

HOW GOOD IS THE BOND MARKET AT FORECASTING THE RISK-FREE RATE?

1 INTRODUCTION

Companies have to constantly decide how to manage their funds. Consequently, buying and selling assets it is the order of the day.

In order to start any negotiation, a value must be assigned to the underlying asset of the transaction. Here is where valuation methods come to the fore.

In short, valuation methods try determine cash flows that the asset may produce. Once the cash flows are clear, time and risk effects must be taken into account to determine the value of the asset.

Valuation methods first isolate the effects of risk by observing the rate of return of a risk-free asset (the risk-free rate), and then risk premiums are added to risk-adjust the value of the asset.

Therefore, the starting point of any valuation is the risk free-rate. Generally, government bonds are used to derive the risk-free rate since they are the most similar to the theoretical concept of a risk-free asset.

3 METHODOLOGY

This study uses historical data from 1961 to 2020 provided by two main sources: the U.S. Board of Governors of the Federal Reserve System and the Survey of Professional Forecasters conducted by the Federal Reserve Bank of Philadelphia. Two quantitative analysis were performed:

TEST 1: LINEAR MIXED EFFECT MODEL

$$(error)_{it} = \beta_1(y.since)_{it} + \beta_2(y.since)_{it}^2 + \beta_3(y.to)_{it} + u_t + \epsilon_{it}$$

- The implied forward rates were derived for zero-coupon bonds ranging from one to five years maturity using the provided zero-coupon yield curve.
- The implied forward rates were compared to the actual future rates, obtaining the error made by the implied forward rates.
- A linear mixed effect model was used to obtain statistical results. The implied forward rates' error (*error*) was used as a dependent variable, while the length of the forecast (*y.since*) and the type of bond (*y.to*) were used as explanatory variables.

2 OBJECTIVES

This study has the following 2 objectives:

- 1) Determine if the implied forward rates derived from the bond market are a reliable indicator of the future risk-free rate.
- 2) Understand why differences between the implied forward rates and the actual future risk-free rate may arise.

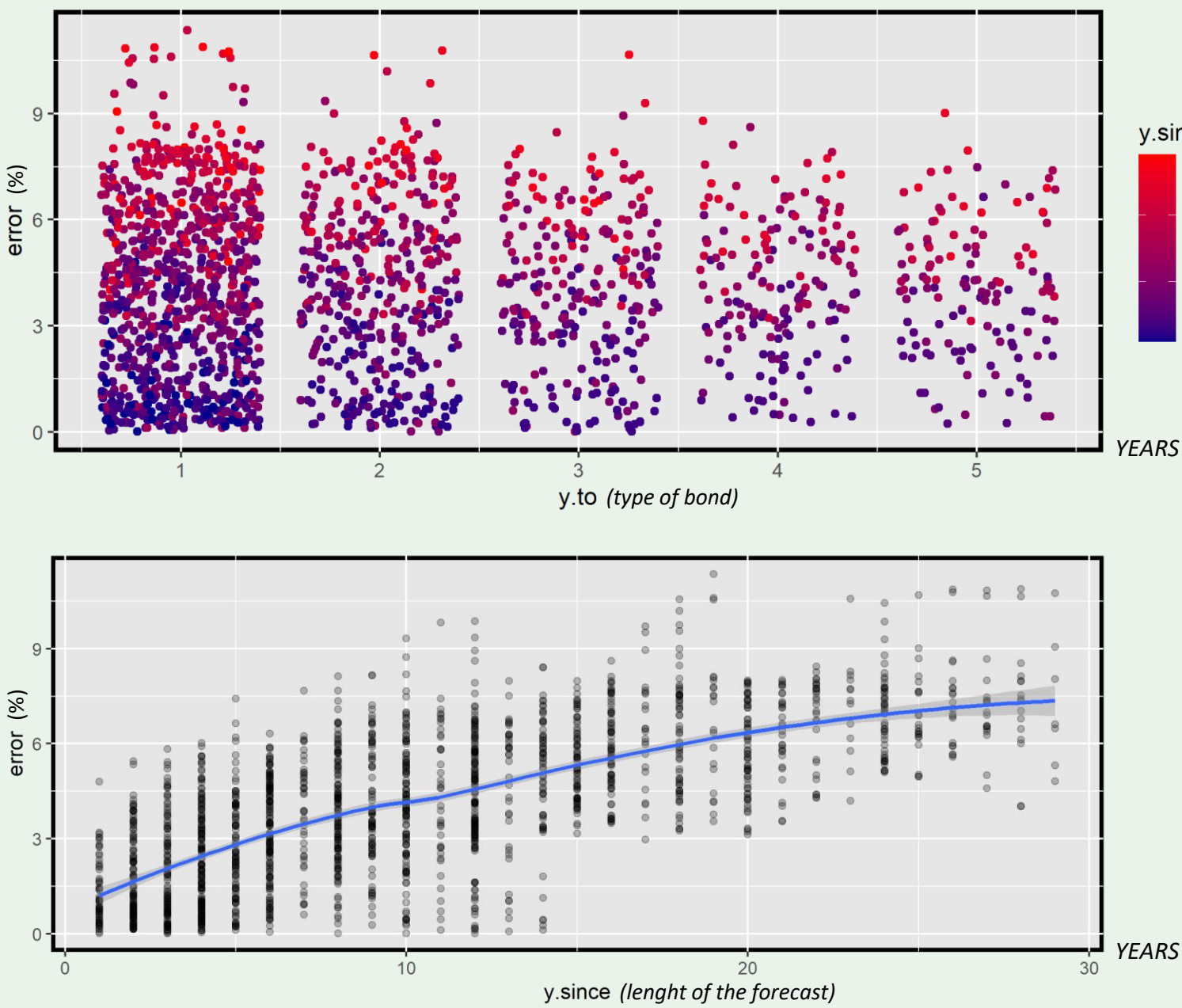
TEST 2: MULTIVARIATE LINEAR REGRESSION MODEL

$$(error)_t = \beta_0 + \beta_1(CPI_ERROR)_t + \beta_2(NGDP_ERROR)_t + \beta_3(FFUNDS_ERROR)_t + \epsilon_t$$

- The yield curve is mostly affected by inflation, economic growth and interest rate. Therefore, three proxies were selected to perform the analysis: Consumer Price Index, GDP and Federal Funds Rate.
- The forecast for each of the previous variables was compared to the historical value, obtaining the errors made by each of the forecast.
- A multivariate linear regression model was used to obtain statistical results. The implied forward rates' error (*error*) was used as a dependent variable, while the errors made by the forecasts of CPI, GDP and Federal Funds Rate were used as explanatory variables.

4. FINDINGS

TEST 1



RANDOM EFFECTS	intercept	residual
	Std. Deviation	1,293 1,130

FIXED EFFECTS	ESTIMATE	LOWER	UPPER	P-VALUE	
intercept	1,298	0,929	1,667	0,000	***
y.since	0,322	0,294	0,351	0,000	***
(y.since)^2	-0,003	-0,004	-0,002	0,000	***
y.to	-0,133	-0,174	-0,092	0,000	***

Number of observations: 1859
Number of groups: 59

TEST 2

COEFFICIENTS	ESTIMATE	LOWER	UPPER	P-VALUE	
intercept	0,730	0,061	1,400	0,034	*
CPI_ERROR	-0,200	-0,633	0,233	0,353	
NGDP_ERROR	0,000	-0,001	0,001	0,767	
FFUNDS_ERROR	0,735	0,443	1,026	0,000	***

5 CONCLUSION

After performing both quantitative analysis, the following conclusions were drawn:

- The implied forward rates' error vary depending on the type of bond (*y.to*). To be more specific, the longer the years to maturity of the bond, the more lower the implied forward rates' error. Thus, for example, the implied forward rates found in a 5-years zero-coupon bond are more accurate when forecasting the future rate than the implied forward rates found in the 1-year zero-coupon bond.
- The implied forward rates' error also vary with the length of the forecast (*y.since*). There exist a clear positive relationship between these two variables: the longer the length of the forecast, the greater the implied forward rates' error. It is reasonable to think that, for example, a forecast about the 2050 risk-free rate will be more inaccurate than a forecast about the same variable one year forward, that is, 2021.
- The federal funds rate is the only variable that is significant at all levels from the three variables that I used to explain why implied forward rates may not succeed at forecasting the future risk-free rate.

Taking this into account along with the easy access to the data of implied forward rates, implied forward rates can be used as a reliable indicator of the future risk-free rate if time and/or resources are a constraint.