nikko am
Nikko Asset Management

A DYNAMIC APPROACH TO MANAGING CREDIT RISK

Nikko AM Global Credit Team

Global economic, credit and interest rate cycles are becoming desynchronised – in one market we could see spreads widening and leverage edge up, while in another observe the opposite. Nikko AM's global credit investment team applies a fundamental-driven investment approach to analyse the global credit market and establish top-down investment themes to benefit from such non-synchronisations. Additionally, we rely on fundamental bottom-up analysis when researching individual corporates, analysing balance sheet data, interacting with management teams and predicting cash flows to assess future credit quality of corporates. Nevertheless, beside our strong reliance on fundamental research as an alpha source, we also use quantitative models to aid our credit screening in our investment process. With the global credit universe comprising of over 1,400 corporate bond issuers full in-depth coverage of each individual corporate represents a challenge to most research teams. To overcome this dilemma, the Nikko AM credit research team has developed a dynamic credit risk model that predicts a corporate's medium-term default risks (implied by the equity market, fundamental accounting data and historical default events). This enables the investment team to expand to almost full coverage of the aforementioned credit universe. Since its inception, the model has gained wide acceptance among our portfolio managers, partly due to our analysts' inputs into the development of the model and promising back-test results (see Figure 2).

The credit risk model has been developed for two main purposes.

1) Allows more research resources in the high yield space

Although our model estimates issuer credit ratings, implied by the medium term default risk, for corporates along the entire credit quality spectrum, we pay more importance to the investment grade space (BBB-/Baa3 and better) and the crossover area (the intersection of high yield and investment grade bonds). These areas of the credit spectrum are the most informationally efficient, partly due to market's ability to quickly incorporate new information into prices (and hence default probabilities), and also due to the standardisation of accounting data and extensive coverage by analysts. As such, defaults are relatively easier to model, and therefore forecast, while also being able to achieve the desired balance between type I and II errors (some would say that you should define such, but I am ok to assume proficiency). Subsequently, as a significant number of investment grade and crossover issuers get assessed quantitatively, more of the team's time can be reallocated to the research-intensive high yield space.

2) Acts as a Secondary credit rating provider

The model serves as an additional, independent credit opinion to our in-house fundamental credit assessments. Divergence of results among such often leads to further examination until a final assessment is reached. Just as an academic exercise, we consider firm A – a distressed issuer in the energy sector. The choice of sector is relevant given the vast majority of defaults globally in 2016 were in that space. Pre OPEC's output cut deal in late 2016, the sector was the utmost distressed amid deepening global supply glut which, in turn, sent oil prices plummeting to multi-year lows. Against that backdrop, coupled with deteriorating credit metrics and eroding equity valuations, the model would have exerted downward pressure on firm A's implied issuer rating, towards CCC/D, well in advance to eventual downgrades by credit rating agencies, which tend to be more reactive than proactive. While benefits of the model's early warning signals are undisputed, analysts' due diligence is still warranted in order to minimize false signals (type II error).

Since the model has been integrated into our investment process in 2016, it has proven its ability to provide early warning signals for the deterioration in issuers. Details of our model are summarised below.

The Econometric Model

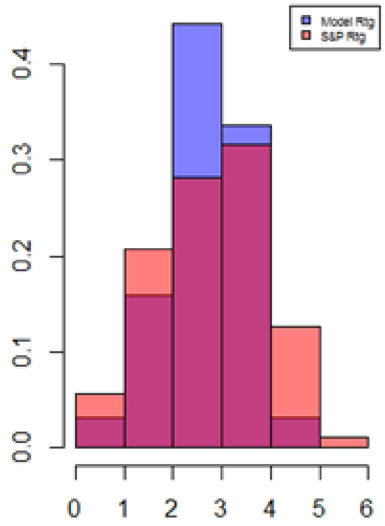
We define a default in our model as, "a corporate's failure to pay interest/principal on a debt/loan, bankruptcy filing or distressed exchanges."

Our approach for estimating the probability of default for corporates is to strike the right balance between objectivity, accuracy, stability and timeliness. We achieve this by combining the pioneering work of Altman's (1968) Z-Score and the economic theory embedded in the Merton (1974) model – a hybrid of structural and statistical models similar to Z-Metrics, Altman et al. (2010). While each of these models has its own strengths and weaknesses, we find that the best approach of default prediction combines equity market and accounting data. That is because neither equity markets nor accounting statements fully reflect all the information related to a company; and the default risk is an empirical exercise better addressed by the data itself as opposed to being specified a priori as in the Merton model. For instance, Falkenstein et al. (2000) find that default probabilities implied by Merton-type models are not consistent with historically observed default rates. Still, Merton's economic theory offers invaluable insight on how equity value and volatility are interconnected to default risk.

As stated above, fundamental factors and equity market-derived variables are the building blocks of our model. The former are accounting ratios that not only define the creditworthiness of a corporate, but are also distinct from each other and statistically significant in forecasting defaults. These factors are: profitability, earnings volatility, corporate size, interest coverage and leverage. To ensure uniformity across sectors, certain accounting adjustments are applied. In our modelling method the fundamental factors follow those of Altman & Rijken (2004). Specifically, we employ their agency-rating prediction model to objectively determine weights for the fundamental factors. In doing so, we minimise two common forms of estimation problems: omitted explanatory variables and collinearity in the regressor matrix.

Figure 1 (below) compares the distribution of corporates across the rating categories, as rated by S&P and our fundamental model between 1995 and 2015. Overall, the fit is good, although the model-implied rating distribution has a higher kurtosis, reflecting a greater centre of mass around the BB tier (denoted 3 in Figure 1). The differences in shape between the two distributions can in part be explained by variation in the "through-the-cycle" methodology that S&P applies in their rating assessment. More specifically, S&P's measure of what it treats as a permanent component of default risk varies over time, as it manages the tension between accuracy and stability (its dual objectives).

Figure 1: Distribution of Fundamental & S&P Ratings



Source: Nikko AM

While the fundamental model captures the link between fundamental factors and agency ratings (S&P, see footnote below), the equity model is designed to provide early warning signals for corporates facing near-terms default risks, which builds on the earlier work of Shumway (2001) and Chava & Jarrow (2004). The output from the equity model is statistically derived using a nonlinear technique, which models the nonlinear nature between default risk and three equity market-derived factors. Two of these factors embody the economic theory rooted in the Merton model. According to his theory, the equity holder will drive the corporate into bankruptcy when its asset value falls below its debt level. In this model, the corporate's equity value and volatility – both of which are observable – are linked to the default risk. The third factor is a risk-adjusted metric of excess return.

Subsequently we model the outputs of the fundamental and equity models using CreditSights' methodology by applying multi-year default indicators, which identify corporates that have defaulted over one- to five-year horizons. These estimates are forward default probabilities which are then used to construct a default term structure, similar to Bloomberg's DRSK and Citigroup's bank default models.

Let DP_t represent the model designed to predict forward corporate default *t* years from the present, conditional on the given corporate surviving to year *t-1*. Let *i* denote the models; then we can represent DP_t that we get for years $t = 1, \ldots ,5$ as:

$$DP_t = \left[1 + e^{-(\hat{\beta}_{t,0} + \sum_{i=1}^{2} \hat{\beta}_{t,i} \cdot x_{t,i})}\right]^{-1}$$

Then, for each corporate *j*, the probability of default in year *t* conditional survival to year *t-1* is given by:

$$DP_{t,j} = \left[1 + e^{-\left(\hat{\beta}_{t,0}+\Sigma_{i=1}^{2}\hat{\beta}_{t,i}\cdot x_{t,i,j}\right)}\right]^{-1}$$

[1] Whenever possible, we use the S&P actual rating. When the S&P rating was not available, and Moody's was, we used Moody's.

We translate the cumulative 5-year default probability $(CDP_{5,j})$ into a more familiar metric of credit ratings. The model implied ratings are inferred from a grid that we construct on a periodic basis by establishing the relationship between the median CDP_5 within each rating category and the rating itself, as this is less affected by changes in forward default probabilities along the term structure. $CDP_{5,j}$ is computed directly from $DP_{t,j}$ by cumulating survival probabilities over 5 year as:

$$CDP_{1,j} = DP_{1,j}$$
$$CDP_{2,j} = CDP_{1,j} + \left(1 - CDP_{1,j}\right)\cdot DP_{2,j}$$
$$\cdots$$
$$CDP_{5,j} = CDP_{4,j} + \left(1 - CDP_{4,j}\right)\cdot DP_{5,j}$$

Finally, corporates are assigned a credit rating as an issuer-level assessment of their credit health using the mapping described above, as summarised in Table 1. All of the values closely match S&P's global corporate average cumulative default rates (1981 – 2015) for the same time horizon. Robustness of ratings under the model inputs is ensured – to address excessive equity market volatility – by requiring certain conditions to be met prior to a migration. For example, the CDP_5 must be moving in the right direction for at least a month (i.e. up for a downgrade and down for an upgrade).

Table 1: CDP for Implied Credit Ratings

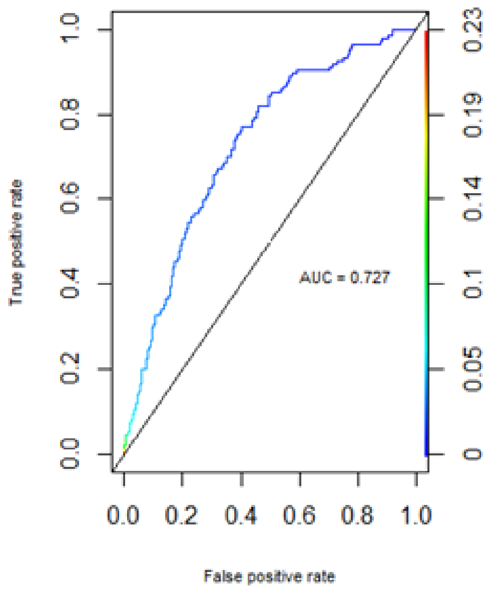
Rating	5y CDP (Mid; %)
≥ AA-	
A+	1.17903
A	1.46998
A-	1.54342
BBB+	2.10374
BBB	2.63029
BBB-	3.76100
BB+	5.31654
BB	6.88803
BB-	9.26820
B+	14.58487
B	19.33281
B-	25.37656
CCC	30.53352
D	

Source: Nikko AM

Robustness

Figure 2 illustrates the Receiver Operating Characteristic (ROC) curve of our model. The predictive power of a default probability model is characterised by its ability to distinguish healthy corporates from distressed ones. The most commonly used measure of such is the ROC curve and its main statistics – the area under the ROC curve (AUC). We construct the curve by varying the cut-off probability. In particular, for every cut-off, the ROC curve defines the "true positive rate" (percentage of defaults that the model correctly classified as defaults) on the y-axis as a function of the corresponding "false positive rate" (percentage of non-defaults that are mistakenly classified as defaults) on the x-axis. The 45-degree line represents the ROC curve of a random predictor, which has an AUC of 0.5, whereas an AUC of 1 represents a perfect model. Our model has an AUC of ~0.73, which compares fairly well with other available models over the same time period.

Figure 2: ROC curve (1995-2015)



Source: Nikko AM

US Financial Model

In this section we give a brief overview of our proprietary credit risk model for US banks, brokers and insurers, which supplements the aforementioned quantitative model for corporates. Methodology-wise, the financial model doesn't diverge from corporate's with the exception of estimates for DP_t, where we use 6-month ahead forecasts (as opposed to 1-year) and hence $t = \frac{1}{2}, \ldots, 2\frac{1}{2}$. These shorter term horizons are more suitable given the "jump-to-default" nature inherent in US financial default data. By the same token, we estimate the financial entity's medium-term default risk with the cumulative 2½-year default probability.

From a default data standpoint, a hurdle we faced in modelling the default risk was the lack of distress events in agency-rated, publicly-listed US financial entities. Thus, in addition to bankruptcies, liquidations and defaults, we also treat government-led interventions – mainly regulatory seizures and state-led equity injections – and forced mergers as distress events. In more detail, we define forced merged entities to be in distress if 1) an acquirer receives state support within a year after the merger or 2) if a merged entity has a negative coverage ratio within 1-year prior to the merger (González-Hermosillo, 1999).

At the core of our credit risk models is the fundamental score, which we estimate using (unbalanced) firm-quarter data based on the following panel regression model:

$$\widehat{\text{FundamentalScore}}_{i,t} = \widehat{\alpha} + \sum_{j=1}^{3} \widehat{\beta}_i \, x_{j,i,t},$$

where the three fundamental factors are our best proxies for 1) asset quality, 2) liquidity and 3) firm size. Asset quality is represented by return on average assets (ROAA). The share of last 12-month (LTM) interest costs to total liabilities represents liquidity; whereas the book value of total tangible assets proxies for firm size. Overall, larger financial entities with a higher asset quality and better liquidity profile are less likely to default, reflected by a higher fundamental score. However, a key metric missing from the above-mentioned fundamental factors is a proxy for capital adequacy – mainly Tier 1 ratio and firm-level risk-based capital ratio for banks and insures respectively. This is in part due to the fact that the relationship between credit ratings and capital adequacy isn't statistically significant. In periods of downturn financial entities that pose a systematic risk to financial systems are often required by regulator(s) to hike their capital levels, which render the relationship with financial distress ambiguous. Difficulty in estimating a ratio that is time-invariant, model-free and not distorted by Basel 1-to-3 frameworks, which came into effect at different points in time, also contributed to the decision of excluding the variable.

Regarding the other parts of the financial model – the equity part (for early warning signal) and the default curve part (for computing the cumulative survival probabilities), the same methodology applies.

Conclusions

The paper introduces Nikko AM's first generation credit risk model for corporates, as well as offers a non-technical note on our US financial model. These models incorporate firm-specific information ranging from equity performance to accounting-based ratios, as well as certain industry effects. The credit risk model produces forward-looking default probabilities that provide timely signals of impeding defaults and ratings migration over the credit cycle. Despite the team's heavy reliance on fundamental research for generating alpha, we believe that quantitative models are vitally complementary to our investment process and focus our team's time and resources in an efficient manner.

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