

Validation of Credit Risk Models

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'Neither a borrower, nor a lender be'
Hamlet, W. Shakespeare

1 Introduction

The Basel Committee on Banking Supervision has been working since 1999 on a revision of the 1998 regulation on capital requirements (Basel II). According to the new regulation to be implemented by the end of 2006, many banks will want to calculate the amount of regulatory capital requirements on the basis of default probabilities estimated from internal credit ratings. But the creation, calibration and validation of a credit risk model raise many technical questions and issues: How to measure the credit risk itself ? How to obtain a realistic migration matrix ? What kind of computational models to use ? How to take into account the business cycles ? How to properly calibrate the correlations in the model ?

The aim of this paper is not to provide answers to all these questions but to try to present and summarize a number of key problems that are currently discussed by researchers and academics working on credit risk.

2 Credit Risk and Spreads

The type of credit risk model used to estimate a rating and a probability of default of a borrower is a central question. If the model used to establish the ratings is wrong then: (1) the pricing of the credit itself will be wrong, (2) the equity requirement won't be optimal and (3) the risk itself won't be

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correctly evaluated. Traditionally, two types of models are opposed: structural models and reduced forms models. The structural models are based on the firm value and were introduced by Merton (1974). The reduced forms models are 'intensity based models' and were introduced by Duffee (1999).

Recent works shows that structural credit risk models tend to Over-estimate the spread on corporate bonds. This is explained by the fact that models like CreditMetrics only explain these spreads in terms of default risk. Then, these structural models lead to capital requirement that are higher than they should be.

Elton et al (2004) use a non-structural model on Moody's and Standard & Poor's data. Using this model they show that only 25% of the corporate spot spread can be explained by default risk and that the 75% remaining are determined by tax premium and systematic risk premium. These results were confirmed on a structural model estimated on the same datasets by Huang & Huang (2003). Turnbull (2003) also find that credit spreads depends on systematic factors, firm specific factors, liquidity and taxation. But Dionne et al (2004) also suggests that these studies could underestimate the share of the default risk that explain de corporate spreads (that could reach 80% of the estimated spreads).

The studies are convergent on the fact that default risk is not the only factor that explain spreads, but the exact share of this factor is still on debate. If structural factors can affect the spreads, how the credit risk itself should take into account the business cycles ?

3 Credit Risk and Business Cycles

When building a credit risk rating, the way to treat the business cycle into the model is central. The Basel II accord does not impose any kind of model or specification, but should the rating depend on the business cycle? Is there a model that performs better than the other?

The first kind of models produce 'through the cycle ratings' (TTC). These ratings measure the future risk over one or more business cycle, and consequently they are relatively stable over time. The measures are not subject to change with the business cycle. These models are used by rating agencies like Moody's and Standard & Poor's.

The second kind of models produce 'point in time ratings' (PIT). These models are mostly used by banks to measure the credit risk of their borrowers in the short run (usually one year). Consequently, these ratings are more volatile than

the PIT ratings. This is mainly because of the shorter horizon. The KMV's model, that uses the current equity prices to create the rating, produces PIT ratings.

It is now generally accepted that 'point in time' rating models are more appropriate for capital allocation and that 'through the cycle' ratings reduce pro-cyclical capital requirements. But Rosch (2004), shows using Standard Poor's datasets and structural models that the differences between the two philosophies are not only on the estimated default probabilities but also on the implied asset correlations. Using 'through the cycle' ratings, the default probabilities are stable over time and short-term movements are captured by asset correlations. But 'point in time ratings', ratings exhibit lower asset correlation than TTC ratings. As the Basel II recommendation presumed fixed asset correlation (between 12% and 20%), these ratings will be penalized during downturns.

4 Credit Risk and Correlations

As defaults do not occur independently, the estimation of the correlation on defaults is important both to estimate contagion on a class of risk and on a portfolio. In particular, Egloff et al (2004) show that using 'value-at-risk' (VaR) to manage credit can lead to '*dangerous underestimation of portfolio losses*'. But it raises the question of the estimation of the contagion. To estimate these correlations, the credit risk modeller will have most of the time to deal with copulas and joint probabilities, reduced form models and structural models.

On this paper, we choose to illustrate the correlation on credit risk, using the popular structural credit risk model: the so called 'one factor model' (OFM). Various forms of this model are available but the purpose of this model is to estimate the migration between classes of risk and the correlation matrix using different factors. These models are derived from the Merton (1974) model of the value of a firm's assets. The financial situation of the obligors are given by their asset values². If the asset value of a firm falls under a specified threshold, the default is triggered.

Technically, if R_i represents the return of the obligor i at the end of the period, F the systematic factor (a macro or industry shock), and U_i the idiosyncratic shock. We then express the return on asset as a linear function of these two

² In KMV methodology, the model and the correlation matrix is computed on asset returns but proxied by equity returns on CreditMetrics.

factors as:

$$R_i = wF + \sqrt{1 - w^2}U_i$$

If the shocks, F and U_i are assumed to be independent standard normal variables, then w measure the exposure to the common factor (the systematic risk) and w^2 the correlation on the return of two obligors. The default itself is stated when R_i falls under a defined threshold.

In the 2001 proposal of the Basel II Committee, the correlation parameter was set to 20%. But in the proposals of 2002 and 2003, these correlations were revised to a range from 12% to 24%, depending on the probability of default. But these correlations on credit risk remains a controversial concept the Basel II proposals.

Various studies show that a correlation parameter on default is not always bound into this range, but ranging from negative to very high correlation parameters (see Lucas (1995), Bahar and Nagpal (2001), Rosch (2004)) and that the dispersion can be wide accross sectors (Servigny and Renault (2003)). Rosch (2004) explains also that the correlation parameter should not be fixed and should vary depending on the economic risk. Finally, Servigny and Renault (2003) not only show that the equity correlations are poor indicators of default correlations but also that the correlations increase in the horizon.

5 Conclusion

The credit risk models used by banks and ratings agencies are more and more sophisticated, but these models have to deal with the constraints imposed by the Basel II accord. From the choice of the type of model, to the estimation of a 'correct' correlation parameter that would be in accordance with the Basel II constraints, the credit risk modeller have to make a number of important choices that may led to very different credit ratings, and capital requirements for banks. But to validate a credit risk model you need a large database with sufficient historical data and defaults. In Europe, many new databases of corporate ratings and defaults are now available (in Italy, France, Sweden,...), and we expect that they will help researchers to find out more precise results on these few subjects on European companies.

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