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Predicting output using the entire yield curve ☆

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ABSTRACT

Many papers find that the term spread of the term structure of government bond yields can predict future output growth. This paper extends that literature by exploiting information in the entire term structure of interest rates. I apply a dynamic version of the Nelson–Siegel yield curve model to jointly model real GDP growth and yield factors. I find that the dynamic yield curve model produces better out-of-sample forecasts of real GDP than those generated by the traditional term spread model. The main source of this improvement is in the dynamic approach to constructing forecasts versus the direct forecasting approach used in the term spread model. While I confirm the importance of the term spread as a predictor of future output, there is also a gain from using information in the curvature factor.

1. Introduction

There are numerous papers which explore the question: "What information does the term spread contain about future real economic activity?" These studies are based on the intuition that, when agents price assets, they take into account expectations about future states of the economy, and therefore interest rates potentially contain useful information about future economic growth. Among early work in this literature, Estrella and Hardouvelis (1991) find evidence that the U.S. government bond term spread contains information about future U.S. real economic activity at horizons of up to 4 years. Subsequent studies confirm the predictive ability of a term spread for future output growth and recessions using data from different countries, as well as different measures of output. Wheelock and Wohar (2009) provide a comprehensive survey of this literature.

Most studies in the literature consider regressions of future output growth on a past term spread. Although this approach has the advantage of its simplicity, it does not exploit all of the information contained in the term structure of interest rates that might be useful for output prediction.

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This paper extends the dynamic version of the Nelson and Siegel (1987) yield curve model proposed by Diebold and Li (2006) to examine the predictive power of information contained in the entire yield curve for real output growth. The choice of the dynamic Nelson–Siegel (NS) model for this study is driven by its relative parsimony compared to other yield curve models and its good out-of-sample forecasting performance for future yields.[1] The model describes the entire term structure of interest rates using only three factors. Diebold and Li (2006) show that these factors can be interpreted as the level, slope, and curvature of the yield curve. The authors introduce dynamics to the evolution of these factors and show that the dynamic NS model has a more accurate in-sample fit and produces better forecasts of future yields at long horizons relative to other models. In terms of predicting output, the dynamic NS model has two advantages over the traditional term spread framework: (i) the model contains information about the entire term structure of interest rates and (ii) real GDP growth can be modeled jointly with yields in a parsimonious way using the three endogenously-defined yield curve factors.

The focus of my analysis is to examine whether real GDP growth forecasts can be improved by exploiting information from the entire yield curve, as opposed to a term spread traditionally used in a forecasting term spread model. For this analysis, I perform pseudo out-of-sample forecast comparisons for real GDP growth based on root mean square errors (RMSEs) for the NS dynamic yield curve model and the forecasting term spread model based on OLS regressions of the GDP growth rate on a term spread. I consider various versions of the dynamic yield curve model in which real GDP growth is explained by different yield factors in order to analyze the contributions of the individual factors to the forecasting performance.

I find that the dynamic yield curve model significantly improves out-of-sample forecasts of real GDP growth at all horizons relative to the forecasting term spread model. The main source of this improvement can be attributed to the dynamic specification of the model. Although I find that the predictive power of the yield curve for future output growth is concentrated in the term spread, there is also a gain from extracting more information from the entire yield curve relative to a specific exogenously-defined term spread. In particular, there is a gain from using information in the curvature factor. The results are robust to studying various forecast horizons and evaluating the recent recessionary episode separately.

This paper contributes to the emerging literature on the predictive power of the entire yield curve for output growth. Among these papers, Ang et al. (2006) study the predictive power of the short-term yield and term spread for real GDP growth using an affine arbitrage-free dynamic yield curve model. Their approach is based on modeling real GDP growth jointly with an exogenously-defined short-term yield and term spread and imposing no-arbitrage constraints on the pricing of bonds. Contrary to earlier findings, the authors find that the short-term interest rate has more predictive power for real GDP growth than the term spread. Consistent with early work in this literature, I find that the level factor, which is closely correlated with the short-term rate, does not improve forecasts of real GDP growth.

Hillebrand et al. (2011) use the three Nelson–Siegel factors to propose a method of forecasting output growth and inflation. The method combines forecasts of output growth produced by several models that consider only one of the three yield curve factors at a time. The authors find that combining forecasts outperforms a method that relies on a single model that includes all yield curve factors. Although their study compares two forecasting methods that use the same set of yield curve information, it does not analyze the individual contributions of the yield curve factors to the output growth forecasts and does not compare forecasts with those from the traditional term spread model.

Chauvet and Senyuz (2012) extract a single latent factor from exogenously-defined level, slope, and curvature factors to forecast future industrial production growth and the timing of recessions. The authors forecast industrial production growth using lags of the single factor and lags of the industrial production growth rate. They compare the predictive performance of this model with models that use lags of the exogenously-defined yield curve factors and lags of industrial production growth. They find that the model with two lags of the single factor and lags of industrial production growth outperforms other considered models out-of-sample. The authors focus on finding a combination of the lags of factors and the lags of output growth with the best out-of-sample forecasting performance. My study focuses on the contributions of individual yield curve factors to the output growth forecasts, starting with the slope factor found to be useful for the output growth prediction in the previous literature. In contrast to the single factor in Chauvet and Senyuz (2012), all three factors – level, slope, and curvature – considered in my study have economic interpretations. In addition, my study provides numerical analysis of the sources of forecast improvements relative to the traditional term spread model, identifying contributions of information differences and modeling aspects. Also, Chauvet and Senyuz (2012) use information in three yields, while my study uses information in the term structure of eight yields.

The rest of this paper is organized as follows. Section 2 describes the data. Section 3 motivates and presents the traditional term spread model and reports the predictive power of this model for output. Section 4 describes the dynamic yield curve model. Section 5 reports estimation results for the dynamic yield curve model. Section 6 reports out-of-sample forecasting results and compares various versions of the dynamic yield curve and term spread models. Section 7 concludes.

2. Data

The raw interest rate data are monthly-average yields on U.S. government bonds for maturities 3, 6, 12, 24, 36, 60, 84, and 120 months obtained from the FRED database. The yields are constant maturity rates, except for the 3- and 6-month

[1] One alternative approach is the affine arbitrage-free class of models. While theoretically appealing, this method involves more parameters and restrictions. Also, as reported by Duffee (2002), these models produce poor out-of-sample forecasts of future yields.