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Journal of Banking & Finance 30 (2006) 23–35
Journal of BANKING & FINANCE
www.elsevier.com/locate/jbf

Discrete versus continuous state switching models for portfolio credit risk ☆

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Received 25 September 2002; accepted 25 November 2004
Available online 12 March 2005

Abstract

Dynamic models for credit rating transitions are important ingredients for dynamic credit risk analyses. We compare the properties of two such models that have recently been put forward. The models mainly differ in their treatment of systematic risk, which can be modeled either using discrete states (e.g., expansion versus recession) or continuous states. It turns out that the implied asset correlations and default rate volatilities for discrete state switching models are implausibly low compared to empirical estimates from the literature. We conclude that care has to be taken when discrete state regime switching models are employed for dynamic credit risk management. As a side result of our analysis, we obtain indirect evidence that asset correlations may change over the business cycle.

☆ We thank Bert Menkveld, Roman Kraeussl, and two anonymous referees for useful comments on an earlier version of this paper. We also thank Standard and Poors and Arnaud de Servigny for making available to us the CreditPro 1981–2002 database for the empirical estimates.
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doi:10.1016/j.jbankfin.2004.11.007

JEL classification: G21; C22; C53

Keywords: Credit risk; Regime switching; Latent variable models; Factor models

1. Introduction

Credit risk management has evolved considerably over the past decade. Earlier work in the area was characterized by a dominant focus on credit scoring and static assessment of default probabilities, see for example the overview of Caouette et al. (1998). Though the evaluation of a counterparty's creditworthiness at the loan contracting stage is still very important, the increased number (and liquidity) of instruments and markets for credit risk has required a more dynamic approach to credit risk management. Trading derivatives on credit risky instruments, for example, requires dynamic hedging decisions. Also the possibility to securitize part of a bond or loan portfolio at flexible points in time provides banks with much more options for their credit risk management process. To evaluate the alternative options, models are needed to describe the evolution of key credit risk drivers such as default and credit rating migration probabilities, as well as recovery rates.

In this paper we concentrate on alternative dynamic model specifications that have been introduced for credit rating migrations. A credit rating summarizes the creditworthiness of the underlying firm. Credit rating transitions may vary with economic conditions. For example, following the empirical evidence in Nickell et al. (2000) and Bangia et al. (2002), defaults and downgrades are more likely during recessions than during expansions. Time variation in transition probabilities, especially if correlated with economic conditions, may have an important impact. Under risk sensitive capital requirements as proposed in the new Basel Capital Accord (Basel Committee on Bank Supervision, 2004), capital buffers would have to be raised significantly if an expansion turns into a recession, see the numerical experiments in Bangia et al. (2002).

We distinguish two types of models in the literature for linking rating transition probabilities to economic conditions. They differ in their treatment of the state of the economy. Nickell et al. (2000) and Bangia et al. (2002) use discrete states. Bangia et al. (2002) for example use a panel data set on rating migrations and divide their sample into recession and expansion quarters.[1] Next, they estimate separate rating transition probabilities for each regime. This approach is intuitively appealing and yields plausible results for the transition probabilities. However, the question remains whether the limited number of discrete states provides a rich enough characterization of portfolio credit risk. An alternative approach is to model the state of the economy as a continuous variable. This can be done using observed components as in for example Wilson (1997a,b) or Kavvathas (2001), Das et al. (2002), or unobserved components, see for example Jarrow and Turnbull (1995), Duffie and

[1] Nickell et al. (2000) use GDP growth and also distinguish a middle regime.