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Journal of Econometrics 130 (2006) 337–364
JOURNAL OF Econometrics
www.elsevier.com/locate/jeconom

Forecasting the term structure of government bond yields

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Accepted 21 March 2005
Available online 23 May 2005

Abstract

Despite powerful advances in yield curve modeling in the last 20 years, comparatively little attention has been paid to the key practical problem of forecasting the yield curve. In this paper we do so. We use neither the no-arbitrage approach nor the equilibrium approach. Instead, we use variations on the Nelson–Siegel exponential components framework to model the entire yield curve, period-by-period, as a three-dimensional parameter evolving dynamically. We show that the three time-varying parameters may be interpreted as factors corresponding to level, slope and curvature, and that they may be estimated with high efficiency. We propose and estimate autoregressive models for the factors, and we show that our models are consistent with a variety of stylized facts regarding the yield curve. We use our models to produce term-structure forecasts at both short and long horizons, with encouraging results. In particular, our forecasts appear much more accurate at long horizons than various standard benchmark forecasts.
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JEL classification: G1; E4; C5

Keywords: Term structure; Yield curve; Factor model; Nelson–Siegel curve

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0304-4076/$ - see front matter © 2005 Published by Elsevier B.V.
doi:10.1016/j.jeconom.2005.03.005

1. Introduction

The last 25 years have produced major advances in theoretical models of the term structure as well as their econometric estimation. Two popular approaches to term structure modeling are no-arbitrage models and equilibrium models. The no-arbitrage tradition focuses on perfectly fitting the term structure at a point in time to ensure that no arbitrage possibilities exist, which is important for pricing derivatives. The equilibrium tradition focuses on modeling the dynamics of the instantaneous rate, typically using affine models, after which yields at other maturities can be derived under various assumptions about the risk premium.[1] Prominent contributions in the no-arbitrage vein include Hull and White (1990) and Heath et al. (1992), and prominent contributions in the affine equilibrium tradition include Vasicek (1977), Cox et al. (1985), and Duffie and Kan (1996).

Interest rate point forecasting is crucial for bond portfolio management, and interest rate density forecasting is important for both derivatives pricing and risk management.[2] Hence one wonders what the modern models have to say about interest rate forecasting. It turns out that, despite the impressive theoretical advances in the financial economics of the yield curve, surprisingly little attention has been paid to the key practical problem of yield curve forecasting. The arbitrage-free term structure literature has little to say about dynamics or forecasting, as it is concerned primarily with fitting the term structure at a point in time. The affine equilibrium term structure literature is concerned with dynamics driven by the short rate, and so is potentially linked to forecasting, but most papers in that tradition, such as de Jong (2000) and Dai and Singleton (2000), focus only on in-sample fit as opposed to out-of-sample forecasting. Moreover, those that *do* focus on out-of-sample forecasting, notably Duffee (2002), conclude that the models forecast poorly.

In this paper we take an explicitly out-of-sample forecasting perspective, and we use neither the no-arbitrage approach nor the equilibrium approach. Instead, we use the Nelson and Siegel (1987) exponential components framework to distill the entire yield curve, period-by-period, into a three-dimensional parameter that evolves dynamically. We show that the three time-varying parameters may be interpreted as factors. Unlike factor analysis, however, in which one estimates both the unobserved factors and the factor loadings, the Nelson–Siegel framework imposes structure on the factor loadings.[3] Doing so not only facilitates highly precise estimation of the factors, but, as we show, it also lets us interpret the factors as level, slope and curvature. We propose and estimate autoregressive models for the factors, and then we forecast the yield curve by forecasting the factors. Our results are encouraging; in

[1]The empirical literature that models yields as a cointegrated system, typically with one underlying stochastic trend (the short rate) and stationary spreads relative to the short rate, is similar in spirit. See Diebold and Sharpe (1990), Hall et al. (1992), Shea (1992), Swanson and White (1995), and Pagan et al. (1996).

[2]For comparative discussion of point and density forecasting, see Diebold et al. (1998) and Diebold et al. (1999).

[3]Classic unrestricted factor analyses include Litterman and Scheinkman (1991) and Knez et al. (1994).

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