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The effects of estimation error on measures of portfolio credit risk

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Abstract

This paper uses Monte Carlo simulations to assess the impact of noisy input parameters on the accuracy of estimated portfolio credit risk. Assumptions about input quality are derived from the distribution of historical sample statistics commonly used in default risk modelling. The resulting estimation error in the distribution of portfolio losses is considerable. Losses that are judged to occur with a probability of 0.3% may actually occur with a probability of 1%. The paper also shows that estimation error leads to biases in value at risk estimates and significance levels of backtests. The biases can be corrected by analysing predictive distributions which average over the unknown parameter values.

JEL classification: G21; C13
Keywords: Credit risk; Estimation error; Value at risk; Predictive distributions

1. Introduction

In the past few years, several new models for the measurement of portfolio credit risk have been proposed (cf. Crouhy et al., 2000). They have the potential to effect major changes in the ways banks are managed and regulated. So far, however, little is known about the reliability of these models. Nickel et al. (2001) is the only paper which tests the predictive ability of portfolio models on an out-of-sample basis.

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The major reason for the scarcity of research is the lack of data suitable for backtesting (cf. Jackson and Perraudin, 2000). In this paper, I therefore use Monte Carlo simulations to quantify the accuracy of credit risk models. More precisely, I analyse the impact of uncertainty about input parameters on the precision of measures of portfolio risk. I confine the analysis to losses from default, i.e., exclude the risk of credit quality changes, and model default correlations by means of correlated latent variables. The framework builds on CreditMetrics (JP Morgan, 1997), and closely resembles the one used by the Basel Committee on Banking Supervision (2001) to adjust capital requirements for concentration risks.

The necessary inputs for assessing default risk are default rates, recovery rates, and default correlations. They are usually derived from historical data, which means that their precision can be inferred using standard statistical methodology. This is the first step of the analysis in this paper. In the second, I determine the accuracy of value at risk (VaR) measures in the presence of noisy input parameters. This is done separately for portfolios which differ in their average credit quality and in diversification across obligors.

The aim of such an analysis is threefold. First, the results are useful for defining the role credit risk models should play in credit portfolio management and bank regulation. Second, modelling parameter uncertainty allows to compute risk measures which take estimation error into account. Since the loss distribution is a non-linear function of the input parameters, its estimate can be biased even if the parameter estimates are not. To correct such biases, I employ a Bayesian approach and analyse the predictive distribution, which averages the loss distributions pertaining to different but possibly true parameter values. [1] Finally, the analysis helps to identify inputs with a large marginal benefit of increasing input quality.

The analysis shows that estimation error in input parameters leads to considerable noise in estimated portfolio risk. The confidence bounds for risk measures are so wide that losses which are judged to occur with a probability of 0.3% may actually occur with a probability of 1%. Several observations, however, suggest that available credit risk models can be useful for risk management purposes even though their application is plagued with data problems. The magnitude of estimation error is comparable to a setting in which VaR estimates can be based on a long time series of portfolio losses, and it differs little between perfectly diversified portfolios and small portfolios with 50 obligors. In addition, the bias in conventional VaR figures which results from estimation error is modest. The relative importance of the three input factors for the quality of VaR estimates depends on the portfolio structure and the extremeness of the events under analysis. The impact of correlation uncertainty, for instance, is larger for more extreme events and for riskier portfolios.

Related papers are Jorion (1996) and Butler and Schachter (1998) who argue that market risk measures should be reported with confidence intervals and show how these can be estimated. The methods are not directly applicable to credit risk mea-

[1] See, e.g. Zellner and Chetty (1965) for an application to regression analysis.