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Simulating historical inflation-linked bond returns☆

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ABSTRACT

Empirical research on the benefits of investing in inflation-linked bonds usually relies on a limited number of observations due to the relatively recent introduction of these assets. We estimate models for the break-even inflation rate and use these to create hypothetical inflation-linked bond returns. We compare these with the return on actual inflation-linked bond returns on a recent sample and find that surveys of professional forecasters and moving average models perform best. We confirm these findings for a sample of 19 international inflation-linked bond markets. Using surveys of professional forecasters, we create hypothetical inflation-linked bond return series for 41 countries starting in 1987 or later depending on the availability of nominal bond markets. These simulated series can be used by asset allocation researchers, but an average correlation of 0.7 means that the simulated series are at best reasonable proxies for real data on inflation-linked bond returns. This cautionary note is also relevant to appreciate existing research using simulated inflation-linked bond returns.

1. Introduction

Asset allocation studies typically use historical data on asset classes as inputs for expected returns, standard deviations, or correlations. In addition, models for asset liability management make direct or indirect use of real interest rates or inflation-linked bond returns when pension liabilities contain cost-of-living adjustments.

Unfortunately, inflation-linked bonds have only been introduced relatively recently as investment opportunities for the public, which limits the available historical return series that can be used for empirical analyses.[1] The longest inflation-linked bond return data series produced by Bloomberg Barclays are available for the United Kingdom (May 1981), Australia (January 1997), Canada (January 1997) the United States (February 1997), and France (September 1998). Since then, many other governments, both from developed and emerging markets, have started issuing inflation-linked bonds; see Swinkels (2012) and King and Low (2014). The existence of inflation-linked bond markets helps economists determine the real interest rates across countries; see Mishkin (1984) and Barro and Sala-i Martin (1990) for historical estimates of real interest rates for developed countries.

The available inflation-linked bond return series of developed markets are not well-suited to determine the potential advantage that inflation-linked bonds have in an asset allocation problem, as inflation has been relatively constant around two percent. Brière and Signori (2009) investigate the benefits of inflation-linked bonds using historical data on the U.S. and France over the period

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[1] Shiller (2005) indicates that inflation-linked bonds have existed in the U.S. at least since 1780. However, only recently they have become mainstream investment instruments. Roll (1996) explains trade-offs between asset characteristics in the design of US TIPS.

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1997 to 2007. They conclude that inflation-linked bonds did not add much value in an investor's asset allocation after 2003. Cartea et al. (2012) find that inflation-linked bonds can be attractive to US long-term investors with a real investment objective. In order to determine the asset allocation benefits of inflation-linked bonds in times of inflation, Kothari and Shanken (2004) simulate historical inflation-linked bond returns starting in 1953. It does not become clear from their study what the quality of the simulated return series is relative to actual inflation-linked bond returns. Their sample period ends in December 2000, just after the introduction of inflation-linked bonds in the U.S., so called Treasury Inflation-Protected Securities (TIPS). Perhaps the short sample period is the reason they do not compare their simulated returns with observed returns on U.S. inflation-linked bonds.[2] We aim to fill this gap in the literature.

The use of extended time-series by historical simulation allows researchers to also include inflationary periods in their analyses. Another possibility is to increase the cross-section with observed inflation-linked bond returns. Swinkels (2012) extends the cross-section of inflation-linked bond returns to 9 emerging and 11 developed markets. Inflation in emerging markets has been markedly higher and more volatile than for developed markets, which is a good environment to investigate the benefits of inflation-linked bonds. Unsurprisingly, for samples with more inflation variability than in Brière and Signori (2009), inflation-linked bonds turn out to be a more attractive asset class for investors, mainly because of increased diversification with nominal bond returns in these environments. Barnes et al. (2010) advocate the use of index-linked bonds as an effective hedge against changes in the real yield or inflation shocks, especially for longer holding periods.

Since many countries only started issuing inflation-linked bonds over the past decade, they all share the global financial crisis, a peculiar time for the pricing of inflation-linked bonds; see Campbell et al. (2009) and D'Amico, Kim, and Wei (2014). Therefore, it might be a valuable extension to have available inflation-linked bond time-series both for a large cross-section of countries and a long sample period, even though this line of research is hampered by the difficulty to model the risk premia embedded in inflation-linked bonds, such as the inflation and liquidity risk premiums; see Driessen et al. (2017).

Methods described in, e.g. Pástor and Stambaugh (2002), Agarwal and Naik (2004) and Page (2013) make it possible to combine information from assets with long and short data histories. The methods in these papers typically assume that correlations or covariances with other asset classes in the period that both assets are available are the same in the period that one asset class was not traded. This makes it potentially problematic when covariances are expected to be time-varying, for example because nominal bonds and inflation-linked bonds have a high return correlation when inflation is stable around an expected level, but low when inflation unexpectedly increases or decreases. This expected covariance dynamics leads us to model the inflation-linked bond returns using a model for break-even inflation instead of extrapolation of returns using observed covariances in periods that all assets are traded.

Our paper contributes to the literature in two ways. First, we estimate the model accuracy of the model by Kothari and Shanken (2004) by comparing it to the returns of actual inflation-linked bonds in the United States over the period 1997 to 2017. Second, we develop a more accurate and less data intensive method to simulate historical inflation-linked bond returns. This allows asset allocation researchers to use long-run data series on inflation-linked bonds without having to estimate complicated simulation models.

Our main findings are threefold. First, no matter whether we use the coefficient estimates of Kothari and Shanken (2004) or the coefficients from expanding or rolling window regressions, or even the out-of-sample period only, the correlation between simulated and realized inflation-linked bond returns is about 0.6 to 0.7. The volatility of the return differences between the simulated and realized bond returns is larger than the volatility of the realized bond returns themselves, with respectively 5.5 and 5.0 percent. This suggests a relatively poor performance of this model during the period that inflation-linked bonds exist. Second, using survey of professional forecasters' inflation estimates as a proxy for break-even inflation produces correlations above 0.8 with a return difference volatility of 3.1 percent. When inflation surveys are not available, a moving average of realized inflation produces a correlation of 0.7 and return difference volatility of 4.0 percent. This is a closer match than the more data intensive Kothari and Shanken (2004) method. Third, we confirm for an international sample of realized inflation-linked bond returns that the simulations using inflation surveys has a correlation above 0.7 and a volatility of return differences below 5 percent. These simulated series, which are available online, can be used by asset allocation researchers, but an average correlation of 0.7 means that the simulated series are at best reasonable proxies for real data on inflation-linked bond returns. This cautionary note is also relevant to appreciate existing research using simulated inflation-linked bond returns.

The remainder of this paper is organized as follows. In Section 2, we explain the models we use to estimate the break-even inflation rates. Section 3 contains the empirical results of our comparison of each of the models for the US. In Section 4, we simulate inflation-linked bond returns for 19 countries that have issued inflation linked bonds. Section 5 contains the summary statistics of the simulated inflation-linked bond series for 41 countries starting in 1987 or later depending on the availability of nominal bond markets. Finally, Section 6 concludes.

2. Estimating break-even inflation

A historical simulation of inflation-linked bond returns that we have in mind is equivalent to historical simulation of the break-even inflation. The break-even inflation is defined as the difference between the nominal and real yield on an inflation-linked bond, and its most important components are the expected inflation, the inflation risk premium, and the liquidity risk premium. It is often

[2] Note that Kothari and Shanken (2004) do include analyses on observed inflation-linked bond returns over the period February 1997 to July 2003. Roll (2004) also empirically analyses the asset allocation benefits of TIPS using historical data from February 1997 to September 2003 and concludes that TIPS are a valuable asset class. D'Amico, Kim, and Wei (2014) find that before 2003 liquidity in TIPS was poor and pricing therefore included a substantial liquidity premium, up to 100 basis points.

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