Available online at www.sciencedirect.com
ScienceDirect
Journal of Econometrics 142 (2008) 399–424
JOURNAL OF Econometrics
www.elsevier.com/locate/jeconom

The multi-state latent factor intensity model for credit rating transitions

Siem Jan Koopman[a,c], André Lucas[b,c,*], André Monteiro[b,c]

[a]*Department of Econometrics, Vrije Universiteit Amsterdam, The Netherlands*
[b]*Department of Finance, Vrije Universiteit Amsterdam, FEWEB/FIN, De Boelelaan 1105, NL-1081HV Amsterdam, The Netherlands*
[c]*Tinbergen Institute Amsterdam, The Netherlands*

Available online 13 July 2007

Abstract

A new empirical reduced-form model for credit rating transitions is introduced. It is a parametric intensity-based duration model with multiple states and driven by exogenous covariates and latent dynamic factors. The model has a generalized semi-Markov structure designed to accommodate many of the stylized facts of credit rating migrations. Parameter estimation is based on Monte Carlo maximum likelihood methods for which the details are discussed in this paper. A simulation experiment is carried out to show the effectiveness of the estimation procedure. An empirical application is presented for transitions in a 7 grade rating system. The model includes a common dynamic component that can be interpreted as the credit cycle. Asymmetric effects of this cycle across rating grades and additional semi-Markov dynamics are found to be statistically significant. Finally, we investigate whether the common factor model suffices to capture systematic risk in rating transition data by introducing multiple factors in the model.
© 2007 Elsevier B.V. All rights reserved.

JEL classification: C15; C33; C41; C43; G11; G21

Keywords: Unobserved components; Credit cycles; Duration model; Generator matrix; Monte Carlo likelihood

1. Introduction

Ratings play a prominent role in the credit industry. Their key purpose is to provide a simple qualitative classification of the solidity, solvency and prospects of a debt issuer. The importance of credit ratings has increased significantly with the introduction of the new regulatory framework known as Basel II (BCBS, 2004). In this framework, ratings can be used directly to determine the size of a bank's capital buffer. As capital constitutes a relatively costly source of funding for a bank, ratings and rating changes directly affect the banks' willingness to grant credit to individual firms. Moreover, if ratings and thus capital requirements co-vary with the business cycle, economic fluctuations may be exacerbated by capital becoming increasingly scarce in adverse economic conditions, precisely when it is needed most. It is clear that a good understanding

*Corresponding author. Department of Finance, Vrije Universiteit Amsterdam, FEWEB/FIN, De Boelelaan 1105, NL-1081HV Amsterdam, The Netherlands. Tel.: +31 20 598 6039; fax: +31 20 598 6020.
E-mail address: alucas@feweb.vu.nl (A. Lucas).

0304-4076/$ - see front matter © 2007 Elsevier B.V. All rights reserved.
doi:10.1016/j.jeconom.2007.07.001

of the dynamic behavior of ratings and rating changes is therefore important from both a regulatory and financial industry perspective.

In this paper we introduce a new model for rating transitions. The main novelty of our model is that rating transitions are modeled continuously in event time rather than calendar time and are subject to common dynamic latent factors. Although the model is relatively complex, we show that it can be estimated efficiently using modern importance sampling techniques for non-Gaussian models in state space form.

The literature on modeling credit events such as defaults and rating changes has grown rapidly over the past 10 years. Wilson (1997a, b) modeled default rates using logistic regressions with macroeconomic explanatory variables. Nickell et al. (2000) and Bangia et al. (2002) show that upgrade, downgrade, and default probabilities differ over different economic regimes, whether characterized by NBER business cycle classifications or by GDP growth rates. Default and downgrade intensities are higher during recessions. In the same spirit, Kavvathas (2001), Carling et al. (2002), Couderc and Renault (2004), and Duffie et al. (2006a) use a duration approach conditional on observed macroeconomic and firm characteristics and show that average times-to-default decrease if economic activity decreases. Koopman and Lucas (2005) and Koopman et al. (2005) have adopted a direct time series approach and identified the time-varying cyclical nature of default rates over a long historical period. Also Fledelius et al. (2004) corroborate the existence of time-fluctuations for credit rating migration rates.

Whereas some of the contributions in the literature introduce observed macro-variables to capture co-variation in default intensities between firms and industries, an alternative approach is to estimate the common components of default risk directly from the data. An advantage of such an approach is that one is less prone to misspecification caused by the use of an incorrect macroeconomic proxy for the credit cycle. Couderc and Renault (2004) tested a large number of macroeconomic variables for their predictive ability and found five significant factors. Still, a large part of the fluctuations in systematic default probabilities could not be accounted for. Second, by estimating the default dynamics directly from the data, one obtains an integrated framework for capital determination and risk management, see Koopman et al. (2005). By contrast, if observed macroeconomic variables are used, one needs an auxiliary forecasting model for such variables, see for example Duffie et al. (2006a, b).

Suggestions for dynamic models with latent components are Gagliardini and Gourieroux (2004), McNeil and Wendin (2007), and Koopman and Lucas (2007). These models, however, are all set in a calendar time framework: rating transitions are observed empirically over discrete time slots, e.g., years or quarters. The observed frequencies are subsequently modeled by non-Gaussian time series processes. By contrast, in this paper we use a duration model with unobserved components. The duration (continuous time) approach is the more natural approach in the current context, where durations to transitions are endogenous rather than exogenous. In this way, we are able to use all the information in the data-set. Lando and Skødeberg (2002) provide a further detailed discussion of the advantages of the continuous-time approach. Our model can be regarded as a multi-state extension of the latent factor intensity (LFI) model of Bauwens and Hautsch (2003). The LFI model is a point process model for stock transactions in tick-time. Durations in the LFI model are the time to the next trade. By contrast, in our model it is not only the time to the next rating event that is unknown, but also the type of event that is going to occur, e.g., upgrade, downgrade, or default. In that sense, our model is set in the so-called competing risks framework. Given a firm's initial rating, there are multiple states for the firm's next rating. Each of these states has its own duration process and we observe only the minimum of those. This leads to a more complicated likelihood structure than considered by Bauwens and Hautsch (2003).

The likelihood function of our model contains a high dimensional integral involving the latent common risk factor. In this way, our parameter driven model differs from well-known observation driven counterparts like the autoregressive conditional duration (ACD) model of Engle and Russell (1998), or the autoregressive conditional intensity (ACI) model of Russell (1999). We evaluate the likelihood using a multi-variate extension of the Monte Carlo techniques that are developed by Durbin and Koopman (1997, 2001). We demonstrate the effectiveness of the method by means of a simulation experiment.

The model is estimated for the CreditPro7.0 data set from Standard & Poor's (S&P), containing all issuer ratings over the period 1981–2005. We classify firms into seven standard rating categories and specify a dynamic model for upgrades, downgrades, and defaults using all available data. This yields a data set

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
✓ امکان دانلود نسخه ترجمه شده مقالات
✓ پذیرش سفارش ترجمه تخصصی
✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
✓ دانلود فوری مقاله پس از پرداخت آنلاین
✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات