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Treasury yields and credit spread dynamics: A regime-switching approach

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ABSTRACT

The purpose of this paper is to shed new light on the conflicting empirical evidence on the relationship between credit spreads and Treasury rates. Following a general-to-specific modeling approach, we were unable to accept the presence of a long-run relationship between Baa credit spreads and long-term Treasury rates. At the same time, and in support of the structural models on credit risk modeling, a negative short-run relationship was obtained by means of impulse response functions. Subsequently, by employing a regime-switching estimation technique, we were able to establish the importance of the Treasury yield curve slope for the Baa credit spread determination in periods characterized by low interest rate volatility. Finally, we were able to provide evidence of an asymmetric response of the Baa credit spread to term spread changes according to the source of these changes, i.e. short or long term Treasury rates.

1. Introduction

The enquiry into the determinants of corporate credit spreads has stimulated a large body of academic research over recent years. The existing literature on credit risk modeling revolves around two fundamental theoretical approaches: the structural and reduced form models. Structural form models treat corporate debt as being equivalent to a synthetic asset consisting of a long position on a risk free bond and a short position on a put option written on the value of the firm and struck at the face value of the debt. Within this class of models, default is basically determined by the firm's asset value relative to some default threshold. In contrast, reduced form models employ market information instead of the company's financial fundamentals and take as a premise that bonds, when grouped by ratings, are homogenous with respect to risk.

The present study departs from the main body of empirical studies on credit spread determinants and focuses on a segment of the relevant literature that deals solely with the relationship between risk free interest rates and the corporate – Treasury yield spread (e.g., Duffee, 1998; Longstaff & Schwartz, 1995; Neal, Rolph, Morris, 2000).[1] In particular, the main issue we address in this paper is whether the slope of the Treasury yield curve constitutes an explanatory factor of corporate credit spreads. The underlying rationale is that the slope of the yield curve acts as an indicator of future economic activity and is therefore closely related to credit spreads which quantify, among others, default risks and liquidity squeezes. For example, an increase in the yield curve slope is associated, under the expectations hypothesis and neglecting term

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[1] Throughout this study we refer interchangeably to credit spread and corporate – Treasury yield spread, although a number of papers refute their close association and assign to credit risk a minor importance as an explanatory factor of the latter variable (see Collin-Dufresne, Goldstein, Martin, 2001; Longstaff, Mithal, Neis, 2005; Dionne, Gauthier, Hammami, Maurice, Simonato, 2004; Elton, Gruber, Agrawal, Mann, 2001).

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premiums, with improving economic conditions, higher expected future short rates, a higher drift of the company's value process and therefore a smaller probability of default. Equivalently, a negative slope might be the outcome of a tighter monetary policy, often intended to reduce inflationary pressures, which makes a slowing-down over subsequent months more likely and therefore increases the probability of default (e.g. Estrella & Trubin, 2006). Despite the fact that structural models do not include the yield curve slope as a possible explanatory variable, it is nevertheless present in many empirical specifications of the stochastic behavior of credit spreads; still, the empirical evidence is rather conflicting.

Methodologically, this paper is most closely associated with the empirical work of Neal et al. (2000, 2012). However, our analysis is novel in a number of ways. First, we employ a vector error-correction methodology, in accordance with Johansen (1995), using monthly bond yields of the 1- and 10-year U.S. Treasuries as well as Moody's Baa bond index over the period 1960–2010. This specification permits the incorporation of the market's perspective on future growth, as this is reflected in the slope of the yield curve, in the empirical investigation of credit spreads. The approach adopted in this paper departs from a large part of the existing literature that initially tests the credit spread series (i.e. the difference between corporate and government bond yields) for unit roots and then applies, accordingly, either cointegration or "conventional" econometric techniques (Davies, 2004). Instead, our approach is integrated in the sense that we identify equilibrium relationships among the variables under study, within the context of cointegration. We provide evidence for the existence of two cointegrating vectors of the form $(1,-1)$, between Baa and 10-year Treasury rates, and between 10- and 1-year Treasury rates. The first cointegrating vector rejects the hypothesis that there exists a long run relationship between credit spreads and Treasury rates since they have different integration orders. However, through an impulse response analysis, we show that in the short run the Baa credit spread declines due to a rise in the 10-year Treasury rate and that it requires more than 40 months to return to its initial level. Our results are consistent with the evidence of, among others, Longstaff and Schwartz (1995), Duffee (1998), who reported a negative short run relationship between changes in credit spreads and Treasury yields. They differ however from the findings of Neal et al. (2000, 2012) and Davies (2008), who reported a widening Baa credit spread in the long run due to positive Treasury rate changes and a negative short run reaction only for the first periods in their impulse response exercise.

The second contribution of this paper involves the examination of the temporal stability of the aforementioned long-run relationships, using a sequence of tests suggested by Hansen and Johansen (1993). The results indicate that two cointegrating vectors are established after (1990), and that the single cointegrating vector prior to that date is identified with the yield curve slope and not the credit spread. In the early 1980's, the tests carried out for the constancy of the cointegration space and the stability of the estimated eigenvectors indicate a structural break.

Third, we further extend the short-run dynamic analysis by allowing for the presence of different regimes, which are found to be related to the inflation rate and industrial production. There is currently a large volume of empirical literature that documents nonlinearities in interest rates as well as the suitability of regime-switching models for capturing this feature. For instance, Ang and Bekaert (2002) found overwhelming evidence for multiple regimes in the data generating process of the 3-month short rates for the U.S., Germany, and Great Britain. Clarida, Sarno, Taylor, and Valente (2006) estimated a non-linear VECM that is theoretically based on the expectations model of the term structure. They estimated a MS-VECM, and showed that it provides good in- and out-of-sample fits and that the regimes are related to the state of the business cycle and the inflation rate. Our paper employs a Markov-switching vector equilibrium correction model (MS-VECM), using the estimation techniques developed by Krolzig (1997). The analysis indicates that the yield curve slope embodies useful information for the credit spread determination during low conditional volatility periods only. Through an impulse response analysis, we explore the behavior of credit spreads with respect to the source of term spread changes, i.e. the 1- and 10-year Treasury rates. The obtained evidence suggests that credit spreads react asymmetrically to shocks in short- and long-term rates when either of these shocks results in identical initial term spread changes.

The remainder of the paper is organized as follows. Section 2 briefly reviews the empirical evidence on the relation between credit risk, risk-free interest rates and the yield curve slope. Section 3 presents the dataset and describes the econometric methodology, with an emphasis on the application of Markov-switching techniques to cointegrated vector autoregressions. Section 4 reports and interprets the empirical results from the cointegration analysis, the MS-VECM and the impulse responses. Section 5 concludes.

2. Related literature

Structural models follow the framework set out by Merton (1974), who incorporated option pricing theory to the pricing of corporate debt. Among the assumptions embedded in Merton's model are that the value of the company assets is the only random variable, and that interest rates are constant. Higher spot interest rates increase the risk-neutral drift of the company value process and this reduces the probability that a default threshold will be hit; assuming that the initial company value remains unchanged. Longstaff and Schwartz (1995) allowed for stochastic interest rates, and their model still implies a negative relation between credit spreads and the level of risk-free interest rates. The magnitude of this relation depends on the value of the instantaneous relation between the asset value and the interest rate processes. Their model was tested on monthly data for eleven Moody's corporate bond yield averages for the period 1977–1992 and the results appear to be consistent with theory. Duffee (1998) argued that the negative relation between corporate bond yield spreads and Treasury yields is much stronger for callable bonds, and this was validated empirically when tested on monthly investment-

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