



# An Empirical Study on Stock-Bond Rotation Strategy Based on the Black-Litterman Model in the UK Stock Market

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**Abstract.** The growing instability of financial markets is making it harder to allocate capital efficiently among key asset types such as equities and bonds. Traditional static asset allocation methods struggle to adapt to dynamic market conditions, leading to growing interest in dynamic allocation strategies in recent years. Using the Black-Litterman model, the paper constructs a dynamic UK asset allocation framework to implement equity-bond rotation, evaluating their impact on portfolio performance and risk control. Specifically, the possibility of achieving improved investment returns via the adjustment of allocation weights between equities and bonds under different market conditions is investigated. Based on data from the Financial Times Stock Exchange (FTSE) 100 Index and UK government bonds spanning 2010 to 2023, asset weights are computed using the Black-Litterman model, and statistical methods are adopted to analyze return characteristics and their correlations. The results indicate that portfolios dynamically adjusted using the Black-Litterman model outperform traditional static strategies. Besides, economies of scale favor equities, showing that higher equity allocations may deliver stronger returns in current market conditions. In short, the Black-Litterman dynamic rotation portfolio (Portfolio 1) achieves superior risk-adjusted returns in the UK market and proves highly practical.

**Keywords:** Stock-Bond Rotation, Black-Litterman Model, UK Stock Market, Investment Strategies

## 1 Introduction

The stock-bond rotation strategy is a common investment approach that dynamically reallocates assets between equities and bonds to enhance returns based on expected market performance. A related approach involves flexible allocation driven by the differing risk-return characteristics of stocks and bonds. Stocks typically outperform during economic expansions, while bonds lead during slowdowns or recessions. This dynamic asset allocation approach is grounded in the principles of modern portfolio theory, which emphasizes optimizing risk and return through effective market timing [1].

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X. Pan et al. (eds.), *Proceedings of the 2026 11th International Conference on Financial Innovation and Economic Development (ICFIED 2026)*, Advances in Economics, Business and Management Research 382,

[https://doi.org/10.2991/978-94-6239-642-5\\_4](https://doi.org/10.2991/978-94-6239-642-5_4)

Although the stock-bond rotation strategy has been discussed extensively in both academic and practical finance, studies using quantitative methods to optimise this strategy are relatively recent. By integrating investor views and market equilibrium, the Black-Litterman model refines standard asset allocation. Moreover, the model incorporates time-varying covariance matrices and macroeconomic indicators for more effective equity-bond allocation [2,3]. Nonetheless, there is still a notable lack of research employing the Black-Litterman model to optimise stock-bond rotation strategies within the UK market context. Thus, this study assesses the effectiveness of the Black-Litterman model in dynamic asset allocation strategies, building upon a review of empirical research concerning its application to stock-bond allocation in the UK market. Also, it mainly focuses on assessing the model's practical performance in allocating between stocks and bonds, thus uncovering the interrelationship between the UK stock market and bond returns, and exploring the potential value of rotation strategies under varying market conditions. Besides, it compares the Black-Litterman model with traditional asset allocation approaches to assess its advantages in boosting portfolio returns and improving risk management. This research confirms advanced allocation strategies and offers guidance for managing portfolios in changing markets.

## **2 Literature Review**

### **2.1 Market Suitability Issues**

The UK market presents significant challenges for asset allocation due to its distinct economy, politics, regulation, and Brexit-related uncertainty. The disruption of trade and economic rules by Brexit has shaken investor confidence and caused markedly different stock and bond performance compared with other regions. The uncertainty surrounding the UK's economic growth prospects has increased market volatility, heightening investor caution. In addition, the UK has experienced multiple inflation cycles, with recent inflationary pressures further intensifying market turbulence and diminishing the effectiveness of traditional stock-bond rotation strategies designed for stable markets. The Bank of England's interest rate adjustments directly impact UK government bond yields, with bond prices typically moving inversely to interest rate changes. This necessitates that asset allocation between equities and bonds carefully considers macroeconomic indicators and monetary policy shifts. Moreover, the UK market is particularly sensitive to scale effects, and Brexit-related policy uncertainty and structural market changes have added complexity to rotation strategies. Research indicates that inflation, interest rate changes, and political uncertainty greatly impact stock and bond performance, hence causing rotation strategies to vary in effectiveness across market conditions. Thus, asset allocation strategies must continuously monitor the UK's unique political, economic, and regulatory dynamics, adapting flexibly to enhance applicability and robustness, thereby achieving superior performance in a complex and evolving market landscape [4-6].

## 2.2 Model Complexity Considerations

The Black-Litterman model is recognised for its sophistication in blending investor views with market equilibrium, thereby offering a robust framework for tactical asset allocation. However, this complexity also introduces several practical limitations. The model's reliance on historical data for estimating returns and risk metrics presents a notable challenge. This reliance may undermine its effectiveness during periods of heightened market volatility, where historical patterns fail to capture forward-looking risks and shifts in market dynamics. Besides, the integration of subjective investor views increases flexibility but risks bias and suboptimal allocations when such views are inadequately informed or inconsistent with shifting macroeconomic conditions. Additionally, though the model operates under assumptions of market equilibrium, it typically abstracts from real-world considerations like transaction costs and liquidity constraints, which can significantly impact portfolio performance, particularly during frequent re-balancing episodes [7,8].

## 2.3 Limited Empirical Evidence in the UK Context

Despite a large theoretical foundation for stock-bond rotation strategies, data from the UK is still insufficient. Research tends to emphasize the US or emerging markets, where economic and market features contrast sharply with those of the UK. And the Black-Litterman model is commonly employed globally for tactical asset allocation, yet studies rarely examine its role in UK stock-bond strategies. The UK market's distinctiveness limits the usefulness of conventional rotation approaches. Empirical research on stock-bond rotation generally ignores details that are important to the UK, including Brexit-induced political uncertainty and upgrades to financial regulations. These factors significantly impact asset performance amid shifts in economic policy. Brexit triggered financial market volatility and eroded investor confidence [4,5]. In addition, unpredictable fluctuations in interest rates and inflation often undermine the effectiveness of stock-bond rotation strategies in the UK. Due to the lack of research on UK-specific challenges, it is necessary to reevaluate stock-bond rotation strategies in the UK using the Black-Litterman model [9,10]. This study addresses this gap by applying the model to the UK market, offering new insights into its application amid both domestic and international uncertainties.

# 3 Methodology

## 3.1 Data Sources and Pre-Processing

This study employs historical data from the Financial Times Stock Exchange (FTSE) 100 Index as a proxy for the UK equity market and the FTSE 1-Year UK Treasury bond index as a proxy for bond returns. The analysis spans January 2010 to December 2023, covering both stable periods and times of heightened uncertainty like Brexit. These datasets were selected for their representativeness of the overall performance of the UK

stock and government bond markets. The FTSE 100 comprises the 100 largest companies listed on the London Stock Exchange, while UK government bonds serve as a widely accepted benchmark for risk-free returns [2]. Monthly returns, expressed as percentage changes, were derived from adjusted closing prices of stocks and bonds. To align with medium-term investment horizons and minimise the noise typically associated with short-term market fluctuations, monthly data was selected. Besides, missing values were addressed using forward-filling techniques to ensure continuity in the time series. To mitigate potential scale bias, identified outliers or anomalies were either normalised or removed as appropriate. Finally, the stock and bond return series were synchronized by matching common dates to ensure consistency for the subsequent empirical analyses [11,12].

### 3.2 Model Construction and Variable Definition

The Black-Litterman model was chosen to guide asset allocation between stocks and bonds. To manage portfolios, the model integrates historical covariance with investor insights, thus facilitating dynamic weight adjustments. Initially developed to integrate market equilibrium data derived from the optimization of expected returns versus risk along with subjective investor views, the model facilitates refined adjustments to asset allocation. The formal model specification is presented below.

$$\pi = (\tau \cdot \Sigma) \cdot \omega_{market} \quad (1)$$

Where  $\pi$  denotes the implied returns of the assets based on market equilibrium,  $\tau$  represents a scalar reflecting the confidence level in the covariance matrix ( $\Sigma$ ), and  $\omega_{market}$  is the market capitalization weights.

The investor then inputs ( $Q$ ) to adjust the implied returns, incorporating their views on expected returns, momentum, or macroeconomic factors like inflation or interest rates. The  $Q$  is obtained by putting both investor opinions and the equilibrium returns together through this formula:

$$\mu = [(\tau\Sigma)^{-1} + P^T\Omega^{-1}P]^{-1} \cdot [(\tau\Sigma)^{-1}\pi + P^T\Omega^{-1}Q] \quad (2)$$

Where  $P$  denotes the matrix that defines the relationships between views and asset returns,  $Q$  reflects the investor's expectations based on factors like momentum, macroeconomic conditions, or predictive signals, and  $\Omega$  refers to a diagonal matrix representing the confidence level or uncertainty in those views.

This study uses macro insights such as expected inflation, interest rate changes, and historical asset trends to form views ( $Q$ ), leading to a more accurate and practical estimate of expected stock and bond returns. This study analyzes stock, bond, and expected market returns, measuring volatility through standard deviation and using historical data to assess asset co-movements. The effectiveness of the stock-bond rotation strategy was evaluated using key metrics like the Sharpe ratio, the portfolio's lowest value point, and the total accumulated return. Python was the tool selected for putting the model into action, using library packages such as SciPy and pandas to determine returns, variances and covariance matrices [5,13,14].

### 3.3 Assumptions and Rationality Discussion

Financial models often assume that returns follow a normal distribution, an approach incorporated in the Black-Litterman framework. However, empirical evidence shows that real-world returns typically exhibit skewness and excess kurtosis, particularly during periods of market stress, deviating from the normality assumption. Although it improves computational efficiency, the assumption may lead to reduced accuracy in times of major market turbulence. Furthermore, the stability of the covariance matrix is a key assumption, presupposing that asset return correlations do not vary markedly across different periods. Despite being necessary, this method often fails during major market upheavals or structural shifts. Future research may benefit from incorporating time-varying or dynamic covariance estimation techniques to better capture evolving market relationships [1,7]. Moreover, The model also overlooks extreme events such as the 2008 financial crisis and the Brexit referendum, which can greatly distort asset return distributions. To boost robustness and capture market anomalies, future studies should incorporate sensitivity analysis or stress testing [15].

### 3.4 Analytical Methods and Computational Tools

To evaluate the effectiveness of the stock-bond rotation strategy, a range of statistical and computational methods were employed. Regression analysis was conducted to examine the relationship between stock and bond returns, while hypothesis testing involved the Shapiro-Wilk test to assess the normality of return distributions and the Pearson correlation coefficient to measure the linear association between the two asset classes. These methods clarified the data and model assumptions. The analysis was performed using Python and its associated libraries, with pandas utilized for data manipulation and SciPy for statistical testing. The performance of the stock-bond rotation strategy was measured by the Sharpe ratio for risk-adjusted returns. This approach ensures transparency, replicability, and statistical rigor, thereby enhancing the reliability and credibility of the results.

## 4 Results

### 4.1 Basic Statistical Descriptions

To evaluate the stock-bond rotation strategy, the fundamental statistical properties of stock and bond returns were first computed. The mean return for stocks was 0.0049, while for bonds it was 0.0062, indicating that bonds slightly outperformed stocks on average from 2010 to 2023. Stock returns had a standard deviation of 0.1154, much higher than the 0.0195 for bonds, showing greater volatility, as shown in Table 1.

**Table 1.** Descriptive Statistics of Stock and Bond Returns

Statistic	Stock Returns	Bond Returns
Mean Return	0.0049	0.0062
Standard Deviation	0.1154	0.0195

### 4.2 Model Estimations

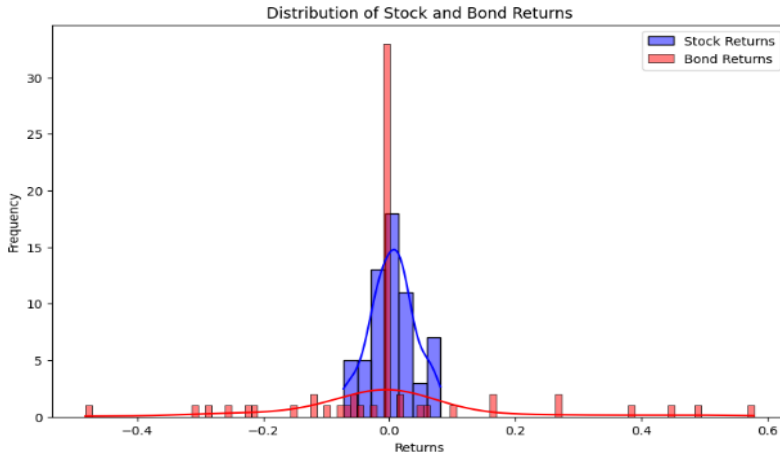
The allocation between stocks and bonds was optimized using the Black-Litterman model. The model assumes expected returns based on historical averages and uses the historical covariance matrix of the asset returns. Based on the model’s output, the optimal portfolio heavily favored equities, allocating 94.51% to stocks (FTSE 100) and only 5.49% to UK government bonds, as shown in Table 2. Since there was a historically significant preference in favor of equities over bonds, this result indicates that, facing these options, the model prefers equities to bonds much more during the study period than during any other period.

**Table 2.** Black-Litterman Model - Portfolio Weights

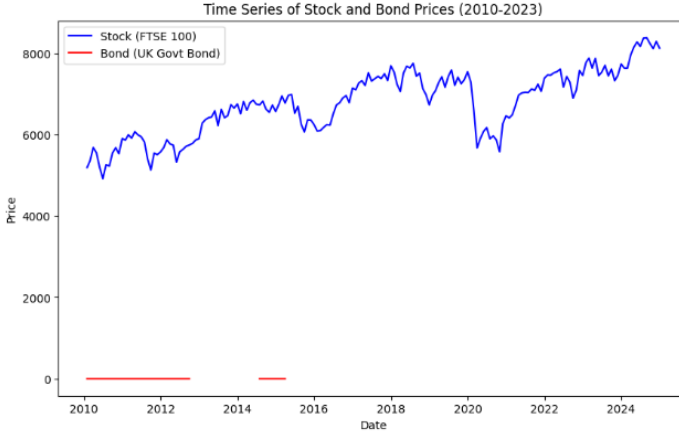
Asset Class	Weight
Stock (FTSE 100)	0.9451
Bond (UK Govt Bond)	0.0549

### 4.3 Normality Testing and Correlation Analysis of Asset Returns

The Shapiro-Wilk test was used to assess asset return distributions. For stock returns, the resulting p-value of 0.5954 shows that the null hypothesis of normality cannot be rejected, indicating an approximately normal distribution, as shown in Figure 1. In contrast, bond returns yielded a p-value of 8.07e-08, strongly rejecting normality, likely due to structural policy changes or market anomalies, as shown in Figure 2. The Pearson correlation coefficient between stock and bond monthly returns was 0.1512, indicating a weak positive linear relationship. The weak correlation between stock and bond returns highlights their diversification potential, as combining both can enhance portfolio stability.



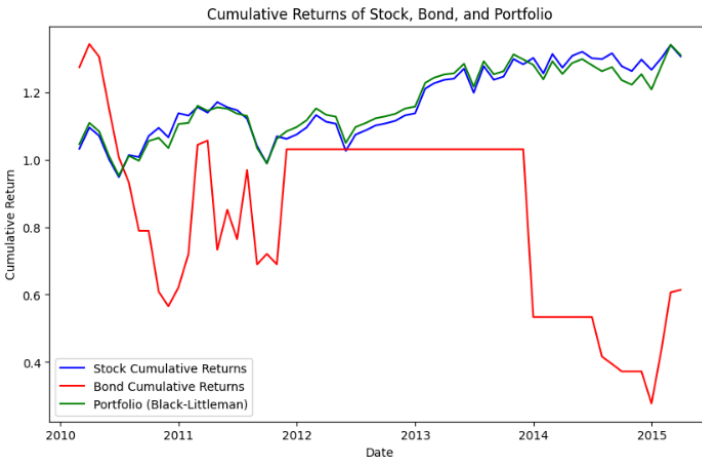
**Fig. 1.** Normality Test Results for Stock Returns using Shapiro-Wilk Test



**Fig. 2.** Normality Test Results for Bond Returns using Shapiro-Wilk Test

#### 4.4 Visualization of Asset Performance and Correlations

To enhance understanding of asset performance and their interrelationships, key visualizations are presented and discussed below. Figure 3 illustrates the long-term cumulative performance of stocks, bonds, and the optimized portfolio. Over the observed period, stocks exhibited higher growth accompanied by greater volatility, while bonds maintained relatively stable returns. The Black-Litterman optimized portfolio followed a more balanced path, reflecting the advantages of diversification and strategic allocation. As shown in the time series, the FTSE 100 displayed a steady upward trend, in contrast to the more stable but flatter movement of bond prices, thus highlighting the differing risk-return profiles of the two asset classes.



**Fig. 3.** Cumulative Returns of Stock, Bond, and Portfolio

Moreover, Figure 4 reveals the relationship between monthly returns of stocks and bonds. The points form a loose cluster with a weakly positive trend, indicating a mild correlation between the two asset classes. The observed pattern is consistent with the earlier Pearson correlation results, suggesting a modest correlation and reinforcing the diversification benefits of combining stocks and bonds.

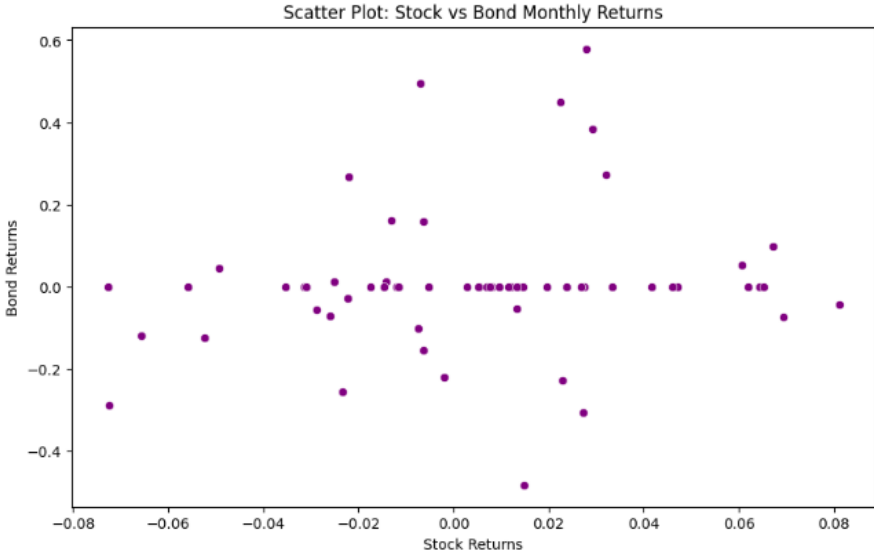


Fig. 4. Scatter Plot of Stock vs Bond Monthly Returns

## 5 Discussion

### 5.1 Model Assumptions, Limitations, and Practical Challenges

The Black-Litterman model assumes asset returns follow a normal distribution. While this assumption may hold under stable market conditions, empirical evidence, such as that presented in this study, suggests that return distributions, particularly for bonds, often deviate from normality during periods of market turbulence. Events like the 2008 financial crisis and Brexit caused skewed, leptokurtic returns, reducing the model’s reliability during stress [8,16]. The stability of the covariance matrix over time is a second key assumption, which is critical for optimal asset allocation. However, in practice, covariances are highly sensitive to changing market conditions, particularly during episodes of heightened volatility. The model’s limitation lies in its inability to capture time-varying market dynamics. To improve accuracy during volatile conditions, extensions like rolling-window estimations and incorporating relevant macroeconomic indicators have been proposed [3]. Moreover, practical use of the model is limited by transaction costs and liquidity constraints. High transaction costs from frequent rebalancing can diminish portfolio efficiency. During financial stress, liquidity constraints in assets such as government bonds can delay rebalancing, posing a key practical challenge. [7,14].

## 5.2 Applicability Across Different Markets and Policy Implications

The Black-Litterman model is widely applicable, including in emerging markets that differ significantly from developed economies like the UK. However, its reliance on historical data may prove less effective in such markets, where asset prices are often more volatile and susceptible to political risk. Consequently, both equilibrium return estimates and investor views may require more frequent adjustments to account for external shocks and structural uncertainties [11]. Future studies could test the model's robustness in countries with unstable macroeconomic policies, high inflation, or inconsistent financial regulation [10]. From a policy perspective, the Black-Litterman model holds value for institutional investors and policymakers alike. Its ability to incorporate subjective views into asset allocation makes it particularly useful in environments impacted by shifting economic policies. For instance, during periods of low interest rates or expansive fiscal stimulus, the model may favor a higher equity allocation in anticipation of economic recovery. Conversely, during periods of monetary tightening or fiscal austerity, the model is likely to favor a shift toward safer assets, such as government bonds [12,13]. This flexibility is particularly vital in the current macroeconomic environment, where central banks worldwide are raising interest rates to curb persistent inflation. This framework systematically balances market equilibrium and investor views for more informed portfolio decisions [3,9].

## 6 Conclusion

This study evaluates a stock-bond rotation strategy in the UK stock market based on the Black-Litterman model. Historical return results indicate that the model recommended a high allocation to equities (94.51%), which aligns with the finding that average stock returns exceeded those of bonds during the study period. The model's ability to integrate market equilibrium with investor views highlights its strength as a dynamic asset allocation tool. However, it also recognizes key limitations of the Black-Litterman model, including its reliance on the assumption of normally distributed returns and a stable covariance matrix. Future research could address these issues by incorporating dynamic adjustments and external macroeconomic factors that influence market behavior. In practical applications, it is also essential to consider the impact of transaction costs and liquidity constraints, particularly the diminishing marginal effect of transaction costs on trade size and cost dispersion under limited liquidity conditions. Moreover, the applicability of the Black-Litterman model can be explored in other markets, including emerging markets. Other model aspects could be explored to evaluate their effects on asset allocation across different macroeconomic policies. The model can also be refined to address non-normal returns and market volatility.

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