



# Modeling Eurobond credit ratings and forecasting downgrade probability

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## Abstract

This article proposes and empirically tests a two-step model to forecast the downgrade probability of sterling-denominated Eurobonds. In the first step, the conditional expectation of credit rating is estimated, employing an ordered probit. In the second step, the likelihood of downgrade is modeled using credit rating, as obtained from the conditional mean in the first step, alongside with traditional operating measures in a binary-probit framework. By parameterizing a system of two equations, we are able to accommodate the disentangled effect of credit quality and company financial information on the downgrade risk. We find evidence of a nonlinear response to shifts in both credit rating and leverage. The model's forecasting performance is ascertained by means of cross validation and is benchmarked against both a naive model and a neural network model.

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## 1. Introduction

This article proposes and empirically tests a two-step model to forecast the downgrade probability of sterling-denominated Eurobonds issued in the 1992–1999 period. A system of probit equations is introduced to separate bond ratings from bond downgrade events and to ultimately assess the role of credit quality and company-specific distress factors in determining the likelihood of downgrade. The focus on downgrade risk must be understood against a recent background of continuous redefinition of credit risk and the development of techniques for its isolation (credit derivatives), trading (securitization), and regulation (regulatory capital).

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While several studies model default and bankruptcy events,<sup>1</sup> no empirical work directly models the probability of a bond having its rating revised. In fact, the modeling of migrations has started very recently and only within the framework of rating transition matrices.<sup>2</sup> Although a reason often proposed for the embryonic status of these studies is that rating actions data has only recently been released by rating agencies, the actual reason could rather be the traditional “default mode” of thinking of most financial institutions, leading to their having a consensus view of transitions as nonfundamental economic events. However, new developments, such as entering into credit derivatives and securitization contracts, with the objective of transferring credit risk, have forced financial institutions to switch from a “default mode” to a focus on the transitions short of default.

From this new perspective and in the recent credit risk climate, changes in credit quality, as anticipated by a downgrade model, may be of interest to different market participants. While fixed-income investors are concerned with changes in the value of bonds following rating migrations, institutions can be affected in terms of the amount of below-investment-grade loans that they are approved to hold. Moreover, rating changes drive policy decisions in terms of the determination of regulatory and economic capital, shaping, at the same time, the actions of credit risk managers involved in the pricing of credit derivatives.<sup>3</sup>

Having outlined the theoretical and practical justifications for a downgrade model, this study extends previous analyses by developing an econometric framework that accounts for the ordinal nature of bond ratings, the role of credit risk, and the information contained in financial statements and data from credit rating agencies. Moreover, given the similarity in objectives of rating agencies and regulators, the model aims to capture the expected substantial relationship between bond ratings and financial/accounting ratios. These multiple tasks are achieved by developing a two-step estimation procedure, where, in the first step, the conditional expectation of credit rating is modeled as a function of bond- and firm-specific factors using an ordered probit. The second step assesses the disentangled effect of credit rating, as obtained from the conditional mean estimated in the first step, on the likelihood of downgrade, using a binary probit. The output of this two-step model is a 1-year estimate of the downgrade probability. To fully understand how accurately the dynamics of credit risk are estimated, the forecast performance of our probabilistic model is evaluated using different validation techniques, crucial for both commercial and regulatory purposes. The model is block and full validated and also benchmarked against both a naive constant probability model and a more complex neural networks representation.

The remainder of this article is organized as follows. Section 2 presents a critical overview of the quantitative approaches developed in the credit rating literature. In Section

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<sup>1</sup> See Kao (2000) for a comprehensive overview of credit risk models.

<sup>2</sup> Transition matrices concisely measure the probability for any given rated obligor to migrate from one credit rating to another or to default within a specific time period. The horizon considered depends on its application: while a 1-year transition matrix is standard for the calculation of credit risk exposures, shorter horizons are required for the pricing of credit derivatives.

<sup>3</sup> See Lucas (1995) for a discussion of how OTC market participants use downgrade provisions to reduce counterparty risk.

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