Abstract

This paper analyzes the impact of the sentiment expressed in speeches by Fed chairs on bond yields, using an affine term structure model, similarly to the framework developed in Ang and Piazzesi (2003). The speeches by Fed Chairs are evaluated using finBERT (Huang, Wang, Yang, 2022) to generate three sentiment factors: negative, neutral, and positive. The variance decomposition analysis indicates that sentiment factors account for a considerable portion of the variance in short-term and long-term yield forecasts. Also, the inclusion of sentiment factors is helpful to improve out-of-sample forecast performance for relatively long-term yields.

Introduction

Central bank communication plays an important role in financial market conditions. Leombroni et al. (2021), Swanson and Jayawicke (2023), Swanson and Yang (2023) and many other papers show that central bank communication, especially ECB president or Fed chair’s speeches have a significant impact on bond yields using high frequency data. I test whether the sentiment factors captured from the speeches by the Chair of the Federal Reserve System using finBERT. Incorporating the sentiment factors to an affine term structure model for U.S. Treasury bonds with macroeconomic variables, I analyze the contribution of macroeconomic and sentiment factors as well as latent factors to yield determination. Also, I compare the forecast performance in Treasury bond yields. The sentiment of central bank communication is measured by a finBERT model developed by Huang, Wang, and Yang (2023). FinBERT models are a class of BERT models which are additionally pre-trained with financial communication documents. The model by Huang, Wang, and Yang is trained by corporate reports (10-K & 10-Q), earnings call transcriptions, and analyst reports. Using this model, I construct the sentiment factors for each speech by the Fed chairs during 2001—2022 using sentiment scores and macroeconomic variables. Incorporating the sentiment factors as additional observed factors to an affine term structure model with macroeconomic variables (see Ang and Piazzesi, 2003), I estimate parameters of the term structure model and conduct variance decomposition to see the contribution of each factor. Moreover, I implement out-of-sample forecast to compare the forecast performance.

Data

I use the speeches and Congressional testimony (henceforth “speeches”) by Fed chairs from December 2001 to June 2022. During this period, Chair Alan Greenspan gave 117 speeches; Chair Ben Bernanke, 234 speeches; Chair Janet Yellen, 57 speeches; Chair Jerome Powell, 46 speeches. Using Huang, Wang, and Yang (2023)'s finBERT model, I compute the sentiment scores for each speech and compile monthly data using the last speech of the month. If there is a month without a speech, I interpolate the missing value. Figure 1, 2, and 3 show the changes in negative, neutral and positive sentiment scores over time.

For macroeconomic variables, I use percentage changes of the PCE, the PPI for finished goods, and Case-Shiller U.S. National Home Price Index and extract the first principal component to form an inflation measure. A real activity measure is based on the first principal component extracted from the growth rate of the number of job openings for total nonfarm from JOLTS, the unemployment rate, the employment-population rate, and the growth rate of industrial production. All inflation and growth rates are annualized monthly rate.

I use data on bond yields of maturities 1, 3, 6, 12, 24, 36, 60, and 120 months from December 2001 to June 2022. All bond yields are based on constant maturity Treasury yields as reported in the FRED database of the Federal Reserve Bank of St. Louis. I choose 1, 3, 12, 60 month yields as key rates representing short, medium, and long end of the yield curve.

Model & Results

I estimate a discrete-time term structure model similar to Ang and Piazzesi (2003). The model combines three sentiment factors $S_t$ with the principal components for the inflation measure $\pi_t$ and the real activity measure $y_t$ as observable factors along with three latent factors $F_t$: 
$$ [\pi_{t+1} y_{t+1} S_{t+1} F_{t+1}] = \phi + \rho \cdot [\pi_t y_t S_t F_t] + \mu_{t+1} 
$$
$$ i_t^2 = \hat{A} + \hat{B} \cdot [\pi_t y_t S_t F_t] + \mu_{t+1} 
$$

The three sentiment factors ($S_t$) are residuals after regressing the sentiment scores on the macroeconomic principle components. For identification and estimation, I follow conventional restrictions and use MCSE by Hamilton and Wu (2012).

Figure 4 shows the response of annualized yield to one SD increase in each factor. Positive sentiment shock seems to lower short-term bond yields while negative and neutral sentiment shocks seem to lift short-term bond yields. Table 1 (and 2) summarize the relative contribution of each factor to forecast variances for 1-month (120-month) ahead forecast. Sentiment factors explain 77-88% of the 1-month ahead forecast variance while they explain 46-60% in 120-month ahead forecast variance. In the latter, the role of macro factors becomes more significant. Also, I perform 1-month ahead out-of-sample forecast over 24 months by expanding windows to compare bond yield forecasting performance between the macro model of Ang and Piazzesi (2003) and the model with sentiment factors. For 120-month (60-month) bond yield, the root mean squared errors (RMSEs) are 0.1170 for the macro model and 0.0288 for the model with sentiment factors (0.3878, and 0.1919). Including sentiment factors seem to improve the out-of-sample forecasting performance for long-term yields relative to the macro model.

Figure 3 shows the response of annualized yield to one SD increase in each sentiment factor. The sentiment scores for each speech and Congressional testimony are residuals after regressing the sentiment scores on macroeconomic and latent factors. For identification and estimation, I follow conventional restrictions and use MCSE by Hamilton and Wu (2012). Figure 4 shows the response of annualized yield to one SD increase in each of the macro factors and sentiment factors.

Conclusions

This paper analyzes the impact of negative, neutral and positive sentiments in speeches by Fed Chairs on bond yields. Sentiment factors are constructed using sentiment scores by finBERT (Huang, Wang, Yang 2023). They seem to play a key role in yield determination, and including them shows better out-of-sample forecasting performance relative to the macro model of Ang and Piazzesi (2003). This analysis, however, relies on the performance of the finBERT score system and shares its limitations. There exists room for improvement in sentiment analysis by finBERT, considering the Fed chairs’ euphemism.

References


Contact

Dr. Eunmi Ko
Assistant Professor, Economics,
Rochester Institute of Technology
Email: emko@rit.edu
Website: https://emmako.net/