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Testing affine term structure models in case of transaction costs

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Abstract

We empirically analyze the impact of transaction costs on the performance of essentially affine interest rate models. We test the implied Euler restrictions and calculate the specification error bound of Hansen and Jagannathan to measure model misspecification. Using both short-maturity and long-maturity bond return data we find, under the assumption of frictionless markets, strong evidence of misspecification of affine yield models with up to three factors. Next, we incorporate transaction costs in our tests. The results show that the evidence of misspecification of essentially affine yield models disappears in case of monthly holding periods at market size transaction costs.

JEL classification: G12; E43

Keywords: Interest rate models; Market frictions; Transaction costs; Model misspecification

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1. Introduction

Nowadays term structure models are used extensively for many purposes, including risk management of portfolios containing bonds and the valuation of interest-rate derivatives. Empirical tests of term structure models have therefore attracted considerable attention in the literature. In line with a large part of the empirical asset pricing literature, the tests are based on the assumption of trading in frictionless markets. In particular, the large literature on affine term structure models[1] tests these models using data on Treasury bills and bonds under the assumption of trading in frictionless markets. However, market frictions such as transaction costs are an important fact of life for investors. The implicit assumption when ignoring transaction costs is that these costs are sufficiently small, so that they do not seriously affect the empirical results. In this paper we explicitly take transaction costs into account in the empirical testing of affine term structure models, and show that including market size transaction costs can considerably affect the results of the tests.

Our approach is to test whether the stochastic discount factor of a given term structure model satisfies the Euler restrictions. These Euler restrictions are implied by the no-arbitrage assumption, and can be derived in both frictionless markets and markets with frictions. Based on these Euler restrictions, we use two approaches to analyze and test the models. First, we use Wald-type tests to test the Euler restrictions. For the frictionless case, the analysis of Euler restrictions using Wald tests is extensively discussed by Cochrane (1996, 2001). In case of transaction costs, we use tests of inequality restrictions adopting the approach developed by Kodde and Palm (1986). A disadvantage of this approach is that, if one rejects a model, there is no clear indication of the direction of misspecification, for example, which individual assets are possibly mispriced by the model and which are not. Also, the Wald test does not allow for a comparison of the degree of misspecification of two non-nested models that are both rejected. To overcome these problems we also consider the *specification error bound* (SEB) developed by Hansen et al. (1995) and Hansen and Jagannathan (1997). This bound measures the extent to which a model misprices a given set of assets. Hansen and Jagannathan (1997) show that this bound can be interpreted as the maximum pricing error for all portfolios that can be constructed from the assets under consideration. This specification error bound allows for direct comparison across (non-nested) models and the method indicates which (portfolios of) assets contribute most to the misspecification. Hansen et al. (1995) extend the setup of Hansen and Jagannathan (1997) to allow for market frictions. We apply their approach to affine term structure models and compare the results with standard tests using the Euler restrictions.

[1]For example, Stambaugh (1988), Chen and Scott (1993), Gibbons and Ramaswamy (1993), Backus and Zin (1994), Brown and Schaefer (1994), Pearson and Sun (1994), Babbs and Nowman (1999), De Jong (2000), Backus et al. (2001a, 2001b), Dai and Singleton (2001), and Duffee (2002). In addition, there is by now a large literature that studies models outside the affine class, including Boudoukh et al. (1999), Bansal and Zhou (2002), Ahn et al. (2002a, b), Duarte (2003), and Leippold and Wu (2003). Dai and Singleton (2003) provide an extensive survey of this literature.