

Rating Transitions: How Do They Vary With the Business Cycle?

Chief Investigators

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Project Summary

The aim of the project is to advance the work of Koopman, Lucas and Monteiro (2005) on the relationship between rating transitions and macroeconomic conditions by adopting an econometric approach which can test a greater variety of specifications of systematic risk. The use of Bayesian sampling techniques for inference is innovative in this area because the method can handle complex target densities when inference is intractable in the maximum likelihood setting. The approach significantly improves the prediction of default probabilities by allowing for a more accurate weighting of the contribution of macroeconomic variables according to their posterior probability.

Background and aims of project

Rating transitions play an important role in credit decisions and under the new Basel II Capital accord they can be used to determine the size of a bank's capital buffer. Thus, a good understanding of the dynamic behaviour of transition matrices and their co-variation with economic conditions is important to the finance industry and to the regulatory authorities.

There is a growing literature on the relationship between rating changes and macroeconomic conditions. See for example Nickell, Perraudin and Varotto (2000) and Bangia et.al (2002) for an analysis of how upgrades, downgrades and default probabilities differ over economic regimes, and see Koopman and Lucas (2005) and Koopman, Lucas and Klassen (2005) for an application of more recent time-series methodology to decompose default risk.

More recently Koopman, Lucas and Monteiro (2005) have proposed a multi-state latent factor intensity (MLFI) model to allow for multiple origins and destination states for ratings. This approach adopts a continuous time framework to derive a model which explains ratings as a function of observable macroeconomic, firm-specific factors and unobservable latent factors. However, the authors note that the "econometric issues related to the generalisation are intricate and the computational consequences are severe". Consequently their empirical application ignores the role of macroeconomic variables which creates serious problems of misspecifications and raises questions about the reliability of results.

The aim of this project is to develop and apply more sophisticated econometric techniques to estimate the model to overcome the problem of uncertainty regarding the contribution of macroeconomic variables.

Significance and Innovation

The innovation proposed in this project is to apply Bayesian sampling techniques for inference on a model of rating transitions. The advantage of these techniques is that they are able to handle arbitrarily complex target densities upon which inference is intractable in the maximum likelihood setting. Such methods are therefore particularly appropriate for modelling rating transitions.

As discussed by McNeil and Wendin (2005) MCMC algorithms such as the Gibbs sampling algorithm are capable of dealing with models featuring complex latent structures, such as serially correlated random effects and/or multivariate random effects capturing heterogeneity across industry sectors. Adopting Bayesian techniques for inference will hence advance the work of Koopman, Lucas and Monteiro (2005) by allowing for a variety of specifications of systematic risk which are infeasible using those authors's maximum likelihood approach.

There are additional advantages to adopting the Bayesian approach to inference on the modelling of rating transitions. McNeil and Wendin (2005) note that Bayesian MCMC techniques provide a method of calculating standard errors for the primary model parameters as well as the derived model parameters; that forecasting of future default events is straightforward; and that the simulation algorithms are fast. McNeil and Wendin also note that the Bayesian approach could make use of prior distributions for the default probabilities and overcome identification problems which may occur when there is no information on a particular default event, or where that event is very rare. In principle this would allow clearer inference about default risk than would have been possible from empirical default data alone.

The innovation is also significant because it will overcome the mis-specification problem noted earlier. The Bayesian approach to inference will allow the practitioner to test alternative specifications to determine which particular macroeconomic variables are important for predicting default probabilities, either for the whole economy or for a specific industry group. Alternatively, if there is no clear 'winning' specification, the practitioner may wish to account for this uncertainty by combining the dynamics of several specifications. This can be achieved by averaging the dynamics of each candidate model and weighting them according to their posterior probability. The Bayesian approach therefore allows inference on the probability of future default events, averaged over a range of macroeconomic variables rather than conditioned on a particular specification.

Nature of Expected Outcomes

This project has the potential to yield two contributions. The first is the general development of a Bayesian methodology to estimate multi factor models of migration transition matrices. The second is the increase in our understanding of the causes of changes in ratings. The results could then be used in two ways: (1) to forecast default risks conditioned on forecasts of the economy and (2) to produce rating matrices that are "cycle-free", i.e., independent of economic peaks and troughs.

References

- Durbin, J. and S.J. Koopman (2002), A simple and efficient simulation smoother for state space time series analysis, *Biometrika*, 89, 3, 603-615.
- Koopman, S.J., Lucas A. and Monteiro, A. (2005), The Multi-State Latent Factor Intensity Model for Credit Rating Transitions, mimeo, Vrije Universiteit Amsterdam.
- Koopman, S.J., Lucas,A. (2005) Business and default cycles for credit Risk, *Journal of Applied Econometrics*, 20, 311-323.
- Koopman, S.J., Lucas,A. and Klassen, P. (2005) Empirical Credit Cycles and Capital Buffer Formation, *Journal of Banking & Finance*, forthcoming.
- Nickell, P., Perraudin, W. and Varotto, S. (2000) Stability of Rating Transitions, *Journal of Banking & Finance*, 10, 423-444.
- Bangia, A., Diebold,F.X. Kronimus,A. Schagen,C. and Schuermann,T. (2002) Ratings migration and the Business Cycle with applications to credit portfolio stress testing. *Journal of Banking & Finance*, 26, 445-474.
- McNeil, A.J. and Wendin, J. (2005) "Bayesian Inference for Generalized Linear Mixed Models of Portfolio Credit Risk" Mimeo, Departement Mathematik, ETH Zurich.