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Credit Derivatives : Main Concepts and Pricing

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ABSTRACT: The investors have the possibility to structure and to optimize the risk adjusted performance of their liabilities by diversifying them among several markets and instruments. Credit derivatives are financial instruments which allow a restructuring of the risk/return profiles of credits and permit investors to access new markets. They facilitate the trading of credit risk, its transfer and hedging. They can reduce transaction costs and provide managers a way to "short sell" loans or bonds. They offer to investors the possibility to leverage bond or loan positions. These products complete also the market since they provide a mean to synthesize assets which are not available in the market. This paper surveys the main types of credit derivatives and their valuation. Forward contracts on bonds, Total Return Swaps, Credit Default Swaps, Basket Default Swaps, Credit Default Exchange Swaps, Credit Linked Notes, Basket Default Notes, Levered Portfolio Notes, and Credit Spread Derivatives are subsequently studied in terms of definition, overview, structure, benefits, and pricing.

KEYWORDS: Credit Derivatives, Risk Management, Hedging, Forwards, Swaps, Options

I. INTRODUCTION

Credit derivatives serve at least three goals. They improve risk management, optimize exposure and facilitate access to markets. They are often presented in the form of three classes of instruments: total return swaps (total rate of return swaps, loan swaps or credit swaps), credit-default instruments and credit-spread instruments. Total return swaps are conceived to transfer the credit risk to the counterparty. Credit-default instruments give a certain payoff upon the occurrence of a default event. They can correspond to a credit-default swap or default options. Credit spreads instruments take often the form of forward or option contracts on credit-sensitive assets.

Smithson (1995) advances two main reasons at least for the use of credit derivatives. The first reason is that they represent a mean to implement the main prescriptions of modern portfolio theory. The second reason is that they can be used in the management of interest rate risks. Belkin et al. (1998) develop a direct approach to measuring credit risk at the transaction level. They identify credit risk as the ``cost" of buying credit ``insurance" in the spirit of the models of Merton and Bodie (1992) and Merton and Perold (1993). According to this approach, each credit instrument has an associated risk premium that reflects the competitively determined cost of a form of credit insurance. Li and Marinc (2014) find that credit default swaps represent 95% of credit derivatives possessed by US banks. The authors conclude that the utilization of credit derivatives is positively and significantly correlated to risk exposures of publicly listed U.S. bank holding companies. Corte, Jeanneret, and Patelli (2023) use the price difference between sovereign credit default swaps denominated in different currencies to predict the exchange rate. Such a difference expresses the credit-implied risk premium, and represents the expected currency depreciation conditional on a credit event. Our paper is organised as follows. The next section presents the main categories of credit derivatives: forward contracts on bonds, total return swaps, credit default swaps, basket default swaps, credit default exchange swaps, credit linked notes, basket default notes, levered portfolio notes, and credit spread derivatives. The third section shows how we price the total return credit swaps and credit spread derivatives.

II. MAIN CONCEPTS OF CREDIT DERIVATIVES

The main categories of credit derivatives are forwards, swaps, options, and building blocks combining some of these main products. For further readings about the credit derivatives and their different forms, the reader can refer to Das (1998), Brown (1996), Howard (1995), and Bomfim (2022).

Credit Derivatives : Main Concepts and Pricing

A. Forward Contracts

Forward contracts on bonds can be either cash-settled or physical-settled. The cash-flows for this forward agreement commits the buyer to buy a given bond at a specified future date at a predetermined price specified at contract origination (time $t = 0$). The agreement can specify that instead of using the price, the bond's spread over a treasury asset or a benchmark will be used. In this operation there are two maturity dates: the maturity of the forward agreement and the maturity of the reference bond. The maturity of the forward agreement is in general shorter than that of the reference bond. The payoff of the credit spread forward contract *CF* at the maturity date *T* is:

$CF_T = (CS_T - CS_0) \,.\, MD \,.\, A$

Where CS_T is the observed credit spread at maturity, CS_0 is the credit spread in forward agreement, *MD* is the modified duration, and *A* is the notional amount of the forward. When there is a credit event, the transaction is marked to market and unwound. At any date between 0 and *T*, the credit spread reflects the default risk of the bond (Petitt et al. (2015)). The value of a long position in a forward is an increasing function of the credit spread. The short position value is a decreasing function of the credit spread.

B. The Structure of Credit Default Instruments

Credit default instruments dissociate the risk of default on credit obligations. They are often presented in the form of credit-default swaps or credit-default options. In general, when there is a credit event by the reference credit, then according to the terms of a credit-default swap, the bank pays the counterparty an agreed default payment. The counterparty pays a periodic fee and benefits from the protection of the risk of default of the reference credit. This credit derivative structure is based on the replication of the total performance of the underlying credit asset (a reference bond, a loan). The swap is done between an investor and the bank. The investor assumes the risks of the reference bond. The bank passes through all payments of the bond and in return, the investor makes a payment akin to a funding cost. The transaction is based on a notional amount. The current bond price is used to compute the settlement value under the transaction. The investor receives interest payments and pays a money-market interest rate plus or minus a specified margin.

1) Total Return Swaps: In a total return swap, the rate payer makes periodic payments to another party (the total return payer). He receives the total return less the principal and interest payments plus or minus price changes of the reference asset. The total return swap is often used in the swap structures on default risk. The two parties in a total return swap define at origination the initial value P_0 of the reference asset and agree on the reference rate. At any time between $t = 0$ and the maturity date corresponding to settlement dates, the asset receiver obtains the cash-flows from the reference asset. He pays a certain amount fixed in connexion with the reference rate. At the maturity date of the contract, the value of the reference asset P_T is used. If this value is greater than P_0, the asset receiver gets the difference $(P_T - P_0)$, otherwise, he pays the difference $(P_0 - P_T)$.

The credit swap can also be based directly on a spread. In this case, the asset receiver pays at maturity the difference in the spread of the reference asset over a treasury security with a comparable maturity at origination and at maturity.

2) Credit Default Swaps: This derivative contract allows one party (the protection seller) to receive fixed periodic payments from the protection buyer. The payments are in return of making a single contingent payment covering losses with respect to a reference asset following a default or another specified “credit event”. Credit default swaps are internationally the most practised credit derivatives by banks, insurance companies, and financial guarantors.

The main idea behind credit default swaps is that they strip off the default risk of some reference assets. This risk will be traded separately. By implementing a credit default swap, the protection seller earns investment income and the protection buyer hedges the risk of default on the reference asset. Developed by the US bank J.P. Morgan in 1997, this contract allows investors to hedge credits without implementing costly strategies consisting of buying and selling cash securities and loans.

Let us consider an illustration adapted from a sponsor's statement by Barclays capital. An investor *A* gains customized access through a bank *B* to a corporate bond by selling three-year default protection to the bank *B* on the bond. The investor *A* receives a fixed premium of 120 bp per annum and agrees to make a credit event payment if the borrower defaults on the bond. In the credit event, the swap terminates and the investor *A* pays the bank *B* the notional times the percentage fall from par of the bond. The investor *A* can also settle the swap by buying the bond from the bank *B* at par.

3) Basket Default Swaps: An investor can sell default protection on several assets. In a first-to-default basket default swap, the protection seller assumes the default risk on a basket of bonds by agreeing to compensate market losses on the first asset in the basket to default.

4) Credit Default Exchange Swap: It is possible to swap a default risk on an asset for that of another asset. In a credit default exchange swap, both parties act simultaneously as protection buyers and protection sellers. For illustration, consider

two institutions *A* and *B*. *A* trades the default risk of a loan it holds for that of a complementary loan held by *B*. *A* lays off the default risk on loan *A* in return for assuming default risk on loan *B*. If a reference credit experiences a credit event, then the protection seller must make a credit event payment to the protection buyer. This can terminate the trade. The trade could continue with the protection buyer in the rest of transaction paying an agreed rate. Parties do not make periodic payments and swap just the contingent payments when default risks are perfectly matched.

5) Credit Linked Notes: CLNs are associated to the credit performance of underlying assets. A principal protected note protects a preset portion of principal. A principal linked structure pays enhanced fixed coupons and can redeem principal at a rate associated with the credit performance of reference assets. Credit default notes allow investors to buy or sell default protection on reference credits.

6) Basket Default Notes: It is possible to earn additional yield on sovereign bonds by buying CLNs associated with more than one reference obligation.

7) Levered Portfolio Notes: These notes are basket default notes giving leveraged exposure to a portfolio of reference bonds. They allow investors to gain significant returns on higher grade assets by receiving an enhanced coupon for selling default protection on a certain number of investment grade bonds.

C. The Structure of Credit Spread Instruments

Credit spreads refer to a difference with respect to the riskless interest rate. This difference compensates the investor for the risk of default. Credit spread derivatives can be defined using the riskless rate as a benchmark (absolute spread) or using two credit assets (relative spread). In a credit-spread swap between a bank and a counterparty, the latter gains (losses) if the spread decreases (increases). Call and put options on credit spreads give respectively the right to the buyer to buy (to sell) the spread and benefit from a decrease (an increase) in the spread.

D. Credit Spread Derivatives CSDs

CSDs may be presented in the form of options, forwards or swaps associated with a credit spread difference determined between the current yield of a given reference asset and a risk free asset. The dissociation between credit spread risk, market risk and interest rate risk allows the investors to hedge credit spread risk. Investors using credit spread derivatives can implement long or short exposures to reference assets. These derivatives protect investors from credit deterioration. Credit spread puts are implemented to hedge against rising credit spreads.

The default put is widely used in operations involving options on default risk. The buyer of a default put pays a premium to the seller who assumes the default risk for the reference asset. When there is a credit event, the seller pays the buyer a default premium. Local currency derivatives combine currency derivatives with credit derivatives. They permit foreign investors to manage currency and convertibility risk.

III. PRICING OF CREDIT DERIVATIVES

The pricing of credit derivatives accounts for the exposure, the default probability and the expected recovery rate. The approach is then adapted in different contexts using replication portfolios. There are two main approaches for the pricing of credit securities. The first approach traced back to the Black and Scholes (1973) seminal work. In this approach a credit security is regarded as a contingent claim on the value of the issuing firm. The option pricing theory is applied to the pricing of the claims on the firm's assets. In this approach, default is modelled as the first time the firm's value hits a pre-specified boundary. Models of this category are based on a continuous process for which the time of default is a predictable stopping time. The payoff in the case of default is represented by a fixed fraction of the firm's value in the event of bankruptcy. This approach is adopted in Merton (1974), Black and Cox (1976) and Geske (1977) among others. The second approach models the time of default as the time of the first jump of a Poisson process with random intensity, referred to as a Cox process.

A. The Pricing of Total Return Credit Swaps

Total return credit swaps are in general priced off the risk-free return in combination with the pricing of a default swap. The method of replication reproduces the loan characteristics using surrogate instruments. In general, the correlation between the bonds and equity is used to implement a ``composite'' hedge. The derivation of default risk is based on the firm's model developed in Merton (1974), Black and Scholes (1973) and Geske (1977). Lou (2023) prices the total return swap using valuable asset as collateral to secure a loan. The author considers the total return swap hedging financing constraints.

B. The Pricing of Credit-Spread Derivatives

The credit spread is defined as the difference between the yield of a security and the yield of a corresponding risk free asset. The concept of a risk-neutral yield credit spread is often used in practice and is defined as the difference in the yield of a risky

bond and the yield on a risk-free bond. The determination of risk-neutral credit spreads allows the modeling of the term structure of credit spreads. The reader can refer to the study of Litterman and Iben (1988).

The credit spread is a key element in the valuation of credit derivatives because it represents a compensation for the assumed credit risk. The knowledge of the credit spread and the utilization of the classic option pricing methodologies allow the computation of forward and option prices on the credit spread.

The pricing of forwards on credit spreads practices the classic methodology which comprises three steps. The first step uses the spot price of an asset and the risk free rate. The second step determines the forward prices of the securities. The third step concludes the forward credit spread by the difference between the forward asset yield and the forward riskless rate. The pricing of credit-spread options depends on the volatility parameter of the underlying asset which is the forward credit spread of the nominated assets. The forward spread corresponds to the differential between the forward rates of the assets at the option's maturity date.

CONCLUSIONS

Credit derivatives permits to trade of credit risk, its transfer and hedging. Forward contract on bonds is an agreement that commits the buyer to buy (and commits the seller to sell) a given bond at a specified future date at a predetermined price specified at contract origination. A long position in a forward is an increasing function of the credit spread. In a total return swap, the rate payer makes periodic payments to the total return payer. Credit Default Swap allows the protection seller to receive fixed periodic payments from the protection buyer. The payments are in return of making a single contingent payment covering losses with respect to a reference asset default. Credit Default Exchange Swap permits to exchange a default risk on an asset for that of another asset. The default put is the most used options on default risk. The buyer of a default put pays a premium to the seller who assumes the default risk for the reference asset. The pricing of credit derivatives and credit instruments depends on the default probability of the reference asset, the expected recovery rate and the nature of the exposure. The pricing approaches concern individual transactions and portfolios. The pricing of individual transactions or single transactions concerns the loss exposure, the default probability, the recovery rate and the correlations between these features in order to predict future credit losses. The pricing in a portfolio approach is focused on the correlations between individual exposures, which means that we must account for the joint default probabilities (correlations between default) and the correlation between loss exposure and recovery rates. The proprietary models are based on an option approach to default in which the equity of a levered firm is equivalent to a call on the net asset value of the firm. This approach is initiated by Black and Scholes (1973), Merton (1974), Black and Cox (1976), Geske (1977), etc. This approach considers the position of debtholders as a combination of a long position in a bond plus a short position in a put on the firm's assets.

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