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The macroeconomy and the yield curve: a dynamic latent factor approach

Francis X. Diebold[a], Glenn D. Rudebusch[b], S. Borağan Aruoba[c,*]

[a]*Department of Economics, University of Pennsylvania, 3718 Locust Walk, Philadelphia, PA 19104-6297, USA*
[b]*Federal Reserve Bank of San Francisco, 101 Market Street, San Francisco, CA 94105-9967, USA*
[c]*Department of Economics, University of Maryland, College Park, MD 20742-7211, USA*

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Abstract

We estimate a model that summarizes the yield curve using latent factors (specifically, level, slope, and curvature) and also includes observable macroeconomic variables (specifically, real activity, inflation, and the monetary policy instrument). Our goal is to provide a characterization of the dynamic interactions between the macroeconomy and the yield curve. We find strong evidence of the effects of macro variables on future movements in the yield curve and evidence for a reverse influence as well. We also relate our results to the expectations hypothesis.

JEL classification: G1; E4; C5

Keywords: Term structure; Interest rates; Macroeconomic fundamentals; Factor model; State-space model

*Corresponding author. Tel.: +1 301 405 3508; fax: +1 301 405 3542.
E-mail addresses: fdiebold@sas.upenn.edu (F.X. Diebold), glenn.rudebusch@sf.frb.org (G.D. Rudebusch), aruoba@econ.umd.edu (S. Borağan Aruoba).

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1. Introduction

Macroeconomists, financial economists, and market participants all have attempted to build good models of the yield curve, yet the resulting models are very different in form and fit. In part, these differences reflect the particular modeling demands of various researchers and their different motives for modeling the yield curve (e.g., interest rate forecasting or simulation, bond or option pricing, or market surveillance). Still, an unusually large gap is apparent between the yield curve models developed by macroeconomists, which focus on the role of expectations of inflation and future real economic activity in the determination of yields, and the models employed by financial economists, which eschew any explicit role for such determinants. This paper takes a step toward bridging this gap by formulating and estimating a yield curve model that integrates macroeconomic and financial factors.

Many other recent papers have also modeled the yield curve, and they can be usefully categorized by the extent and nature of the linkages permitted between financial and macroeconomic variables. Many yield curve models simply ignore macroeconomic linkages. Foremost among these are the popular factor models that dominate the finance literature—especially those that impose a no-arbitrage restriction. For example, Knez et al. (1994), Duffie and Kan (1996), and Dai and Singleton (2000) all consider models in which a handful of unobserved factors explain the entire set of yields. These factors are often given labels such as "level," "slope," and "curvature," but they are not linked explicitly to macroeconomic variables.

Our analysis also uses a latent factor model of the yield curve, but we also explicitly incorporate macroeconomic factors. In this regard, our work is more closely related to Ang and Piazzesi (2003), Hördahl et al. (2002), and Wu (2002), who explicitly incorporate macro determinants into multi-factor yield curve models. However, those papers only consider a unidirectional macro linkage, because output and inflation are assumed to be determined independently of the shape of the yield curve, but not vice versa. This same assumption is made in the vector autoregression (VAR) analysis of Evans and Marshall (1998, 2001) where neither contemporaneous nor lagged bond yields enter the equations driving the economy. In contrast to this assumption of a one-way macro-to-yields link, the opposite view is taken in another large literature typified by Estrella and Hardouvelis (1991) and Estrella and Mishkin (1998), which assumes a yields-to-macro link and focuses only on the unidirectional predictive power of the yield curve for the economy. The two assumptions of these literatures—one-way yields-to-macro or macro-to-yields links—are testable hypotheses that are special cases of our model and are examined below. Indeed, we are particularly interested in analyzing the potential bidirectional feedback from the yield curve to the economy and back again. Some of the work closest to our own allows a feedback from an implicit inflation target derived from the yield curve to help determine the dynamics of the macroeconomy, such as Kozicki and Tinsley (2001), Dewachter and Lyrio (2002), and Rudebusch and Wu (2003). In our analysis, we