.5	5.4	5.9	6.4	5.1	10.1	3.9	1.6	7.0
Low risk	12.2	7.2	12.5	6.1	15.0	6.8	2.7	11.9	7.6	11.3
Carry	8.6	6.2	7.7	7.9	9.0	7.2	9.3	7.2	6.1	8.4
MFB	5.7	4.4	5.7	4.6	7.6	4.0	7.0	4.6	2.1	6.4
Panel D: Global factors										
Value	2.0	-0.4	1.5	0.8	3.3	0.1	1.8	1.0	-3.0	2.7
Momentum/Trend	7.7	4.9	7.6	5.3	9.2	5.5	5.8	7.2	7.5	6.5
Low risk	0.5	1.9	1.1	0.6	-0.6	1.7	0.8	1.0	3.6	0.0
Carry	5.5	2.9	4.3	5.3	4.3	4.9	4.2	4.9	3.3	5.2
GFP	3.9	2.3	3.6	3.0	4.1	3.0	3.1	3.5	2.9	3.6
Panel E: Assets + Factors – real return										
Equities + MFE	5.4	15.2	6.4	12.0	-3.4	15.0	4.0	10.2	13.9	6.5
Bonds + MFB	11.1	10.8	12.0	9.3	11.9	10.5	7.9	12.2	9.7	11.4
Cash + GFP	10.2	7.6	10.1	7.9	11.0	8.4	8.6	9.6	8.2	9.8
60/40 + All factors	8.4	13.9	9.3	11.5	3.6	13.8	6.2	11.7	12.8	9.2

Appendix

Table A1: Robustness results – Inflation classifications

The table shows historical returns on asset classes (Panel A), and equity, bond, and global macro factor premiums (Panel B) bucketed by two different global inflation category definitions (<3% vs. >3%, and <5% vs. >5%). The sample period is 1875-2021. Returns are in percentages per annum. Significance at the 10% significance level is denoted in italics and at the 5% significance level with a *. A Wald F-test is used to test for significant average return differences across the different inflationary states. All standard errors are computed using the Newey-West procedure.

Panel A: Global equity, bond, and cash returns

Inflation bucket	N (ann.)	Inflation (avg.)	Nominal returns				Real returns			
			Equities	Bonds	Cash	60/40	Equities	Bonds	Cash	60/40
<3%	87.7	0.4	9.0	4.7	2.9	7.3	8.6	4.3	2.5	6.9
>3%	59.3	7.4	7.4	4.2	4.1	6.1	0.0	-3.2	-3.3	-1.3
Wald	-	-	0.45	0.43	*8.39**	0.55	*10.96**	*46.41**	*58.48**	*20.05**
<5%	113.3	1.2	9.3	4.9	3.2	7.5	8.1	3.7	2.0	6.3
>5%	33.8	10.1	5.4	3.1	4.0	4.5	-4.6	-6.9	-6.1	-5.5
Wald	-	-	1.33	*4.42**	1.72	1.96	*11.61**	*62.28**	*70.32**	*20.99**
All	147	3.2	8.4	4.5	3.4	6.8	5.1	1.2	0.1	3.6

Panel B: Factors returns

	Inflation bucket	<3%	>3%	Wald	<5%	>5%	Wald
Equity factors	Value	3.0	4.2	0.47	3.0	5.2	1.09
	Momentum	6.3	7.8	0.69	6.6	7.9	0.49
	Low risk	6.8	6.0	0.22	7.4	3.4	*5.14**
	Quality	3.0	1.9	1.12	2.9	1.4	*2.93*
	MFE	5.1	5.1	0.00	5.3	4.6	0.56
Bond factors	Value	1.2	4.3	*4.93**	2.0	4.0	1.33
	Momentum	5.3	1.8	*5.06**	5.1	0.0	*8.00**
	Low risk	3.2	5.8	1.75	3.8	6.2	1.59
	Carry	7.6	7.1	0.08	7.5	7.0	0.08
	MFB	4.6	4.5	0.02	4.8	3.8	0.87
Global factors	Value	2.4	2.1	0.24	2.3	2.2	0.03
	Mom (Trend)	6.9	8.0	1.11	6.9	8.9	2.19
	Low risk	1.3	2.0	1.10	1.6	1.4	0.05
	Carry	5.8	5.2	0.40	6.0	3.9	3.71
	GFP	4.1	4.3	0.07	4.2	4.1	0.51

Table A2: Robustness results – Annual changes in inflation

The table shows historical returns on asset classes (Panel A), and equity, bond, and global macro factor premiums (Panel B) bucketed by four global inflation categories (from deflation; <0%, to high inflation; >4%) using annual changes in inflation. The sample period is 1875-2021. Returns are in percentages per annum. Significance at the 10% significance level is denoted in italics and at the 5% significance level with a *. A Wald F-test is used to test for significant average return differences across the different inflationary states. All standard errors are computed using the Newey-West procedure.

Panel A: Global equity, bond, and cash returns

Change in Infl. bucket	N (ann.)	Inflation (avg.)	Nominal returns				Real returns			
			Equities	Bonds	Cash	60/40	Equities	Bonds	Cash	60/40
<0%	74.9	-2.5	7.7	5.5	5.2	6.8	10.2	8.0	7.8	9.3
0-2%	44.9	0.8	10.0	4.2	3.3	7.7	9.2	3.4	2.5	6.9
2-4%	10.7	2.9	7.5	2.7	2.7	5.6	4.7	-0.2	-0.2	2.7
>4%	16.5	7.4	7.7	1.6	5.9	5.3	0.3	-5.8	-1.5	-2.2
All	147.0	3.2	8.4	4.5	3.4	6.8	5.1	1.2	0.1	3.6
Wald	-	-	1.13	*8.10**	0.92	1.22	*2.87**	*55.67**	*51.32**	*8.29**

Panel B: Factors returns

	Change in Infl. bucket	<0%	0-2%	2-4%	>4%	All	Wald
Equity factors	Value	3.4	2.9	4.0	5.1	3.5	0.16
	Momentum	9.0	4.4	0.0	8.5	6.9	*3.31**
	Low risk	8.3	4.3	5.5	4.8	6.5	*2.73**
	Quality	2.7	2.4	2.3	1.2	2.5	0.45
	MFE	6.4	3.4	2.8	5.7	5.1	*3.81**
Bond factors	Value	3.9	1.9	-1.8	-0.3	2.4	*3.58**
	Momentum	4.2	4.4	3.7	1.0	3.9	0.82
	Low risk	7.4	6.6	8.6	8.7	7.4	1.38
	Carry	4.6	3.6	8.9	2.8	4.4	0.60
	MFB	5.1	4.2	4.5	3.3	4.6	1.32
Global factors	Value	3.3	2.3	-1.4	0.2	2.3	*6.66**
	Mom (Trend)	7.2	6.7	8.3	9.5	7.4	1.45
	Low risk	2.6	4.1	3.5	2.9	1.6	0.63
	Carry	5.4	6.6	4.4	4.2	5.5	*2.17*
	GFP	4.3	4.4	3.2	3.8	4.2	2.02

Table A3: Robustness results – U.S. inflation analysis

The table shows historical returns on asset classes (Panel A), and equity, bond, and global macro factor premiums (Panel B) bucketed by four global inflation categories (from deflation; <0%, to high inflation; >4%) using U.S. inflation data only. The sample period is 1875-2021. Returns are in percentages per annum. Significance at the 10% significance level is denoted in italics and at the 5% significance level with a *. A Wald F-test is used to test for significant average return differences across the different inflationary states. All standard errors are computed using the Newey-West procedure.

Panel A: Global equity, bond, and cash returns

Inflation bucket	N (ann.)	Inflation (avg.)	Nominal returns				Real returns			
			Equities	Bonds	Cash	60/40	Equities	Bonds	Cash	60/40
<0%	27.6	-3.6	5.2	5.2	4.1	5.2	8.8	8.8	7.7	8.8
0-2%	42.0	1.0	8.9	3.9	3.9	6.9	7.9	2.9	2.9	5.9
2-4%	40.3	2.9	10.1	5.4	5.2	8.2	7.2	2.5	2.3	5.3
>4%	37.2	7.9	8.2	3.6	4.8	6.4	0.4	-4.3	-3.1	-1.5
All	147.0	3.2	8.4	4.5	3.4	6.8	5.1	1.2	0.1	3.6
Wald	-	-	0.87	*3.01**	*7.94**	0.97	1.99	*30.69**	*37.72**	*5.49**

Panel B: Factors returns

	Inflation bucket	<0%	0-2%	2-4%	>4%	All	Wald
Equity factors	Value	4.1	1.5	3.3	5.5	3.5	1.23
	Momentum	4.3	5.9	8.5	8.3	6.9	1.19
	Low risk	6.9	8.2	6.9	3.9	6.5	1.89
	Quality	2.4	2.0	2.8	2.5	2.5	0.21
	MFE	5.3	4.6	5.6	5.2	5.1	0.33
Bond factors	Value	0.9	2.5	1.1	5.0	2.4	2.07
	Momentum	5.8	5.7	2.9	1.6	3.9	2.00
	Low risk	4.2	3.6	3.4	6.5	4.4	0.75
	Carry	7.5	8.2	6.8	7.0	7.4	0.30
	MFB	4.7	5.3	3.6	4.8	4.6	1.48
Global factors	Value	1.2	2.9	2.5	2.1	2.3	1.04
	Mom (Trend)	7.9	6.1	6.8	9.0	7.4	2.09
	Low risk	1.0	2.0	3.8	5.4	1.6	2.04
	Carry	4.2	5.8	6.1	5.5	5.5	0.98
	GFP	3.5	4.0	4.3	4.8	4.2	*2.42*

Table A4: Robustness results – 3-year analyses

The table shows historical returns on asset classes (Panel A), and equity, bond, and global macro factor premiums (Panel B) bucketed by four global inflation categories (from deflation; <0%, to high inflation; >4%) using a 3-year inflation classification and investment holding period. The sample period is 1875-2021. Returns are in percentages per annum. Note that for equity Quality, which starts in 1940, no 3-year deflationary observations are available. Significance at the 10% significance level is denoted in italics and at the 5% significance level with a *. A Wald F-test is used to test for significant average return differences across the different inflationary states. All standard errors are computed using the Newey-West procedure.

Panel A: Global equity, bond, and cash returns

Inflation bucket	N (ann.)	Inflation (avg.)	Nominal returns				Real returns			
			Equities	Bonds	Cash	60/40	Equities	Bonds	Cash	60/40
<0%	21.0	-2.2	4.7	4.6	3.0	4.6	6.9	6.8	5.2	6.9
0-2%	47.8	1.4	9.5	4.1	2.7	7.3	8.1	2.6	1.3	5.9
2-4%	36.3	2.9	12.3	5.1	3.8	9.4	9.4	2.2	0.9	6.5
>4%	41.9	8.3	5.5	4.3	4.1	5.0	-2.7	-3.9	-4.2	-3.2
All	147	3.2	8.2	4.5	3.4	6.7	5.0	1.3	0.2	3.5
Wald	-	-	*2.46*	0.60	1.83	2.06	*3.12**	*17.13**	*25.37**	*4.53*

Panel B: Factors returns

	Inflation bucket	<0%	0-2%	2-4%	>4%	All	Wald
Equity factors	Value	6.5	2.2	2.8	4.5	3.6	1.20
	Momentum	7.2	5.4	8.4	7.1	6.9	1.18
	Low risk	7.0	6.7	7.3	4.8	6.4	0.57
	Quality	-	3.1	2.5	1.8	2.5	0.55
	MFE	7.0	4.6	5.5	4.6	5.2	0.98
Bond factors	Value	1.1	0.9	2.4	4.7	2.4	*2.16*
	Momentum	5.6	5.2	5.7	0.3	4.0	*2.13*
	Low risk	8.9	1.3	4.7	5.8	4.3	*3.03**
	Carry	7.8	7.4	9.0	6.1	7.5	0.75
	MFB	5.3	4.2	5.7	3.7	4.6	1.48
Global factors	Value	0.8	2.3	2.5	2.8	2.3	1.64
	Mom (Trend)	7.7	6.8	6.5	8.7	7.4	1.05
	Low risk	1.3	1.4	5.4	4.0	1.6	*2.74**
	Carry	4.4	5.8	7.2	4.4	5.6	*2.20*
	GFP	3.4	3.9	4.7	4.5	4.2	*2.16*