EMPIRICAL APPROACH FOR CREDIT SPREADS

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Abstract: *This article analyzes a relatively straightforward approach to get a first estimate of credit risk. It is based on the observation of debt securities issued by a Corporate on the financial market. In this way, we seek to deduct the implicit probability of default contained in the market financial data. The purpose of these models is to calculate a yield spread between the debt of a risky company and a debt without similar characteristics, considered as benchmark debt. Two parameters are available on the credit market: the rating and the credit spread. The spread is the risk premium demanded by investors for credit risk. It is the difference between the remuneration of a product with credit risk (for example a bond) and the risk-free rate.*

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JEL Classification Codes: G20, G21.

1. INTRODUCTION

Credit risk analysis can be conducted under a third approach. It proposes to build credit risk assessment models. They are based on a conceptual and formal logic, based on a quantitative approach. Their goal is to measure credit risk starting from financial theory.

The defect is defined conceptually by the literature, which then proposes several methodologies, mathematics, to calculate it. The application of these models, their estimation, is based on a series of parameters collected from the data available on the financial markets. Consequently, these models only apply to companies that are actually present there, few in number by nature, but corresponding to the largest firms, and therefore to the most important individual risks.

These models do not seek to anticipate the failure but rather non-payment (the anticipated event differs from previous approaches), in that the detection of credit risk is earlier. Their obvious advantage is that they directly provide a mathematical probability of the default on the horizon retained by the model. They experienced a very important development during the implementation of prudential standards for financial institutions, the latter having to put in place systems to manage their credit risk.

There is a rich literature on these models of credit risk assessment. All, under a set of restrictive assumptions, postulate that one can deduce, from observable data on the market, the probability of default of the firm analyzed.

Two major trends are identified. First, an empirical approach, based on the analysis of credit spreads, which provides a simple and intuitive model. Then, parametric approaches, although technically more complex, are widely used by practitioners.

2. EMPIRICAL APPROACH THROUGH CREDIT SPREADS

It is a relatively simple approach to obtain a first estimate of the credit risk. It is based on the observation of debt securities issued by a Corporate on the financial market. In this way, we seek to deduce the implicit probability of default contained in the market data.

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The credit spreads were analyzed also by Sergei A. Davydenko and Ilya A. Strebulaev (University of Toronto, 2004) and they have concluded that corporate bond prices do appear to be affected by the possibility of strategic renegotiation, especially when (1) the costs of liquidation and equity holders' bargaining power are likely to be high, (2) the debt structure does not make renegotiation difficult, and (3) the credit quality of the issuer is relatively low. The studies of Delianides and Gerske (2001), Collin- Dufresne and Martin (2001) and Brown (2001), among others, approach the determinants of credit spreads in a more empirical framework, by applying a variety of econometric models and using a number of different factors as determinants. They find that an increase in the risk-free rate would induce a widening in the credit spreads as opposed to the theoretical literature.

The spread is the risk premium demanded by investors as credit risk. It is the difference between the remuneration of a product with risk credit (for example a bond) and the risk-free rate. As detailed above, the rating of borrowers allows the prioritization of the quality of the latter and, also, to deduct a risk premium (the credit spread). This spread is the market unit that remunerates investors for the credit risk they bear.

The spread is used to reflect the additional yield required by an investor for taking on additional credit risk. Credit spreads commonly use the difference in yield between a same-maturity Treasury bond and corporate bond. As Treasury bonds are considered risk-free due to their being backed by the U.S. government, the spread can be used to determine the riskiness of a corporate bond (Villouta Christian, 2006).

For example, if the credit spread between a Treasury note or bond and a corporate bond were 0%, it would imply that the corporate bond offers the same yield as the Treasury bond and is risk-free. The higher the spread, the riskier the corporate bond.

The formula for the credit spread is:

$$\text{Credit Spread} = \text{Corporate Bond Yield} - \text{Treasury Bond Yield} \quad (1)$$

Note: The maturity dates of both the corporate bond and Treasury bond must be the same.

In addition, it is not uncommon for investors to substitute the Treasury bond yield with a benchmark bond yield of their choice(Callen Jeffrey L., Livnat,Joshua and Segal Dan,2007).

As such, the formula would look as follows:

$$\text{Credit Spread} = \text{Corporate Bond Yield} - \text{Benchmark Bond Yield} \quad (2)$$

For example, an investor may choose to use an AAA-rated corporate bond yield as the benchmark bond yield.

The probability of default is obtained from the observed credit spreads empirically on the markets, based on the "risk neutral" valuation technique. Under the risk neutral universe, all investors are neutral at risk, which means they do not charge a risk premium. This allows the asset price to be calculated as the expectation of the future price, discounted at the risk-free rate.

If we are analyzing the credit risk from the part of the entities, it is useful to mention that companies have to make profits in order to honor their loan commitments, loan notes or corporate bonds are not risk-free. Since they are risky investments the company will need to offer a higher return/yield than is paid on gilts to entice investors. The investors will require both a risk-free return and a risk premium.

However, loan notes are a relatively low-risk investment. Since the loan commitments are legally binding and often secured on company assets they are considered to be less risky than equity investments.

Not all bonds have the same risk. There is a bond-rating system, which helps investors distinguish a company's credit risk. Below are the Fitch and Standard & Poor's bond-rating scales.

Table 1. Bond rating scales Fitch and Standard & Poor's

Fitch/S&P	Grade	Risk
AAA	Investment	Highest quality
AA	Investment	High quality
A	Investment	Strong
BBB	Investment	Medium grade
BB,B	Junk	Speculative
CCC/CC/C	Junk	Highly speculative
D	Junk	In default

Notice that if the company falls below a certain credit rating, its grade changes from investment quality to junk status. Junk bonds are aptly named: they are the debt of companies in some sort of financial difficulty.

Because they are so risky they have to offer much higher yields than other debt. This brings up an important point: not all bonds are inherently safer than shares.

The minimum investment grade rating is BBB. Institutional investors may not like such a low rating. Indeed some will not invest below an A rating.

It is important to highlight also the work of J.L. Prigent, O. Renault and O. Scaillet (March, 2001) that have proposed for implementation another model of credit spreads, considered simplest and easier to apply and understand, which takes into consideration both mean reversion and jumps and the parameters of the process are estimated and test on the restriction imposed by the their own model. They have utilized both parametric and nonparametric techniques to model Aaa and Baa corporate bond spreads indicates.

To minimize the risk of irrecoverable debts occurring, a company should investigate the creditworthiness of all new customers (credit risk), and should review that of existing customers from time to time, especially if they request that their credit limit should be raised. Information about a customer's credit rating can be obtained from a variety of sources. These include:

- Bank references – A customer's permission must be sought. These tend to be fairly standardized in the UK, and so are not perhaps as helpful as they could be.

- Trade references – Suppliers already giving credit to the customer can give useful information about how good the customer is at paying bills on time. There is a danger that the customer will only nominate those suppliers that are being paid on time.
- Competitors – in some industries such as insurance, competitors share information on customers, including creditworthiness.
- Published information – The customer's own annual accounts and reports will give some idea of the general financial position of the company and its liquidity.
- Credit reference agencies – Agencies such as Dun & Bradstreet publish general financial details of many companies, together with a credit rating. They will also produce a special report on a company if requested. The information is provided for a fee.
- Company's own sales records – For an existing customer, the sales ledgers will show how prompt a payer the company is, although they cannot show the ability of the customer to pay.
- Credit scoring – Indicators such as family circumstances, home ownership, occupation and age can be used to predict likely creditworthiness. This is useful when extending credit to the public where little other information is available. A variety of software packages is available which can assist with credit scoring.

3. OBTAINING A ONE-YEAR PROBABILITY OF DEFAULT

A simple analysis can be carried out on the example of a zero coupon maturity 1 year, and nominal value P.

Two scenarios are possible: default or non-default.

Where:

V: the value of the position held
P: the nominal value of the zero-coupon
R: the recovery rate
q: the probability of default

If the issuer defaults, the value of position V at maturity is:

$$V = P-P.\ (1-R) = P.R \qquad (1)$$

If the issuer does not default and repays the nominal P at maturity, then:

$$V = P \qquad (2)$$

The mean value of the position, Vm, is:

$$Vm = q.\ P.\ R + (1 - q).\ P \qquad (3)$$

The spread, noted S, is supposed to compensate the investor for the risk of loss (X) which is expressed in two ways:

$$X = P\text{-}Vm \text{ and } X = S.\ P \qquad (4)$$

We can deduce a simple formula for estimating the spread, depending on the probability of default and the recovery rate (Cecile Kharoubi et Philippe Thomas, 2013):

$$S = q.\ (l\text{-}R) \qquad (5)$$

Thus, the spread depends on two parameters: the probability of default at one year (noted q) and the severity of the loss, noted (1 - R), where R is the recovery rate, estimated historically.

The spread increases with the probability of default and evolves in an opposite way to the recovery rate. Junior debts (characterized by lower recovery rates) offer a higher spread than senior debts.

The probability of default, which is the central element in estimating credit risk, is an increasing function of the recovery rate. If this is 100%, then there is no credit risk, and the credit risk premium must be zero.

This simple approach allows us to estimate default probabilities implicit at empirical credit spreads. This gives us an indication of the credit risk perceived by investors who place their liquidity in the bond markets.

The relationship between long-term creditors (payables) of a company, the management and the shareholders of a company encompasses the following factors:

- Management may decide to raise finance for a company by taking out long-term or medium-term loans or issuing bonds in the case of larger companies. They might well be taking risky investment decisions using outsiders' money to finance them.
- Investors who provide debt finance will rely on the company's management to generate enough net cash inflows to make interest payments on time, and eventually to repay loans.
- However, long-term creditors will often take security for their loan, perhaps in the form of a fixed charge over an asset (such as a mortgage on a building). Bonds are also often subject to certain restrictive covenants, which restrict the company's rights to borrow more money until the loan notes have been repaid.
- If a company is unable to pay what it owes its creditors, the creditors may decide to exercise their security or perhaps eventually apply for the company to be wound up.
- The money that is provided by long-term creditors will be invested to earn profits, and the profits (in excess of what is needed to pay interest on the borrowing) will provide extra dividends or retained profits for the shareholders of the company. In other words, shareholders will expect to increase their wealth using creditors' money.

Credit spreads are not static – they can tighten and narrow over time. The change is generally attributed to economic conditions. For example, in deteriorating market conditions, investors tend to purchase U.S. Treasuries and sell their holdings in corporate bonds. Capital inflows to U.S. Treasuries would increase the price of the treasuries and decrease their yield. On the other hand, capital outflows from corporate bonds would decrease the price and increase the yield on the bonds.

4. OBTAINING CONDITIONAL PROBABILITIES OF DEFAULT

It is also possible to calculate, again from credit spreads, conditional probabilities of default, over a future time horizon, knowing that the issuer has not yet defaulted. These probabilities are conditional on survival up to the horizon considered. From the previous example, it is possible to estimate the one-year default probability, also called the forward probability.

The change in the price of the bond over time (2-year maturity) can be represented as follows:

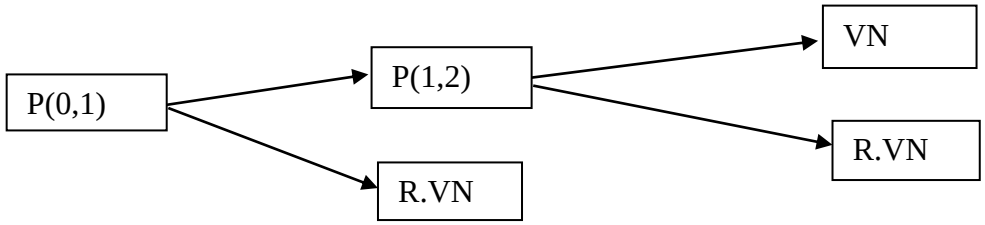

Figure 1 - Evolution of the price of the risked bond

The evolution of the bond price is modeled by a binomial process with two states of nature over the period: either the issuer defaults [then the flow paid by the bond is equal to the nominal value (100) times the recovery rate (R)], or the issuer survives and the bond is worth P (l, 2).

By equalizing the price of the 2-year bond (calculated by discounting with its actuarial rate of return) with the price obtained by the "risk-neutral approach", the conditional probability can be deduced since the probability of default "in the spot" has been deduced previously(Cecile Kharoubi et Philippe Thomas, 2013).

Spreads are often increasing with the recovery rate implying an equally increasing default probability curve.

However, there is no "normal" form because the conditional probabilities are not necessarily increasing over time. For example, a company with a bad rating will have a high probability of defaulting in the short term, but could have a lower conditional probability on longer term.

5. CONCLUSIONS

The main findings of the paper are focused on the fact that the credit risk tends to be priced equally in the two markets in the long run. In other words, no arbitrage opportunity exists in the long run. Also, market participants seem to use swap rates rather than treasury rates as the proxy for risk-free rates. In the short run there is strong evidence of market inefficiency in that the two markets exhibit substantial price discrepancies. This is to a large extent due to their

different responses to changes in the credit quality of reference entities. Overall, the derivatives market seems to lead the cash market in anticipating rating events and in price adjustment.

Like any empirical method, this approach frees itself from any theoretical framework or any modeling hypothesis. We let the data "speak for itself". It will be emphasized that this method is easy to implement. Nevertheless, it suffers from a major problem: its lack of predictive character. Financial literature has long established that the past is not enough to anticipate the future. On the other hand, yield spreads do contain a component related to credit risk, but other factors influence them.

This estimate of credit risk is not pure: it is polluted by other risks such as liquidity risk or market risk. For example, if a company is the object of speculative increasing attacks on its bonds, even though its credit risk has not changed, the spread will still vary because it results from the confrontation of the supply and demand on the debt security in the market.

Finally, the two available indicators, the rating and the spread, are supposed to be close but can sometimes diverge. Indeed, the rating agencies are unable to readjust their estimates in real time. In addition, spreads can be subject to distortions, as mentioned above. This last problem also affects some parametric models.

This approach consists in discounting by using a risk-free rate, but by treating the mathematical expectation of the future price, therefore by integrating the credit risk. The "risk neutral" approach consists in placing oneself under a probability adjusted for the risk under which the agents are neutral to the risks.

It is on this condition that it is possible to determine the price of the risked bond by discounting at the risk-free rate (since the agents are risk neutral) the expectation of the future price (which explicitly takes into account the risk of credit via the issuer's probability of default).

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