

Inflation-Hedging Portfolios in different inflation regimes

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Abstract

This paper studies the strategic asset allocation of an investor willing to hedge inflation risk in different inflation regimes. Using a vector-autoregressive model (VAR) for the joint dynamics of asset returns, inflation and other state variables, we investigate the relationship between asset returns and inflation at different investment horizons in the context of a simulation that allows for serial and cross-sectional inter-temporal dependencies between asset returns and different economic variables. In each inflation regime, (1) high and volatile, and (2) low and stable, we then study the optimal portfolio choice for the investor willing to attain a fixed target real return on his investment horizon, with a shortfall probability constraint. We show that the strategic asset allocation differs strongly across regimes. In periods of high and volatile inflation, equities and commodities play an essential role in hedging a portfolio against inflation. In low and stable inflation environment, nominal bonds play the most significant role. Our results also confirm the value of alternative asset classes in protecting the portfolio against inflation, especially during high and volatile inflation periods. We show the optimal allocation for each investor, depending of its target real return and tolerated shortfall probability.

Keywords: inflation hedge, pension finance, shortfall risk, portfolio optimization
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Extended abstract

Hedging against inflation is a key concern for many investors, both long-term institutional investors (particularly pension funds, which operate under inflation-linked liability constraints) and individual investors, for whom real-term capital preservation is a minimal objective. With the recent increase in inflation volatility and the exceptional rise in government deficits due to the subprime crisis, many investors have realised that the low-inflation regime that has prevailed in developed countries over the past 20 years may not last forever. For these investors, the question is how to build the ideal portfolio that will shield them effectively from inflation risk and, where possible, generate excess returns.

We study the problem of an investor subject to inflation risk, who is able to invest in Treasury bills, government nominal and inflation-linked (IL) bonds, stocks, real estate and commodities. This investor has an asset portfolio that he wants to protect against inflation risk. We consider that he implicitly has a target nominal return of (inflation + $x\%$), with x a fixed real rate of return comprised between 0% and 5%. We are interested in three main questions: (1) What are the inflation-hedging properties of each asset class for a particular investment horizon? (2) What is the optimal allocation for an investor willing to achieve a target nominal return of (inflation + $x\%$), depending on the level of risk he is ready to assume? (3) Are the inflation hedging properties of assets the same whether inflation is high and volatile, as in the 1970s and 1980s, which were subject to large oil shocks, or fairly low and stable, as in the 1990s and 2000s and is the optimal allocation different depending on the inflation regime?

Due to the lack of long enough historical data, studying strategic asset allocation can only be made in the context of a model for the joint distribution of asset returns. We use a vector-autoregressive (VAR) specification to model the inter-temporal dependency across variables, and then simulate long-term holding portfolio returns for a range of different asset portfolios and inflation. Recent research has pointed to instability and regime shifts in the stochastic process generating asset returns. One difficulty stressed by Guidolin and Timmerman (2005), Goetzmann and Valaitis (2006) lies in the fact that a full-sample VAR model can be mis-specified as the correlation structure is not constant over the whole sample.

There is growing empirical evidence that asset returns follow a more complicated process with multiple regimes (Garcia and Perron (1996), Ang and Bekaert (2002), Connolly et al. (2005)). One of the main factors causing a change in the correlation structure between assets and state variables is the changing behaviour of inflation. This is, for example, one of the main causes of the changing sign for correlation between stocks and bonds (Li (2002), Ilmanen (2003)). When inflation is high, it becomes an important determinant of stocks and bonds prices, which are then positively correlated. When it is low, their link becomes much weaker, and the overall correlation is nil, even becoming negative during flights to quality, deflationary recessions and equity weakness.

For this reason, it is especially important to take inflation regimes into account for long-term asset allocation. Using the Goetzmann et al. (2006) test for structural change in correlation, we determine the breakpoint that best separates the sample data, ensuring the most stable correlation structure within each sub-period. During the first part of the sample (1973-1990), inflation is high and volatile, whereas during the second half (1991-2009) it is much lower and stable. The fitted parameters of the two estimated VAR models are used to perform a simulation-based analysis on a long-term horizon of 30 years. The simulated returns are thus used, on the one hand, to measure the inflation hedging properties of each asset class in each regime, and on the other hand to carry out a portfolio optimisation in a mean-shortfall probability framework. We determine the allocation that maximises above-target returns (inflation + x%) within the constraint that the probability of a shortfall remains lower than a threshold set by the investor.

We show that the strategic asset allocation differs strongly across regimes. In periods of high and volatile inflation, equities and commodities play an essential role in hedging a portfolio against inflation. In particular, investing in commodities leads to very low shortfall probabilities at all investment horizons. In contrast, in regimes of low and stable inflation, nominal bonds play the most significant role. In both regimes, IL bonds play a relatively small role in protecting the portfolio against inflation risk, particularly when the real interest rate target is high. This is explained by the fact that IL bonds with long duration are subject to real interest rate risk, and play their inflation-hedging role only imperfectly, especially when the investment horizon is short. Our results also confirm the value of alternative asset classes in shielding the portfolio against inflation, particularly high and volatile inflation and show the

optimal allocation for each investor, depending of its target real return and level of risk aversion.

Our paper contributes to 3 strands of the literature: inflation hedging properties of assets, strategic asset allocation and alternative asset classes. The question of hedging assets against inflation has been very widely studied (see Attié and Roache (2009) for a detailed literature review). Most studies have focused on measuring the relationship between historical asset returns and inflation, either by measuring the correlation between these variables or by adopting a factor approach such as the one used by Fama and Schwert (1977). These approaches present a number of difficulties, especially with regard to the lack of historical data available to study long-horizon returns, the problem of non-serially independent data, non-stationary variables, and instability over time of the assets' relationships to inflation.

The literature on strategic asset allocation has shed new light on this question. Continuing the pioneering works of Brennan et al. (1997), Campbell and Viceira (2002), many researchers have sought to show that long-term allocation is very different from short-term allocation when the investment set varies over time and return-predicting state variables have strong autocorrelation (Barberis (2000), Brennan and Xia (2002), Wachter (2002), Campbell et al. (2003, 2004), Guidolin and Timmermann (2005), Fugazza et al. (2006)). The approach developed in an assets-only framework was extended to ALM (Van Binsbergen and Brandt (2007) using traditional classes (Treasury bills, Treasury bonds and equities), but also alternative assets: commodities, real estate, hedge funds (Goetzmann and Valaitis (2006), Hoevenaars et al. (2008), Amenc et al. (2008)). All these articles are based on a common idea: they model the joint dynamic of asset returns, liabilities and macroeconomic variables via a VAR model (VECM in the case of Amenc et al. (2008)). This provides a data-generating process that will serve to create simulations: a large number of scenarios are simulated from the estimated dynamics of the model. Inflation-hedging characteristics of various asset classes and portfolios are compared for differing investment horizons. Hoevenaars et al. (2008) show the optimal portfolio (minimising the volatility of the surplus) for an investor with and without liabilities, and show that the differences are material.

One common characteristic of these studies is their focus on the situation of investors with liabilities, such as pension funds, which are therefore subject to the risk of fluctuating inflation and real interest rates. In this article, we adopt a different point of view. Not all

investors who seek to hedge against inflation necessarily have liabilities. They may only wish to hedge their assets against the risk of real-term depreciation, and thus have a purely nominal objective that consists of the inflation rate plus a real expected return target, which is assumed to be fixed.

Thus far, most of the research into inflation hedging for diversified portfolios has been done within a mean-variance framework. The studies of inflation hedging properties in an ALM framework with a liability constraint generally focus on a surplus optimisation, which involves maximising the surplus under the constraint that its volatility must be lower than a target value (Leibowitz (1987), Sharpe and Tint (1990), Hoevenaars et al. (2008)). In our context, however, this risk measure is not the one that corresponds best to investors' objectives. Our portfolio's excess returns above target may be only slightly volatile but still significantly lower than the objective, presenting a major risk to the investor. The notion of safety-first (Roy (1952)) is therefore more appropriate. We focus on the shortfall probability, i.e. the likelihood of not achieving the target return at maturity. In an ALM framework, Amenc et al. (2008) measure shortfall probability of ad hoc portfolios. We expand that work and determine optimal portfolios allocations in a mean/shortfall probability framework.

The properties of alternative asset classes have generally been studied alone, not in a strategic asset allocation context with an inflation hedge. There are a few exceptions. Fugazza et al. (2007) find a strong interest in commodities and real estate in a strategic asset allocation. In an ALM context, Hoevenaars et al. (2008) and Amenc et al. (2008) also find a strong interest in these asset classes, which are interesting sources of diversification and inflation hedging in a portfolio. To the best of our knowledge, however, these asset classes have not yet been studied in an assets-only context with an inflation target. Our research tries to fill the gap.

Our paper is organised as follows. Section 2 presents our data and methodology. Section 3 presents our results: correlation structure of our assets with inflation at different horizons, optimal composition of inflation-hedging portfolios. Section 4 concludes.

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