Alpha Strategy for Stripping Beta Returns for Pure Bond Funds

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Abstract. Contemporarily alpha strategy is favorable by investors and funders for its stable performances among volatility market. Although alpha strategy shows great extra returns, it might have great drawdown on account of the stochastic fluctuations of the market (e.g., hedge funds' poor performance during COVID-19 early state including Bridge Water). Despite from stocks and futures, the bond funds are rather a low volatility type underlying assets, hence the alpha strategy based on pure bond will be more favorable for risk aversion investors. By building a five-factor model, this paper dissolves the returns of pure bond funds to the five factors of level, slope, convex, credit and default, which are separated from each other, and Alpha, which is not directly explained by the factors, and verifies the effectiveness of this alpha factor for selecting pure bond funds. Taking 2019 to 2022 as the time interval, the group backtest results show that the alpha factor stripped of beta has a good effect on the selection of pure bond funds in China's public offering fund market, and the base selection ability is better than the Sharpe Ratio and other traditional risk-return factors. Overall, these results shed light on guiding further exploration of portfolio construction with high alpha based on bond funds.

Keywords: Pure bond fund; Multiple factor model; Beta; Alpha.

1. Introduction

Pure bond fund, its main allocation of assets for bonds, compared with the stock fund has a smaller risk, by many investors' attention. In recent years, pure bond funds in China's public offering market have increased rapidly, playing an increasingly important role in asset allocation tools. However, there are more and more fund companies providing pure bond fund products, and the distribution of products in various dimensions has become more extensive, making it more difficult to select pure bond fund. Therefore, in order to select the best among many pure bond funds, the multi-factor model can be used to strip the returns of each beta factor, so as to obtain the alpha factor of the ability of pure bond funds to actively obtain excess returns, and realize the optimization and portfolio construction of pure bond funds.

The multi-factor model of bonds has a long history, and many scholars have studied the influencing factors of bond or bond portfolio returns. Robert et al. decomposed bond returns into four factors: interest rate level factor, slope factor, convexity factor and credit factor, and proposed an effective method to estimate these factors and their loads [1]. Fama and French proposed a method based on factor model to disassemble bond yield into factors of interest rate and credit [2]. Jegadeesh et al. used a dynamic model to estimate the impact of various factors on corporate bond yields from the term structure of interest rates, including six factors: zero-coupon bond yields, financial leverage, liquidity, stock market volatility, corporate size, and the US national economic growth rate [3]. It explains most of the volatility of changes in corporate bond yields. Broussard et al. proposed a model containing four factors of maturity, credit, inflation and interest rate for asset allocation and risk control of bond portfolios [4]. Duffee et al. used the interest rate level, slope, and credit factor to explain the yield of the bond market [5]. Among them, the market price factor of bond default probability is measured by the spread of bond default swap (CDS). Longstaff et al. studied the Default risk and liquidity risk in bond yields and explored their role in the bond market [6]. To explore their relative contribution in explaining bond market yields. Chen et al. proposed a multi-factor model containing six factors for asset allocation and risk control of bond portfolios [7]. The six factors are interest rate level, interest rate curve, credit, maturity, monetary policy and inflation. Collin-Dufresne et al. mainly studied the impact of interest rate fluctuations on corporate bond yields, and discussed

the role of interest rate volatility factors in explaining bond market yields [8]. When calculating the credit factor, the author uses Merton's structural model to separate the default risk and non-default risk of bonds, and uses the bond maturity yield curve fitting to obtain the premium of non-default risk. Bailey et al. proposed a multi-factor model including four factors of interest rate, credit, maturity and liquidity, which was used for asset allocation and risk control of pure bond funds in Canada [9]. The authors validate the model using data, compare the performance of the model with that of the single-factor model, and analyze the holdings of pure bond funds.

The multi-factor model can evaluate the fund's ability to allocate various risks, and explore its ability to actively obtain excess returns after stripping its ability to allocate known risks. Conventional risk-return factors, e.g., Sharpe ratio and Calmar ratio cannot separate the active return and passive return of the fund, so it is often difficult to have sufficient stability. However, after stripping the main betas based on the multi-factor model, the ability to actively obtain excess returns reflected by the alpha factor of the intercept term should be more robust. This paper investigates the feasibility to construct Alpha strategy based on bond funds. The rest part of the paper is organized as follows. The Sec. 2 introduces the selection of data set, the five-factor model used to strip beta returns of pure bond funds, specific strategies, and evaluation indicators. In Sec. 3, the backtest results of Alpha factor are analyzed and compared with the results of risk-return factors. The Sec. 4 discusses the limitations and prospects of this paper. Eventually, the Sec. 5 concludes the whole paper.

2. Data & Method

2.1. Data & Models

This paper selects all pure bond funds in China's public offering market from 2019 to 2022. The model uses multiple regressions as follows:

$$R_t = \alpha_t + (\sum_{i=1}^{5} \beta_{i,t} \times r_{i,t}) + \varepsilon_t \quad (1)$$

Multiple regressions are run on the returns of each pure bond fund, disaggregated onto the five mutually stripped factor returns as well as the Alpha not directly explained by the factors. The five factors belong to three categories: interest rate level, term structure and credit structure. To be specific, the five factors are given as follows.

Factors of interest rate level

The factor reflecting the level of the fundamental interest rate curve in the bond market represents the return that can be obtained by investing in Treasury bonds weighted by market value, which is neither credit sinking nor term structure biased management

The yield of the total index of Chinese bonds and government bonds

Factors of term structure

The return term exposed to the market risk of changing the shape of the interest rate curve can be specifically divided into slope and convex terms.

The relative relationship between long-term bond and short - and medium-term bond interest rates changes.

Buy the short - and medium-term Treasury bond index, sell the long-term Treasury bond index, adjust the weight of the portfolio, so that the duration of each period of the portfolio is 0.

The relative relationship between the interest rate of medium-term bonds and long and short bonds changes

Buy the duration neutral portfolio of short - and long-term Treasury index, and sell the short - and medium-term Treasury index duration neutral portfolio

Factors of credit structure

The return term exposed to the risk of credit sinking market can be divided into shallow credit factor and deep default factor according to the degree of sinking

Changes in the relative relationship between high credit rating corporate bonds and Treasury bond interest rates

Buy the corporate bond index with high credit rating, sell the Treasury bond index, and adjust the weight of the portfolio so that the duration of each period is 0

Changes in the relative relationship between the interest rates of high-yield corporate bonds and high-credit rated corporate bonds

Buy the high-yield corporate bond index and sell the high-credit rating corporate bond index. By adjusting the portfolio weight, the portfolio duration of each period is 0

According to the data from 2019 to 2022, the Pearson correlation coefficient of the five factors is calculated (seen in Fig. 1), and it can be seen that the correlation between the interest rate level factor and the term structure factor is weak, and the level factor and the credit factor show a negative correlation. On the whole, the five-factor system constructed can better realize the income dismantling of pure bond funds.

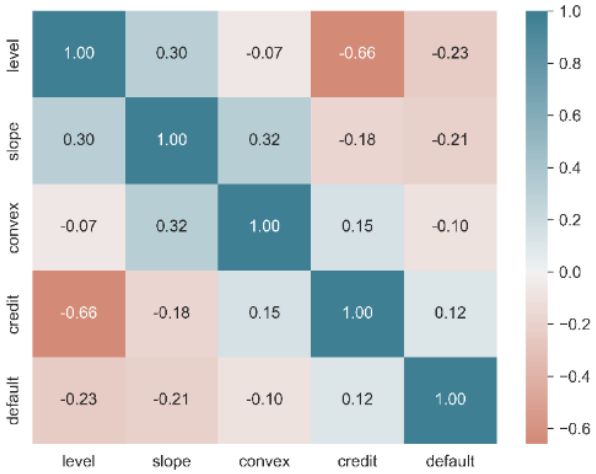


Fig 1. Correlation Coefficients.

2.2. Strategy Designs

In each month, the yield series of each pure bond fund and the yield series of the five factors are used for multiple regression, and the intercept term is used as the Alpha factor value of the fund in this month. At the beginning of each month, based on the Alpha factor value of the previous month, the pure bond funds in the whole market are divided into five groups with the same number, and the pure bond funds in each group are bought with equal weight respectively. After holding for one month, the portfolio is sold at the beginning of the next month, and the amount obtained from the sale is invested with equal weight according to the grouping of the new period, and so on. Continue this Alpha strategy from January 2019 to December 2022.

2.3. Evaluations

Three metrics are utilized for evaluations, i.e., RankIC, Sharpe Ratio and Calmar ratio. Rank IC represents the cross-sectional correlation coefficient between the factor exposure value ranking of a factor in all funds at a certain point in time and its return ranking in the next period. Rank IC can well reflect the predictive power of the factor, and a higher value indicates that the factor has a stronger predictive power for fund returns in the current period. It can be described as:

$$RankIC = corr(order_{t-1}^{f} - order_{t}^{r}) \quad (2)$$

The Sharpe ratio, which represents how much excess return a portfolio will generate for each unit of total risk, is based on the idea of the asset allocation line (CAL) and is the most common measure in the market [10]. If greater than 1, it represents that the fund return rate is higher than the volatility risk; If it is less than 1, it represents that the fund operation risk is too large to return rate. In this way, each portfolio can calculate the Sharpe Ratio, which is the ratio of investment return to excess risk, the higher the ratio, the better the portfolio.

$$SharpeRatio = \frac{E(R_p) - R_f}{\sigma_p} \tag{3}$$

Calmar ratio is also an indicator to measure the risk-return ability of a portfolio, representing how much return can be brought by each unit of maximum retracement. Unlike the Sharpe ratio, which equates standard deviation with risk, the Karma ratio equates risk with maximum regress. The performance of the portfolio can be better evaluated by considering the two risk-return indicators. The expression is given as follows:

$$CalmarRatio = \frac{E(R_p) - R_f}{MaxDrawdown_p} \tag{4}$$

3. Results & Discussion

3.1. Backtesting Results

For the Alpha factor after stripping Beta, its Rank IC annual performance is positive (as seen from Table. 1), and greater than 0.05 in 2019, 2021 and 2022, showing good predictive ability for fund returns. According to the monthly performance of Alpha factor, it can be seen that most months are significantly greater than 0.05, and only a few months are less than 0.05 or negative. Therefore, it can be considered that the Alpha factor is very effective (seen from Fig. 2). Based on the Alpha factor after stripping Beta, the monthly position adjustment period is taken as the group backtest, and the net value curve of the five groups is shown in the figure above. It can be seen from Fig. 3, Fig. 4, and Table. 2 that there are significant differences in the trend of the net value curve of the five groups, and the group with higher Alpha has significantly better returns.

Table 1. RankIC annual performance.

Year	2019	2020	2021	2022
Rank IC	0.051	0.033	0.115	0.076

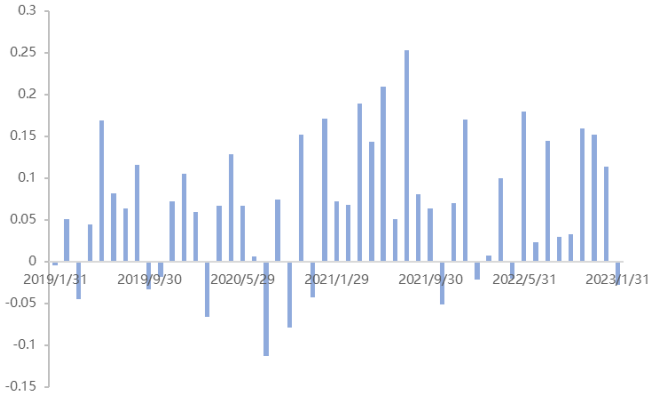


Fig 2. Monthly RankIC.

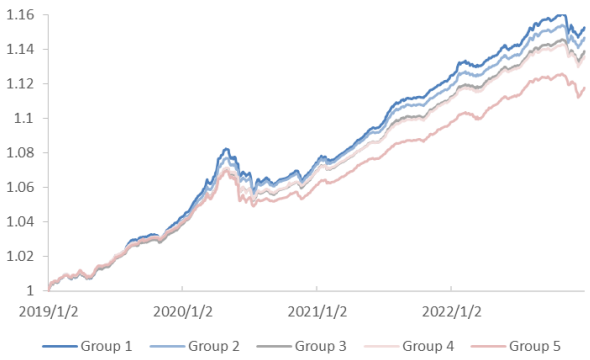


Fig 3. Group backtest.

Table 2. Sharpe ratio and Calmar ratio for different backtesting group.

	Year	Group 1	Group 2	Group 3	Group 4	Group 5
Sharpe Ratio	2019	7.57	7.70	8.16	8.72	8.11
	2020	2.61	3.07	3.19	2.92	2.11
	2021	10.33	10.05	9.83	11.08	10.25
	2022	2.93	3.27	3.68	3.65	2.89
Calmar Ratio	2019	0.79	0.79	0.70	0.76	0.57
	2020	0.08	0.10	0.11	0.11	0.07
	2021	0.95	0.97	1.10	1.31	1.16
	2022	0.13	0.14	0.13	0.12	0.10

In order to further judge the effectiveness of Alpha factor, it is compared with other factors. The Fig. 3 is the back test result of sharpe factor. It can be seen that the sharpe factor does not show good enough effect by using the same position adjustment strategy. For this reason, it should be that risk-return factors cannot distinguish the source of returns, but only reflect the performance of the fund. In this period, select the fund with good performance in the previous period. However, it is difficult for the fund to always maintain good performance, and sometimes the fund obtains good performance due to the correct allocation of Beta. However, the exposure allocation of market risks is often difficult to be sustainable and stable. Therefore, stripping beta from returns to obtain more stable excess return alpha can better select funds.

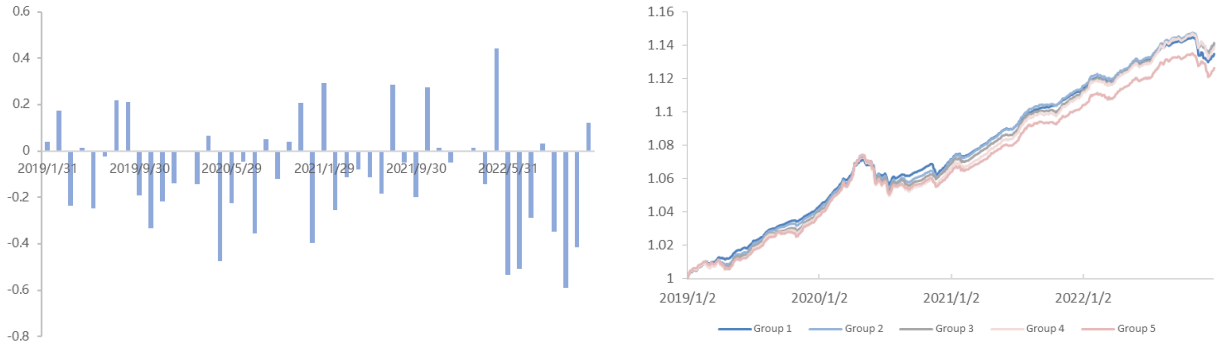


Fig 3. RankIC and Group backtest for other factors.

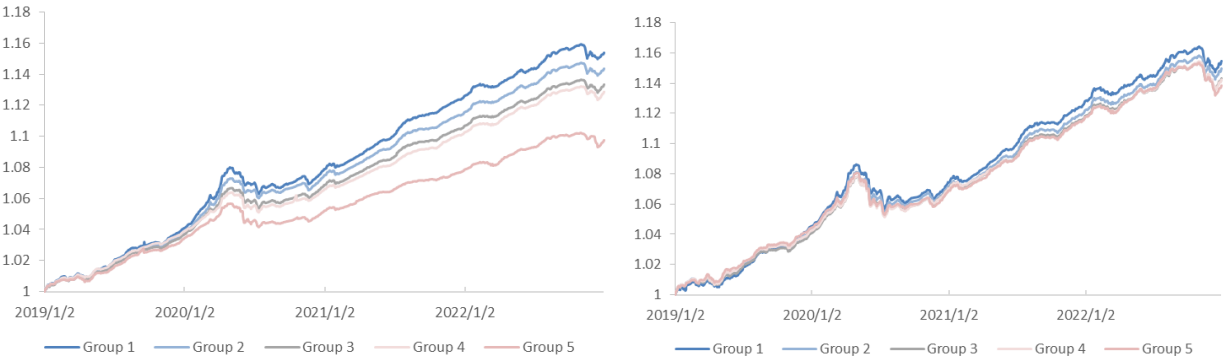


Fig 4. Backtest for different level beta domains.

3.2. Different Level Beta domains

In each period of position adjustment, the returns of the alpha factor strategy in the domains where beta exposure ranks in the top 50% and bottom 50% of the level factor are considered respectively, and the group backtests are carried out in different beta domains of the interest rate level. The results show that there are obvious differences. For the groups with low levels of factor exposure, this alpha

factor performs significantly better, and the returns of different groups show greater stratification. However, for the groups with high levels of factor exposure, the performance of the alpha factor is significantly weakened. On the one hand, this result is due to the uncertainty of the change of interest rate level. If the fund allocates a large exposure to the level factor in the current period, the fund return will be greatly affected by the interest rate level, bear the risk brought by the change of interest rate level, and obtain the corresponding return; On the other hand, for large exposure to level factor allocation, its returns are mainly affected by changes in interest rate level, avoiding the loss of active allocation errors. Thus, the group with the lowest alpha in the low level subdomain has significantly worse earnings performance, while the difference between the groups is relatively small in the high level subdomain.

3.3. Improvements & Suggestion

In this paper, the test is only carried out in all pure bond fund samples and each beta domain, and the portfolio is only constructed based on the alpha factor. However, subsequent strategies can incorporate controls for the exposure of the portfolio to different beta factors, which in turn leads to higher excess returns. For example, the exposure of level, slope, convex, credit and default factors are all controlled at the average level, and then the fund portfolio is constructed based on the alpha factor in order to obtain better returns.

4. Limitations & Prospects

There is still room for optimization of risk disassembly of pure bond fund based on level, slope, convex, credit and default. First of all, the credit and default factors directly constructed based on credit spread and default spread may also be affected by the overall market risk, liquidity and other factors, and cannot completely accurately represent credit and default returns. The construction method of this factor can be further improved to improve the accuracy of beta factor stripping. The stripped alpha factor still inevitably contains certain market factors, which cannot completely and accurately represent the fund manager's ability to obtain excess returns. Therefore, factors such as liquidity can be further added to further strip beta returns and obtain more effective alpha. Alpha factor based on beta factor dismantling can better screen pure bond funds to obtain more robust returns. In this paper, one explored the alpha strategy based on the five-factor model and achieved good results. For future work, on the one hand, the factor disassembly system can be further improved to obtain a more robust and effective alpha factor; On the other hand, it is also possible to try to implement the alpha factor strategy while controlling the portfolio beta, such as selecting the domain with lower beta or controlling the beta at the average level, so as to obtain a better asset portfolio.

5. Conclusion

In summary, the pure alpha factor is obtained by dismantling the betas of different sources of pure bond funds. This paper first dissolves the returns of pure bond funds into five factors, namely level, slope, convex, credit and default, which are separated from each other, and takes the intercept term alpha as an index to measure the ability of fund managers to obtain excess returns. After that, group backtesting was carried out according to this alpha factor, and the results of monthly position adjustment showed that this factor performed better. However, this alpha factor still inevitably includes beta returns that have not been fully stripped, such as liquidity, so there is still room for further optimization. However, the results of this paper show that the alpha factor based on beta stripping is effective in selecting pure bond funds, which has a more unique significance.

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