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Idiosyncratic returns and relative value in the US Treasury market

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ABSTRACT

This paper documents a simple and implementable security selection strategy that has generated a significantly positive risk-adjusted alpha in the US Treasury bond market from 1990 to 2015. The strategy is based on identifying *relatively* misvalued securities based on the Nelson–Siegel (1987) curve, while controlling for unobserved bond specific factors that may lead to persistent value effects. These results are surprising as the liquidity and depth of the US Treasury market substantially reduces barriers to arbitrage. Our findings are robust to controls for duration, known risk factors, and a placebo "random" selection strategy.

1. Introduction

The study of market efficiency, and by corollary the study of market anomalies, is inextricably linked to the growth of modern finance. The academic literature over time has focused on identifying whether seemingly anomalous returns represent premia for unidentified risks or are a result of barriers to arbitrage (Shleifer and Vishny, 1997). Most documented anomalies relate to the equity market where barriers to arbitrage can be significant; for example, several equity anomaly returns are dependent on small, low-price, low-volume stocks with high idiosyncratic risks, while yet others can be explained by existing risk factors (Fama and French, 1996; Mashruwala et al., 2006). In this study, we focus on one of the most liquid asset markets in the world, the US Treasury market, and show that even in a setting with relatively low barriers to arbitrage, a reasonably simple security selection strategy generates significantly positive risk adjusted returns. In doing so, we provide a direct example of how sophisticated fixed income relative value (FI-RV) investors may have been able to utilize pricing differentials to their benefit (Huggins and Schaller, 2013).

The strategy we propose is based on identifying securities that are mispriced *relative* to both other securities and the security's historical value according to the Nelson–Siegel yield curve model (Nelson and Siegel, 1987; Diebold and Li, 2006). Our study uses daily data and a comprehensive sample of 1,037 US Treasury bonds and notes traded from 1990 to 2015, with exclusions made for securities with unique pricing features. As the security selection strategy relies only on historical prices (and yields) of the underlying securities, the results of our study shed new light on weak form market efficiency in this market.

Our methodology starts with the three factor (level, slope, curvature) Nelson–Siegel model to fit the shape of the yield curve. We use the fitted curve to identify the *idiosyncratic* or unexplained portion of the yield for each security. Specifically, we subtract the model implied yield from the actual yield of the security to compute residuals from the Nelson–Siegel fit. This provides a cross-sectional view of securities that are not priced on the Nelson–Siegel curve. However, certain securities may remain persistently priced off the curve either for known factors such as Illiquidity due to on-the-run/off-the-run effects or for unknown factors such as

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unobserved heterogeneity. Thus, we also take a time-series view and standardize each security's residual by computing a z-score by subtracting the mean value of the security's residual over the past three months and scaling the difference by its standard deviation over the same period. The value of this standardized z-score presents a cross-sectional and time-series signal of potentially misvalued Treasury securities. Bonds with low z-scores indicate overvaluation, while those with high z-scores indicate undervaluation.[1] Thus, long portfolios focus on the bonds with the highest z-score values, while short portfolios are constructed from bonds with the lowest z-score values.

We next implement and study a trading strategy in out-of-sample tests by creating both long only and long short portfolios of 1, 2, 5, and 10 bonds on the basis of the z-score signal as of the portfolio formation date. For example, the long only 10 bond portfolio includes bonds with the 10 highest z-scores on the rebalancing date. Since both long only and long short strategies have their own strengths and weaknesses, we study the characteristics of both in the paper. The long only strategy has an average duration of about 5.8 years, which is very close to the average duration of 5.2 in the overall bond sample. We also study a long short duration neutral strategy which is structured to have a duration of zero.

The portfolios are rebalanced weekly based on updated z-score values, and then rolled over. Our analysis shows that the 10 bond *long only* equally weighted strategy provides an average annualized return of 8.06% over the sample period, with a Sharpe ratio of 1.5, while a 10 bond *long short* duration neutral strategy provides a return of 2.45%, with a Sharpe ratio of 1.6. As expected, given a similar Sharpe ratio, the lower returns of the long short portfolio are accompanied by lower volatility (1.6%) in comparison to the long only strategy (5.4%). Thus, in both the long only case, and the long short case, the returns from the selection strategy cannot be said to come from a heightened duration exposure. Finally, we note that since all securities are issued by the US government, they all have the same credit risk.[2]

In order to isolate whether our results are driven by our z-score based selection method, we conduct a placebo simulation where we randomly pick 10 long securities while maintaining all other parameters of the test, including duration, the same. We repeat the random selection procedure 1000 times to generate a distribution of possible returns and then examine its properties. Our tests show that our relative value strategy portfolio returns (8.06%) are significantly higher than the mean placebo portfolio return (5.34%) at a 99% significance level. Accounting for risk gives similar inferences as the Sharpe ratio for the strategy is 1.5 versus a mean of 0.95 for the placebo portfolio, a difference significant at the 99% level. Results from the placebo or random portfolio tests indicate that our selection methodology findings are not an artifact of either the test design or random chance.

Transaction costs are an important consideration for the implementation of any strategy. More importantly, high transaction costs can lead to market inefficiency and create barriers to arbitrage. Our base measure of transaction costs assumes a naïve rebalancing strategy where all bonds indicated by the model are rebalanced on the weekly rebalancing date.[3] Our analysis with naïve transaction costs suggests that the return for the 10-bond long only strategy are reduced by about 200 bp, but remain positive and significant.

We next compute risk-adjusted alphas for transaction cost adjusted returns by controlling for known systematic risk factors following Fama and French (1993) and Jostova et al. (2013). Specifically, we run an OLS regression with Newey–West standard errors that incorporates risk factors for both stocks (market excess returns, size, value, momentum) and bonds (term premium, default premium). Our results suggest that the strategy returns generate significant risk adjusted alpha of approximately 11.86 basis points each week after transaction costs, which translates to an annual alpha of approximately 6.35%.

Anomalies often disappear after they are revealed, with informed traders pushing prices to their efficient thresholds. The modified version of the Nelson Siegel model used in this study was published by Diebold and Li in 2006. A Google Scholar search indicates that the earliest working paper version of the paper was online in 2000. In order to test whether returns to the z-score based selection strategy have attenuated through time, we split the sample into three periods (1990–1999, 2000–2009, and 2010–2015) and compute weekly risk-adjusted alphas again. We find that while the alpha of the strategy remained steady in 1990–1999 and 2000–2009 subperiods at 5.45% and 6.03% respectively, it has relatively declined in the more recent 2010–2015 period to 3.56%. In spite of the decline, the alpha remains economically high and statistically significant.

Past studies in the bond market have documented anomalous returns, most notably with respect to momentum profitability. For example, Asness et al. (2013) show the presence of *equity* value and momentum effects in the international government bond market. However, unlike Asness et al. who study the pricing of an entire asset class by examining asset indices, our study is focused on the security level, wherein we identify relatively misvalued individual securities and then group them in a strategic portfolio. In a related paper, Jostova et al. (2013) find significant evidence of individual bond momentum in speculative grade corporate bonds, but find no evidence of momentum in investment-grade bonds consistent with Gebhardt et al. (2005). However, unlike their studies we find the anomaly to be present in the highest rated (AAA US-Treasuries) investment-grade asset class.

Differing forms of fixed income relative value investing have been popular at Wall Street trading desks for quite some time (Choudhary, 2006; Huggins and Schaller, 2013). For example, Merrill Lynch, JP Morgan, UBS, amongst others offer daily "rich/cheap" reports about individual securities to market practitioners, where richness/cheapness is relative to some benchmark curve. In a related study, Sercu and Wu (1997) examine the information content in Vasicek (1977), Cox et al. (1985), and spline (McCulloch, 1971) bond model residuals in the Belgian bond market. Our study differs from Sercu and Wu (1997) in two important ways. First, we follow the Nelson–Siegel approach to compute residuals which is not studied in their paper. Second, as our study encompasses a

[1] The average and median z-score across all bonds is 0, with 1st and 3rd quartile values being −0.75 and 0.76 respectively.

[2] The credit risk of US Treasury securities is generally assumed to be zero in most models. This assumption has been called into question following the global financial crisis. We abstract from this issue in the paper as it has little bearing on our analysis.

[3] This measure overestimates the extent of transaction costs because transaction costs can, in practice, be lowered by reducing the frequency of rebalancing and by choosing not to rebalance if the resultant portfolio is not substantially different in expected exposure.