An Empirical Analysis of the Impact Factors of China's Long and Short Term Treasury Bond Term Spreads and CPI

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Abstract: This paper selects the monthly CPI data from January 2014 to July 2024 and the maturity yield spreads of 10-year and 3-month treasury bonds, and empirically analyses the correlation between the two and the influencing factors through regression models.The results show that there is a significant positive linear relationship between CPI and the maturity spread of short- and long-term government bonds, with the maturity spread increasing by 0.070 units for every 1-unit increase in CPI, and the relationship is stable and reliable after multiple tests.This conclusion can provide reference for macroeconomic analysis, monetary policy making and investors' decision-making, and help judge the economic cycle, adjust policy direction and optimise asset allocation.

Keywords: Long and Short Term Treasury Bonds; Term Spreads; CPI; Economic Linkages

1. Introduction

1.1 Background and Significance of the Study

The treasury bond market is central to China's financial system, serving as both a sovereign credit instrument and a key benchmark for interest rates. It plays a critical role in government financing, linking fiscal and monetary policies, and enhancing macroeconomic control through open market operations. The term spread between long- and short-term treasury bonds reflects market expectations, encompassing information about economic growth, inflation, and monetary policy. A widening spread typically signals economic strength and rising inflation, while a narrowing or inversion may indicate economic slowdown. Since 2024, both the long-term yield and term spread of treasury bonds have declined, raising concerns about market dynamics.

The consumer price index (CPI) is a crucial macroeconomic indicator, reflecting changes in the prices of goods and services consumed by residents. It is directly tied to living standards and serves as a guide for monetary, wage, and income policies. High CPI levels may prompt central bank tightening to curb inflation, while easing policies are often adopted during downturns. These changes are closely linked to supply and demand shifts across economic cycles.

Theoretically, analyzing these two factors contributes to macroeconomic theory, enhances understanding of their relationship, and reveals transmission mechanisms. It also enriches the application of macroeconomics in financial markets, providing a foundation for future research. Practically, this study offers significant value: for investors, it aids in predicting treasury yield trends and optimizing portfolios; for policymakers, it serves as a reference for fiscal and monetary policy formulation, ensuring effective regulation, financial market stability, and sustainable economic development. Understanding the relationship between CPI and the treasury bond market is crucial for stabilizing the financial system and promoting long-term economic growth.

1.2 Research Methods and Innovations

This study employs empirical methods to analyze the factors influencing long- and short-term treasury bond term spreads and CPI. Monthly CPI data from January 2014 to July 2024 (National Bureau of Statistics) and yield spread data for 10-year and 3-month treasury bonds (China Bond Information Network) are used. CPI data captures short-term fluctuations in consumer prices, aiding the analysis of inflation changes, while treasury bond spread data reflects market expectations of future economic growth and inflation. The long-term tracking of these datasets provides insights into economic trends across different cycles and under varying economic conditions, offering a solid foundation for empirical research.

The time period covers significant phases in China's economic restructuring, financial market reforms, and shifts in both domestic and international economic environments, allowing a comprehensive examination of the relationship between CPI and treasury bond spreads. This dataset's timeliness and completeness provide a more accurate reflection of the current economic landscape, enhancing the practical relevance of the findings.

For the analysis, a regression model will be used to quantify the linear relationship between CPI and the term spreads. The impact of CPI on these spreads will be examined by treating treasury bond spreads as the dependent variable and CPI as the independent variable. Diagnostic methods, including multiple covariance tests, heteroskedasticity tests, and robustness checks, will be applied to ensure model reliability, improve goodness-of-fit, and enhance predictive accuracy.

2. Literature Review

The treasury bond term spread is the difference between the yields of treasury bonds of different maturities, which is an important indicator of the market's expectation of the future economy. According to Yu Jin (2004), the treasury yield curve reflects the level of treasury yields of different maturities, and the term spread is an important feature of it, and analyzing this curve can infer the changes of the economic situation[10]; Zhu Shiwu (2005) also pointed out that the term spread contains the information about the market's expectation of future economic growth and inflation, which is of great significance for macroeconomic analysis[8]. Treasury bond term spreads are crucial for macroeconomic analysis. Chen Hui and Xie Chi (2006) suggest that the Treasury yield curve serves as a reference for monetary policy, helping the central bank adjust policies to promote economic growth and price stability [7]; Zhu Wei et al. (2007) argue that changes in the yield curve reflect market risk appetite, guiding investors in adjusting their investment strategies[6].

The relationship between treasury term spreads and CPI has garnered significant attention, with scholars examining their correlation and transmission mechanisms. Wang Runhua et al. (2014) found a long-run equilibrium between inflation and treasury yields, where an increase in CPI leads to higher treasury yields, with the long-term increase surpassing the short-term, resulting in a widening of the maturity spread. Conversely, a decline in CPI narrows the spread[5]. In terms of transmission mechanism, the two influence each other through market expectations and monetary policy. Liu Ming and Chen Yixiong (2016) pointed out that the adjustment of monetary policy affects the relationship between the two[3]; Zhu Shiwu (2005) found that the term spread of treasury bonds has the ability to predict future inflation, which can provide a reference for investors and policymakers[8]; Yuan Zhihui (2015) mentioned that economic growth, fiscal policy and other factors also have an impact[4].

3. Data Selection and Model Construction

This study uses monthly CPI data from January 2014 to July 2024 and the spread between 10-year and 3-month treasury bond yields to analyze their relationship over a 10-year period. The CPI data, sourced from the National Bureau of Statistics, is accurate and reliable, ensuring a solid foundation for the analysis. Treasury bond spread data is obtained from the China Bond Information Network, which accurately reflects market yields and trading conditions.

To ensure data quality and consistency, CPI is averaged monthly, and treasury bond spreads are calculated by subtracting the 3-month yield from the 10-year yield. Potential outliers are identified using statistical measures (mean, standard deviation, minimum, and maximum) and corrected or excluded based on the economic context, minimizing their impact on the study's results.

Table 1. Descriptive Statistical Analysis

Variable	Obs	Mean	Std.dev	Min	Max
irs	126	0.8413	0.3196	-0.0627	1.7474
cpi	126	101.6865	1.104	99.2	105.4

To examine the relationship between long- and short-term treasury bond maturity spreads and CPI, this study constructs a multiple linear regression model. The yield spread between 10-year and 3-month treasury bonds (IRS) serves as the dependent variable, while the Consumer Price Index (CPI) is the core explanatory variable to assess its direct impact on bond spreads. This model is chosen for its strong explanatory power, clear representation of linear relationships, and ability to intuitively quantify the direction and magnitude of factors' effects through regression coefficients. It also enables effective parameter estimation and hypothesis testing, providing a solid empirical foundation for the analysis.

4.Empirical Results and Analyses

4.1 Basic Regression Analysis

A linear regression model is set up to explore the effect of CPI on IRS:

$$irs=\beta0+\beta1\cdot cpi+\varepsilon \quad (1)$$

Using Stata to estimate the multiple linear regression model, the results (Table 2) show an F-statistic of 7.74 (Prob > F = 0.0062), indicating overall model significance and a linear relationship between CPI and IRS. The CPI coefficient is 0.0702 (p = 0.006), significant at the 1% level, suggesting that for every 1-unit increase in CPI, IRS increases by 0.0702 units on average. The model is generally significant, effectively explaining the impact of CPI on the treasury bond term spread. The intercept term (_cons) is -6.2946 (p = 0.016), significant at the 5% level. However, the model's R^2 is 0.0588, and the adjusted R^2 is 0.0512, indicating that CPI explains only about 5.88% of the variance in IRS. This suggests that other factors, not included in the model, also influence IRS volatility.

Table 2. Base Regression Results

Source	SS	df	MS	Number of obs=	126	
Model	0.7503	1	0.7503	F(1,124)=	7.74	
Residual	12.0198	124	0.0969	Prob>F=	0.0062	
Total	12.7701	125	0.1021	R-squared=	0.0588	
				Adj R-squared=	0.0512	
				Root MSE=	0.3113	
irs	Coefficient	Std.err.	t	P>|t|	[95% conf.	interval]
cpi	0.0702	0.0252	2.78	0.006	0.0203	0.1201
_cons	-6.2946	2.5649	-2.45	0.016	-11.3713	-1.2178

4.2 Model Validation and Robustness Analysis

The multicollinearity test reveals that the variance inflation factor (VIF) for CPI is 1.00, with an average VIF of 1.00, well below the threshold of 10, indicating no multicollinearity issues and stable coefficient estimation; Heteroscedasticity tests, including the White test (chi2(2) = 3.72, Prob > chi2 = 0.1554), fail to reject the null hypothesis of homoscedasticity at the 5% significance level. The Cameron & Trivedi decomposition further supports this, with p-values for heteroscedasticity, skewness, and kurtosis all greater than 0.05, confirming valid OLS standard errors; In the robustness test, using robust standard errors, the CPI coefficient on IRS remains 0.0702, indicating stability. This suggests that a 1-unit increase in CPI results in a 0.0702 unit rise in IRS, reinforcing the reliability of the core relationship. After adjustment, the CPI t-value increases from 2.78 to 3.67, and the p-value decreases from 0.006 to 0.000 (at the 0.1% significance level). The model's overall significance (F-test) also improves (Prob > F drops from 0.0062 to 0.0004). This indicates that the benchmark model overestimated standard errors due to heteroscedasticity, and after correction, the positive relationship between CPI and IRS becomes more significant, confirming its validity.

In the non-linearity test, a model including the quadratic term of CPI was constructed:

$$irs=\beta0+\beta1\cdot cpi+\beta2\cdot cpi^2+\varepsilon \quad (2)$$

Although the overall model passed the 5% significance test (F=3.84, Prob > F=0.0241), its explanatory power remained unchanged (R^2=0.0588, consistent with the linear model). Both the linear (CPI) and quadratic (CPI^2) terms lacked statistical significance (p>0.95), failing to support a nonlinear relationship. Severe multicollinearity between CPI and CPI^2 inflated standard errors (e.g., CPI's standard error increased from 0.0252 to 2.668), compromising statistical inference. Additionally, the narrow CPI range in the sample may have limited the detection of nonlinear effects. Ultimately, the failure of the quadratic model reinforces the linear model, suggesting that the linear relationship between

CPI and IRS is a more robust feature of the data.

Table 3. Regression Results

	Benchmark Models	Robust standard errors	Non-linearity test
cpi	0.070***	0.070***	-0.062
	(0.025)	(0.019)	(2.668)
cpi_sq			0.001
			(0.013)
_cons	-6.295**	-6.295***	0.417
	(2.565)	(1.942)	(135.963)
N	126	126	126
r2_a	0.051	0.051	0.043
rmse	0.311	0.311	0.313

*** p<0.01, ** p<0.05, * p<0.10
* p < 0.10, ** p < 0.05, *** p < 0.01

5. Conclusion and Outlook

Regression analysis reveals a significant positive linear correlation between CPI and treasury bond term spreads: each 1-unit increase in CPI is associated with an average 0.070-unit rise in the spread (IRS), with robustness confirmed by multicollinearity, heteroskedasticity, and robustness tests, which aligns with economic logic as higher CPI elevates market inflation expectations, pushing up term spreads. The findings offer practical insights for multiple stakeholders: macroeconomic analysts can leverage the CPI-spread relationship to refine cycle-stage judgments and forecast growth/inflation trends; central banks may adjust monetary policy direction and intensity based on co-movements in spreads and CPI to balance growth and price stability; investors can optimize asset allocation and portfolio returns by monitoring these indicators.

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