Evolving macroeconomic perceptions and the term structure of interest rates

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ABSTRACT

We explore the role of evolving beliefs regarding the structure of the macroeconomy in improving our understanding of the term structure of interest rates within the context of a simple macro-finance model. Using quarterly vintages of real-time data and survey forecasts for the United States over the past 40 years, we show that a recursively estimated VAR on real GDP growth, inflation and the nominal short-term interest rate generates predictions that are more consistent with survey forecasts than a benchmark fixed-coefficient counterpart. We then estimate a simple term structure model under the assumption that investor risk attitude is driven by near-term expectations of the three state variables. When we allow for evolving beliefs about the macroeconomy, the resulting term structure model provides a better fit to the cross section of yields than the benchmark model, especially at longer maturities, and exhibits better performance in out-of-sample predictions of future yield movements.

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1. Introduction

Economic theory suggests that the term structure of interest rates at any moment ought to reflect agents' perceptions regarding the current state of the macroeconomy as well as its dynamic structure. The endogenous response of monetary policy to inflation and economic conditions provides a strong link between these factors and current and expected future short-term interest rates. And to the extent that investor appetite for risk varies with business conditions, premia on long-term yields would also reflect current and expected business cycle developments.

In this light, the recent emergence of no-arbitrage term structure models with macroeconomic factors in fitting jointly the term structure of interest rates and macroeconomic dynamics of the U.S. economy, has been a welcome development in macroeconomics and finance. These models typically posit that the macroeconomy is governed by a simple fixed-coefficient dynamic structure and that agents know this structure and form expectations consistent with the model.

While such simple fixed-coefficients dynamic models have proven useful, many researchers also find that these models must be supplemented with additional latent factors and unobservable shocks to provide a satisfactory fit of yields across the spectrum of maturities. The key difficulty seems to be that such a fixed-coefficient model implies too tight a link between macro variables and bond yields by assuming they span the same information set and are linked to each other via a time-invariant functional form, an implication that has limited empirical support.

In this paper, we relax the restriction of a time-invariant relationship between macro variables and bond yields by allowing evolving perceptions regarding the dynamic structure of the economy. In particular, we posit that agents engage in real-time re-estimation and updating of a vector autoregression (VAR) model assumed to govern the dynamics of the macroeconomy and, in each period, form expectations based on the estimation results with data available during that period. In this manner, we obtain an anticipated-utility version of a no-arbitrage model of the term structure. We show that such a model generates forecasts about the future path of the economy that are more consistent with the survey evidence and explore its role in improving the empirical performance of the macro finance models.

We estimate the model using real-time vintages of quarterly data on inflation, output growth, the nominal short rate and, in certain variants, the corresponding survey forecasts. The use of real-time data is motivated by the fact that forecasters only have access to the latest vintages of macro data when making forecasts and by previous studies showing that data revisions are large and non-random and have important implications for structural economic modeling, policy analysis, and forecasting.[1] To recover the evolution of perceptions about macroeconomic dynamics, in each quarter we solve for VAR parameters that provide the best fit to historical data and, when used in estimation, to survey forecasts from that quarter. We then fit the time series of bond yields using the VAR estimates from the quarter when yields are observed.

The main findings from this exercise can be summarized as follows. First, our results suggest significant deviations from the benchmark fixed-coefficient model of expectations. Allowing for evolving perceptions regarding economic dynamics results in a significantly improved understanding of the evolution of expectations over time. Second, allowing for evolving macroeconomic expectations leads to a large and economically significant improvement in the fit of the term structure, especially for longer maturities, and in forecasting macro variables and yields out of sample. Third, survey forecasts provide useful information regarding the perceived future path of the economy. Incorporating survey information directly in the estimation stage leads to further improvement in both the in-sample fit and the out-of-sample forecasting performance of the model. Finally, allowing time variations in the perceived dynamics of the economy helps alleviate the puzzle that macro variables seemingly contain little information about yields. The contribution from an additional latent factor becomes less important.

Our paper is related to the large literature on learning. Compared to models imposing rational expectations and a known fixed-coefficient rule governing how the economy evolves over time, models in which agents have to infer in real time the structure of the economy appear to provide a better description of the inflation dynamics and the monetary policy decision making process,[2] and generate forecasts about the future path of the economy that are more consistent with the survey evidence.[3] Term structure implications of learning have been examined by Cogley (2005) based on a two-yield-factor model and Piazzesi and Schneider (2006) in a consumption-based asset pricing framework. However, using yield curve factors in the former study prevents an examination of the economic driving forces behind interest rate variations; the relatively small number of factors in both studies also leads to a less than satisfactory fit of the cross section of yields.

Our paper builds on the rapidly expanding macro finance literature that examines bond pricing implications of New Keyesian models by superimposing either an exogenously specified or an endogenously derived pricing kernel.[4] More recently, learning is incorporated into models where agents continuously update their beliefs regarding the central bank's inflation target (Kozicki and Tinsley, 2001a,b; Dewachter and Lyrio, 2010) or the degree of monetary policy activism in general (Ang et al., 2011). In comparison, this paper makes no *a priori* assumptions about the potential source of structural instabilities, but allows the agents to learn about all aspects—the drift, the slope coefficients and the conditional volatilities—of the economy. The paper most closely related to ours is a contemporaneous and independently written paper by Laubach et al. (2007), who carry out an exercise that is nearly identical to ours—approximating agents' changing expectations about the economy with constant-gain VARs and examining the term structure implications. However, they do not employ information from survey data in estimating or evaluating the model as we do here. The one-step procedure they use also frequently leads to explosive VAR estimates and long-run model forecasts that exhibit implausibly large jumps.

Finally, a number of papers use survey information in term structure estimation. Kim and Orphanides (2006) show that using survey forecasts of the nominal short rate in the estimation helps alleviate the small-sample problem when estimating a latent-factor term structure model. Pennacchi (1991) and D'Amico et al. (2010) use survey forecasts of inflation to identify expected inflation in a real term structure model, where most of the risk factors remain unobserved. In contrast, Chun (2011) directly employs the one-period ahead survey forecasts of the nominal short rate, real GDP growth and inflation as state variables, and assumes that investor expectations depend solely on their own lags with no feedback from subsequent realizations of the macro variables. His analysis also ignores information contained in the entire term structure of forecasts.

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[1] See Croushore (2011) for a recent survey of the literature.
[2] See Cogley and Sargent (2002) for the former and Orphanides and Williams (2005a,b) for the latter.
[3] Branch and Evans (2006).
[4] Among others, see Ang and Piazzesi (2003), Rudebusch and Wu (2008), and Hördahl et al. (2006) for the former, and Bekaert et al. (2010) and Dewachter and Lyrio (2010) for the latter.