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Varying risk premia in international bond markets ☆

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ABSTRACT

Cochrane and Piazzesi [Cochrane, J.H., Piazzesi, M., 2005. Bond risk premia. American Economic Review 95, 138–160] use forward rates to forecast future bond returns. We extend their approach by applying their model to international bond markets. Our results indicate that the unrestricted Cochrane and Piazzesi (2005) model has a reasonable forecasting power for future bond returns. The restricted model, however, does not perform as well on an international level. Furthermore, we cannot confirm the systematic tent shape of the estimated parameters found by Cochrane and Piazzesi (2005). The forecasting models are used to implement various trading strategies. These strategies exhibit high information ratios when implemented in individual countries or on an international level and outperform alternative approaches. We introduce an alternative specification to forecast future bond returns and achieve superior risk-adjusted returns in our trading strategy. Bayesian model averaging is used to enhance the performance of the proposed trading strategy.

1. Introduction

This article gives an introduction and thorough test of a new fixed income trading strategy. The trading strategy uses an international modification of the Cochrane and Piazzesi (2005) model to generate monthly bond return forecasts. The usage of the model by Cochrane and Piazzesi (2005) is motivated by its good forecasting ability for the US bond market. Furthermore, it has never been thoroughly tested as a driver for fixed income trading strategies.

The return forecasts are generated for major global fixed income markets. Using rolling windows to fit the model, our results are not subject to an in-sample forecasting bias. The trading strategy is implemented by constructing portfolios which go long in fixed income markets with relatively positive forecasts and short in fixed income markets with relatively negative forecasts. Per construction the long and short positions of the strategy sum to zero and, thus, the trading strategy is self-financing. The Cochrane and Piazzesi (2005) specification proves to be a good specification to drive the strategy.

The usage of different portfolio construction methodologies and parameter settings prove the stability of our results. We introduce a modified forecasting specification which exploits the forecasting ability of the US market for other financial markets. This modified specification performs particularly well. In our setting there are many possible specifications to forecast bond returns and there is no clear theoretical guidance to choose one of them. Thus, a Bayesian model averaging (BMA) framework is introduced to determine the return forecast as a weighted average across different forecasting models. Running an investment strategy with a BMA forecast proves to deliver the highest performing strategy with information ratios in excess of one. Finally, the performance of the trading strategy is benchmarked against an alternative strategy using short rate momentum, the yield curve slope, and the real yield as forecasting variables. These variables are used in a similar study by Ilmanen (1997). Another benchmark is established by comparing the results of our approach with a trading strategy which uses the yield curve model by Diebold and Li (2006) to forecast bond returns. However, the trading strategy advocated in this article clearly outperforms both benchmarks.

Cochrane and Piazzesi (2005) focus on the US fixed income market. Before applying their results to other fixed income markets we need to test whether their approach is applicable on an international level. Thus, as a by-product of our analysis, we contribute to the existing literature by conducting a thorough analysis on the extension of the Cochrane and Piazzesi (2005) results to other international financial markets. Our analyses find that their approach works well for all major global fixed income markets and serves as a stability test. The fit of the forecasting regressions for

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other countries is comparable to the one found for the US. For 1-year return forecasts R^2's are on average 0.56. In contrast to Cochrane and Piazzesi (2005) there is no evidence for a tent shape of the forecasting parameters.[1]

There is a large range of literature linked to our research which we do not want to neglect. The previous literature around the forecasting of bond returns can be classified in two broad categories. Articles in the first category start with a forecast of the yield curve for a certain point in time in the future. This yield curve forecast is used to discount the remaining cash flows of a bond at this point in time, effectively predicting the bond price. Comparing the market price of a bond today with its predicted price gives a bond return forecast. Diebold and Li (2006), Diebold et al. (2006), Diebold et al. (2007) and Ang and Piazzesi (2003) follow this approach. Articles in the second category do not take the detour via the yield curve forecast, but predict bond returns directly. Often such a bond return forecast is obtained by regressing bond returns on lagged economic variables and using the estimated parameters to forecast.[2]

Ilmanen (1995), Kim and Moon (2005) and Ludvigson and Ng (2005) successfully predict fixed income returns in a regression approach with a range of macroeconomic variables. Fama and Bliss (1987), Stambaugh (1988), and Cochrane and Piazzesi (2005) predict future bond returns using the forward curve. Our research follows the latter approach and adds international evidence to previous work.

Analyses of fixed income trading strategies form another strand of research closely linked to our article. Fixed income trading strategies in their classic form exploit features of the yield curve. Chua et al. (2006) and Bieri and Chincarini (2005) play different points on the yield curve against each other in simultaneous trades.[3]

Duarte et al. (2005) also analyze such yield curve based strategies but extend their article to swap spread arbitrage, mortgage arbitrage, volatility arbitrage, and capital structure arbitrage. However, the strategy we apply is more similar to Ilmanen (1997) who uses bond excess return forecasts. In contrast to this article, we do not apply economic factors but restrict ourselves to a forecast using forward rates. Appendix of Cochrane and Piazzesi (2005) hints at such an application of their model for a successful trading strategy. Results by Kotomin et al. (2008) on seasonality in bond spreads can be used for fixed income trading strategies.

The remainder of this article is structured as follows. In Section 2 the methodology is introduced. A short description of our data is given in Section 3. The forecasting power of the forward curve for future bond excess returns is analyzed in Section 4. In Sections 5 and 6 unrestricted and restricted forecasting models are used to develop profitable trading strategies. This analysis is complemented in Section 7 by an analysis of the profitability of our strategy in single countries. Bayesian model averaging is used in Section 8 to obtain a more stable strategy performance. Section 9 studies the link between the shape of the yield curve and the performance of our trading strategies. In Section 10 the strategy is compared with a range of other fixed income trading strategies. The conclusions are given in Section 11.

2. Methodology

Let P_t^n denote the price of a zero bond with a maturity of u-months at time t. The one period return is

$$R_t^u = \ln(P_t^u) - \ln(P_{t-1}^{u+1}). \tag{1}$$

The forward rate at time t for a 12 month loan between $t+i-12$ and $t+i$ is expressed and calculated as

$$F_t^{(i-12)\to i} = \ln(P_t^i) - \ln(P_t^{(i-12)}). \tag{2}$$

For $i = 12$ Eq. (2) becomes the 1-year spot rate. The bond return in excess of the risk free rate, c_t, is given by

$$RX_t^u = R_t^u - c_t. \tag{3}$$

As the strategies analyzed in this article are implemented using zero coupon swaps with a monthly reset of the floating leg we have reflected this in our notation. While (3) essentially describes the return of such a swap agreement, the average bond return across different maturities is calculated as

$$\overline{RX}_t^{12N} = \frac{1}{N}\sum_{n=1}^{N} RX_t^{12n}, \tag{4}$$

where we introduce the auxiliary index n to make the bond maturities in the sum of Eq. (4) run across 12 month time spacings and set $N = 5$ (i.e., we focus on the shorter end of the yield curve using a set of tenors ranging from 12 to 60 months in equal 12 month steps).[4] Cochrane and Piazzesi (2005) expressed future bond returns as a linear regression of realized excess returns versus 1-month lagged forward rates:

$$RX_{t+1}^u = \gamma_o + \sum_{n=1}^{N}\gamma_n F_t^{(12n-12)\to 12n} + \varepsilon_{t+1}, \tag{5}$$

with $\varepsilon_{t+1} \sim N(0,\sigma)$. This specification is used to forecast future excess returns $\widehat{RX}_{t+1}^n$. We also run regressions with the average period return as dependent variable, i.e.,

$$\overline{RX}_{t+1}^N = \gamma_o + \sum_{n=1}^{N}\gamma_n F_t^{(12n-12)\to 12n} + \varepsilon_{t+1} = \gamma_o + \gamma^T f_t + \varepsilon_{t+1}, \tag{6}$$

where $f_t = [F_t^{0\to 12}, F_t^{12\to 24}, \ldots, F_t^{48\to 60}]^T$. Let us define a single (state) variable that summarizes the information stored in current forward rates as $\Gamma_t = \gamma^T f_t$. We can now run a restricted version of (5). The parameters of this specification are estimated from

$$RX_{t+1}^u = \gamma_o + \eta\Gamma_t + \zeta_{t+1}. \tag{7}$$

This second, restricted specification is used by Cochrane and Piazzesi (2005) to show that the single factor model's restrictions have only a minor impact on the forecasting ability of future bond returns. This illustrates that the forward curve contains a systematic component which forecasts expected bond returns across different maturities. In other words, the factor Γ_t is shown to be a state variable for expected returns of all maturities. Furthermore, the estimation of this restricted model reduces noise inherent in the estimation of the systematic component.

After having estimated the forecasted future excess returns, $\widehat{RX}_{t+1}^u$, with forward rates known at time t, we employ various portfolio construction methodologies. Our first approach is to use Leh-

[1] Cochrane and Piazzesi (2005) find the following pattern for the parameters of the five forward rates in their regression: Parameter 1 < Parameter 2 < Parameter 3 and Parameter 3 > Parameter 4 > Parameter 5. This pattern is robust in a range of stability tests and appears to be a feature of the US fixed income market.

[2] Compare Nam et al. (2005) for a recent study using regression forecasting in the equities space.

[3] A very basic and simplified approach to such a strategy is a carry trade between 2 and 10 year zero couponbonds. As the duration of zero bonds is equal to their time to maturity, a duration neutral portfolio can beconstructed by going long 5 bonds with 2 years to maturity and going short 1 bond with 10 years to maturity. Such a portfolio would earn 5 times the yield on the 2 year bonds and once the yield on the 10 year bond. Unless the yield curve is very steep or there are massive changes in the yield curve during the holding period, such a position should earn a positive return. Refer to Chua et al. (2006) and Bieri and Chincarini (2005) for a more detailed and precise discussion.

[4] The relationship between the auxiliary index n and our superscripts u for the bond maturity as well as i for the forward rates can be expressed as $u = 12n$ and $i = 12n$, respectively.