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A structural decomposition of the US yield curve ☆

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ABSTRACT

By expanding the macro part of macro-finance models, historical fluctuations in US bond yields turn out to be largely consistent with the rational expectations hypothesis. We estimate a medium-scale macro-finance DSGE model of the term structure to establish this. Our finding contrasts with existing macro-finance models and suggests that their—small-scale or non-structural—perspective on the macroeconomy mutes expectations, thereby underestimating the expectations hypothesis' potential. Out-of-sample forecasts are competitive with more flexible term structure models. Given the empirical validation, we interpret various episodes through the lens of the model and investigate which structural shocks cause the yield curve to contain information about future growth.

1. Introduction

Numerous contributions in finance have made it clear that imposing no-arbitrage restrictions in empirical models of the term structure improves their empirical characteristics (e.g., Ang et al., 2006). At the same time, macroeconomic research has shown that theoretical restrictions embedded in dynamic stochastic general equilibrium (DSGE) models make current macro models competitive with VAR's (e.g., Smets and Wouters, 2007). The macro-finance literature aims to combine these two types of restrictions, in view of capturing both dimensions simultaneously, and ultimately, contribute to understanding links between the real and financial economy. However, appending a term structure to the standard New-Keynesian model finds only limited support in the data. The response of the macro-finance literature has been to incorporate flexible features in the model. Examples are time-varying parameters (Fuhrer, 1996; Favero, 2006; Dewachter and Lyrio, 2006), time-varying variances of structural shocks (Doh, 2007b), flexible pricing kernels (Hördahl et al., 2006; Rudebusch and Wu, 2008),

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additional shocks (Bekaert et al., 2006), latent variables (Ang and Piazzesi, 2003). These additional features have brought model-implied yields and observed yields closer together.

The present paper, by contrast, shows how a medium-scale DSGE model receives at least as much empirical support, without the introduction of additional flexibility. The rationale for our approach lies in the possibility that, in current macro-finance models, the description of the macroeconomy is in some way inadequate. When present, such mis-specification will feed through to yield predictions, via the formation of expectations. The additionally introduced degrees of freedom may enable the models to pick up this mis-specification, rather than being truly relevant aspects of the economy themselves. We therefore focus on a more rigorously specified DSGE model—in the same vein as Christiano et al. (2005) and Smets and Wouters (2007)—which, in terms of forecasting key macroeconomic aggregates, is competitive with reduced form VAR's.

As a motivation for our approach, it suffices to look at current estimates of the term premium in the literature (see e.g., Fig. 4 in Rudebusch et al., 2007). The wide dispersion among the various estimates of the term premium underlines the importance of modeling expectations carefully. A more rigorous specification of the macroeconomy results in a more rigorous formation of expectations. This is the main contribution of the paper: we detail how well the rational expectations hypothesis of the term structure describes bond yield dynamics in a medium-scale DSGE model. To anticipate results, we find our restrictive DSGE model to be competitive with models that do incorporate additional flexibility. In particular, we find that up to 90% of yield fluctuations during the past forty years are not inconsistent with the rational expectations hypothesis. Moreover, the model is promising in terms of out-of-sample yield predictions.

The favorable empirical properties of our DSGE model raise a number of issues. First, there has been a large focus on term premia in recent years. By definition, term premia are estimated as the part of yields not explained by the expectations hypothesis. The results of the present paper indicate that the use of reduced form or small-scale macro models to generate the expectations part may well underestimate its potential. As a result, they might also overestimate the importance of term premia.

A second question of interest relates to the observation that the 2004–2006 tightening of the Fed did not result in significant long rate increases, which has puzzled numerous economists. Many observers deem the expectations hypothesis incapable of explaining this recent episode. The alternative explanation put forth is that a fall in the term premium is responsible for the sustained low long rates (e.g., Backus and Wright, 2007). Our model advocates a different view, consistent with the expectations hypothesis. We show that this recent episode can be interpreted as the consequence of the Fed's stabilizing policy response to demand shocks hitting the economy. We provide model-based historical decompositions that make this point explicitly, and contrast them with the behavior of the yield curve in other periods of tight monetary policy. Cochrane (2007) provides an appealing intuition for the recent US yield behavior based on the expectations hypothesis. An additional contribution of this paper lies in confronting such an argument to the data, and providing an explicit structural interpretation for it.

Third, including the yield curve in the analysis, in addition to macroeconomic data, provides a broader perspective on monetary policy conduct in the past decades. We detail the model's interpretation of the two inflation hikes in the seventies. Both the mid-seventies spike in inflation and the early eighties disinflation are characterized by a divergence between actual and expected inflation. The estimated model reproduces these differences and documents the structural shocks that initiated them.

As a final contribution, the paper addresses the predictive ability of the yield curve. Both the short term interest rate and the term spread have an impressive record in predicting GDP growth (Estrella, 2005; Ang et al., 2006). Using our estimated macro-finance model, we present a structural interpretation for the informational content of the yield curve for future growth.

The paper is organized as follows. The next section describes the micro-foundations of the macro-finance model, the mapping of model variables to the data and the estimation procedure. In Section 3 we document the empirical fit. The model is evaluated both in and out-of-sample. We then study several implications of the model. Section 4 decomposes fluctuations in the yield curve in terms of structural macroeconomic shocks and describes how this description relates to alternative representations of the term structure. In Section 5 we investigate the historical evolution of bond yields. This necessitates a precise description of inflation expectations and, ultimately, of monetary policy. As a form of external validation, we compare model-implied inflation expectations to survey expectations. Section 6 assesses the role of the term premium in the 2004–2006 episode with special rigor. The informational content of the yield curve for economic growth is analyzed in Section 7.

2. The model and estimation approach

The model we study is a close variant of Smets and Wouters (2007).[1] In this model, the economy consists of households, final and intermediate goods firms and the monetary authority. Consumers' utility is non-separable in consumption and

[1] We refer to Smets and Wouters (2007) and Appendix to this paper, available via Science Direct, for a detailed presentation and derivation of the model and the estimation results. Therefore, the discussion in this section concentrates on the specific features that differentiate our macro-finance model from the original Smets and Wouters model.