The determinants of credit default swap rates: an explanatory study

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Abstract
The aim of this paper is to explain empirically the determinants of credit default swap rates using a linear regression. We document that the majority of variables, detected from credit risk pricing theories, explain more than 60% of the total level of credit default swap rates. These theoretical variables are credit rating, maturity, risk-free interest rate, slope of the yield curve and volatility level of equities. The estimated coefficients for the majority of these variables are consistent with theory and they are significant both statistically and economically. We conclude that credit rating is the most influential determinant of credit default swap rates.

Key words: credit derivatives; credit risk; credit default swap; credit rating; market variables.

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1. *Introduction*

The two principal types of risks faced by firms and investors engaged in financial transactions are market risk and credit risk. The former is the risk of fluctuations in interest rates, exchanges rates, stock prices, and so on. The latter is the risk caused by changes in creditworthiness of the debtors and that counterparties to transactions in which are engaged fails to make obligated payments[1]. Credit risk pricing has received much attention among academics, practitioners and financial regulators. In assessing credit risk from a single counterparty, an institution must consider three components: default probability, loss given default and recovery rate. A key innovation in the credit risk market in the past decade was the development of the credit derivatives market. A credit derivative is an over-the-counter derivative designed to transfer credit risk from one party to another. By synthetically creating or eliminating credit exposures, they allow institutions to more effectively manage credit risks. Credit Derivatives represent one of the fastest growing businesses in banking today. Investing in and managing credit is a major aspect of capital markets and corporate finance.

Recent empirical work has been done on credit derivative markets. Hull, Predescu & White (2004) analyze the impact of credit rating announcements in the pricing of credit default swap. Norden & Weber (2004) analyse the empirical relationship between credit default swap, bond and stock markets. They examine weekly and daily stock lead-lag relationship in a vector autoregressive model and the adjustment between markets caused by cointegration. They find that weekly and daily stock returns are negatively associated with credit default swap and bond spread changes. Also, the sensitivity of the credit default swap market to prior stock market movements is significantly related to the firm's average credit worthiness. Longstaff, Mithall & Neis (2004) examine the relative pricing of corporate bonds and default swaps. Ericsson, Jacobs & Oviedo (2004) investigate the relationship between theoretical determinants of default risk (firm leverage, volatility and the riskless interest rate) and actual market premia of credit default swap using linear regression.

In the last decade, more substantial empirical studies are devoted on other credit derivatives instruments, in particular corporate bonds. Das & Tufano (1996) focus on the dependence between credit spread and stock market information's. Ericsson & Renault (2000) detect macroeconomic and financial factors for explaining the determinants of credit risk. Collin-Dufresne, Goldstein & Martin use a structural approach to identify the theoretical determinants of corporate bond credit spreads. Gatfaoui (2002) focuses on the systematic and idiosyncratic components of credit risk. Jarrow & Turnbull (2000) show the dependence between market risk and credit risk. Delianedis & Geske (2001) examine the proportion of the credit spread that is explained by default risk using a corporate bond data set. They find that taxes, jumps, liquidity and market risk explain a great fraction of the credit spread. Huang & Kong's (2003) paper explores the possible determinants of credit spread changes using credit spread data. They consider five sets of explanatory variables (default rates, interest rate variables, equity market factors, liquidity indicators and macroeconomic indicators. They provide evidence that credit risk models may need to take into account the impact of macroeconomic variables on credit spreads. Similarly, they find that credit spreads changes for high yield bonds are more closely related to interest rate and equity market factors. Liu, Qi & Wu (2004) examine the effect of taxes on the level of corporate bond spread by considering asymmetric taxation and amortization. They find that the tax premium account for a significant portion of corporate bond spreads. The study of Elton et al (2001) show that the rate spread on corporate bonds can almost be explained by three influences: the loss from expected defaults, state and local taxes and a premium required for bearing systematic risk. In short, the majority of researches on credit risk have concentrated on the estimation of default probabilities from corporate bond data and exploring the determinants and the dynamics of the term structure of credit spreads.

[1] Firms and investors are also exposed to *operational risk* and *liquidity risk* in addition to market and credit risk.

This paper is intimately related to these works. Although our focus is also on credit risk, a major distinction is that we use credit default swap rates rather than corporate bond spreads. Ericsson, Jacobs & Oviedo (2004) show that the use of credit default swaps data rather than bonds has at least two important advantages. First, default swap premia do not require the specification of a benchmark risk free yield curve since they are already “spreads”. Second, default swap premia may reflect changes in credit risk more accurately and quickly than corporate bond yield spreads. The remainder of this paper is organized as follows: Section 2 presents a description of some credit derivatives and shows how this instruments “revolutionizing” management of credit risk. Section 3 exposes the well-known result for the pricing of default risk following the structural and the reduced form approaches and therefore, we detect the “drivers” of credit risk suggested by theories. In sections 4, we describe our data and we explore empirically the impact of these variables to specify the level of credit default swap rates. Section 5 concludes the paper.

2. *The benefits of using credit derivatives*

Credit derivatives transactions are an increasingly important feature of modern financial markets. They provide an efficient means of hedging and separating credit risk from other market variables without jeopardizing relationships with borrowers. There are many different types of credit derivatives contract. Most of them involve a fixed payment by the protection buyer to the protection seller. In return, the protection buyer receives a payment that is contingent upon the credit event[2] (Bankruptcy, failure to pay, and so on). The first class product of credit derivatives is the credit default swap. It is a simple contract in which one party-the seller of protection or the buyer of exposure-receives a periodic payment (premium) from the other party-the buyer of protection or the seller of exposure- and pays a one-off payment in the event of default by a reference entity. Generally, the protection seller compensates the buyer for the difference between the face value of the debt and its market value following the occurrence of a credit event. Using a credit default swap, a bank can hedge its credit exposure without selling the loan or bond. This may justify the principal and the important feature of credit derivatives to isolate credit risk from the distractions of interest rates and currency. Also, they allows access to names and maturities that otherwise may not be available. For the protection seller, too, the benefits are enormous. It can take exposure to the desirable credit in the exact maturity of its choice. So, it obtains exposure which may be otherwise difficult due to legal or settlement restrictions. The second class of credit derivatives is the total return instruments like total return swap. It allows users to transfer the total economic performance of a risky asset against a predetermined rate (e.g. LIBOR plus a spread). Total return swap is a financial contract (swap agreement) between two parties that exchanges the total return from a financial asset between them. Then, this instruments transfer market and credit risk. They are increasingly used by investors that whish to purchase the credit exposure of an asset without purchasing the asset itself. Then, an asset may be removed from the balance sheet. The third class is spread instruments such as credit spread option that allow users to take position on the future spread between two financial assets with one of them of stable credit risk as reference (e.g. government bond). Cossin & Pirotte (2001) argue that credit derivatives make an important dimension of financial risk tradable. These instruments present an important step toward market completion and efficient risk allocation. Another common credit derivative instrument is credit-linked note. It combines a debt instrument with an embedded credit derivative. Under this instrument, the protection seller purchases a note from the protection buyer who agrees to pay a series of coupons and the face value of the note at maturity.

Using credit derivatives, financial intermediaries, investors and corporates can separate market risk from credit risk. These instruments present an efficient way to hedge the credit components of the financial contract although they are more expensive and less liquid given that the majority of the instruments are over-the-counter products that can be designed to meet specific user requirements. Also, international investors use credit derivatives in the management of sovereign risk. Credit

[2] A list of credit events are presented by the international swaps and derivatives associations in the “1999 ISDA credit derivatives definitions”.

derivatives present efficient tools for portfolio managers and investors for hedging credit risk since the bond investors are sensitive to a downgrade in the rating of a bond and bond issuers are sensitive to an increase to their cost of borrowing. Credit derivatives increase the liquidity of bond portfolio; enhance portfolio returns and reduce credit exposure to particular borrowers or sectors without affecting their on-balance sheet exposures or clients relationships. Finally, market participants can use credit derivatives for reasons of speculation, arbitrage or hedging even if they haven't direct exposure to the reference entity. The motivation of the protection buyer is the reduction of credit risk. However, credit derivatives allow for protection seller to have long positions against debtors whose securities are not available in the desired maturity, currency or quantity.

3. *Pricing credit risk and credit derivatives*

Skora (1998) classify the credit risk models according to their ability to describe explicitly or implicitly the default and the recovery process. He distinguishes four classes of credit risk models: Spot rate models, Default models, Credit rating models and Asset models. Merrill Lynch &Co (1998) reveals two divisions of credit risk models: the comparative pricing models (or arbitrage free models) and the econometric models (or equilibrium models). Duffie &Singleton (1999) classify the models for valuing risky assets into two categories. The first branch have been called "*Structural models*"[3] require firm specific inputs to model the default process. Typically, the cause of default is a decline in the value of a firm's assets below a fixed threshold. The second branch called "*Reduced form models*" estimate the risk neutral probability of default over a given interval from actual credit spreads without necessity to know the cause of default. The two classes of models differ substantially in form but there are rooted in the no arbitrage analysis[4] of Black-Scholes-Merton (1973-1974).

The structural models define default as a contingent claim by describing the reasons of the default and price the default security using the Black-Scholes-Merton (1973) option pricing technique. All these models relate default to the process for the firm's asset backing and define the default event in terms of boundary conditions on this process. The boundary can be either endogenous or exogenous. The model of Merton (1974) is at the heart of structural models and its basic idea is to use option pricing technique to value the default risk spreads of fixed income instruments. The firm's debts are considered as contingent claims issued against the firm's assets. The basic Merton model has been extended in many ways. Black &Cox (1976) allowed for a premature default and fixed a threshold value under which the firm is considered at default. Further more, the interest rate risk is assumed to be constant. One early piece of research on credit risk in the context of stochastic interest rates was provided by Shimko et al (1993). They adopted an extension of Merton risky debt with stochastic interest rates. Following this framework, the value of assets is supposed to follow a diffusion process and the short term riskless interest rate follows an *Ornstein-Uhlenbeck* process. In the same way, Longstaff & Schwartz (1995, (a)) eliminate the assumption of deterministic risk free interest rates and allow for stochastic interest rates correlated with the firm process. Similarly, they shows the possibility of constructing a reliable estimate of recovery rates by looking the historical data of defaults and the recovery rates for different classes of debts of comparable firms. Saá-Requejo & Santa-Clara (1999) present a structural model for pricing default risky debt. They define the occurrence of default by the first time that the value of firm's assets (V) crosses some threshold (K) representing insolvency. They allow for stochastic default boundary and therefore, more general than Black &Cox (1976) and Longstaff & Schwartz (1995) whose allow for a continuous and deterministic boundary. Rutkowski (2001) generalizes the Black& Cox framework for the valuation of a zero-coupon defaultable bond and take into account stochastic interest rate risk. Hui, Lo & Lee (2001) develop a three-factor corporate bond valuation model[5] that incorporates a stochastic default barrier (the bond issuer's liability). The default occurs when the bond issuer's leverage ratio increases over a predefined default triggering value. The default barrier follows a standard Wiener process and is correlated with the value

[3] It is called the "structural approach" because it depends on the actual capital structure of the firm. It also called as *firm's value approach* or the *option theoretic approach*.
[4] *No reward without some risk.*
[5] The firm asset value, the firm liability and the short-term interest rate are stochastic variables.

of the firm's assets and risk free interest rates. In the Leland (1994) model, the firm faces costs of both taxes and bankruptcy that imply an optimal capital structure. The value of corporate debt and capital structure are interlinked variables and for this reason, a unified analytical framework is derived for the value of long-term corporate debt and for optimal capital structure when firm asset value followed a diffusion process. In the Leland & Toft model (1996), the firm issues continuously a constant amount debt with a fixed maturity that pays continuous coupons. In the event of default, the equity holders get nothing and bondholders receive a fraction of the firm asset value because the notion of deadweight costs that arises in liquidation. They construct the term structure of default probabilities and shows that the slope of the curve is convex at the beginning and concave at the rest.

Cossin &Pirotte (2001) enumerate some of the advantages of the structural approach like the availability of an economic context underlying the event of default and a clear definition of the latter. The common characteristic of structural models is the predictability of default event because investors can expect the default time since they observe the evolution of firm's assets and the default threshold fixed in advance. The shortcomings of structural models, especially when the default event is predictable, make it necessary to develop others classes of models that take into account the default as a surprise event.

Reduced form models treat default as an unpredictable event governed by a hazard rate process. They describe the conditional law of the default time and the process being modeled is the random time that specifies the probability that a default event occurs prior to maturity of the security. The stochastic structure of default is prescribed by an exogenously given intensity process (Giesecke, 2002).

Jarrow & Turnbull (1995) construct the term structure of risk interest rates by modeling the evolution of prices of zero coupon bonds as a dynamic model. To obtain this term structure of risk interest rates, we must use risky bonds that belong to the same class of risk. Jarrow, Lando & Turnbull (1997) models the evolution of the credit rating[6] during the life of the assets and the probability of default is considered as a exogenously variable and can be obtained from the transition matrices published in the rating agency like Moody's and Standard & Poor's. Following this model, there are no dependency between default probabilities and interest rates; however, there are a correlation between the credit spreads and the credit rating changes. Duffie & Singleton (1999) assume the dependency between probability of default and interest rates level. Lando (1998) extend Jarrow, Lando & Turnbull framework and relax on the assumption of independency between interest rates and default probabilities. Lando's model allows for dependency between credit and market risk through the use of doubly stochastic Poisson process. Jarrow & Yu (2001) extend the Lando's defaultable bond pricing formula to include interdependent default risk. They introduce the notion of counterparty risk that means the risk that the default of a firm's counterparty might affect its own default probability. Jeanblanc & Rutkowski (1999) model the default of credit claims following the "*Subfiltration approach*". The subfiltration is viewed as a set of information that contains everything except the default itself. Default time is modeled as a random time in the reference filtration. The best and the simplest alternative, when possible, consist to pricing credit derivatives via *replication* (Vaillant (2001), Blanchet-Scalliet &Jeanblanc (2003)). Das (1995) suggest a structural model for valuing credit derivatives (especially credit risk option). The starting point consists of modeling the dynamics of firm value by a stochastic process and allows for constant and stochastic interest rates. Longstaff & Schwartz (1995 (b)) propose a model in which the dynamics of credit spreads are supposed to follow an exogenous stochastic process. Hull & White (2000) provide a methodology for valuing credit default swap when there is no counterparty default risk. It consists, in the first time, to calculate the risk neutral probability of default at future times from the yields on bonds issued by the reference entity. In the second time, they calculate the present value of both the future payments and the expected future payoff of the credit default swap. The value of credit derivatives, especially credit default swap, can be derived by applying a reduced form credit risk model. In recent years, a new credit risk models have presented and tried to bridge the gap between structural and reduced form

[6] Credit rating for bonds reflects the credit worthiness of an obligor's and its capacity to pay its financial obligations.

models. They are referred to mixed models. Works like Duffie & Lando (2001), Cetin et al (2002) and Giesecke (2003) have proposed reduced form models in which the intensity of default is not given exogenously but determined endogenously within the model and it is function of the levels of investor's information and firm's characteristics.

4. Exploring credit risk from credit default swap prices

We use a regression technique to show the possible relationship between the credit default swap prices and the "drivers" of default risk (credit rating, maturity, riskless interest rate, slope of the yield curve and volatility of equities).

4.1. Dependent variable

The credit default swap prices (starting prices) are considered as the dependent variable in the model. Theses prices are obtained from UBS (*Union Bank of Switzerland*). It consists of 207 trades during the period from 15 May 2000 to 15 Mars 2001. The data consist of starting prices of credit default swap because the market is conducted between banks and not via an exchange or screens. The credits that are underlying default swaps are composed of 73 contracts and are listed by country in Table 1. Summary statistics of CDS rates are at Table 3.

Country	***Number of credits***
Belgium	1
Germany	17
Italy	5
France	25
Netherlands	1
Poland	1
Portugal	2
Spain	1
Sweden	3
Switzerland	3
United Kingdom	14

Table 1: *Classification of credits by countries*

Other classifications of credits are listed by activity in Table 2.

Activities	***Number of credits***
Banking sector	11
Telecommunication sector	14
Industrial sector (various)	14
Automobiles manufacturing	8
Medical research	6
Insurance sector	5
Supply sector	5
Airline transport	5
Land transport	1
Petrolium sector	1
Water distribution	1
Tobacco sector	1
Multimedia sector	1

Table 2: *Classification of credits by activities*

Variable	N	*MIN*	*MAX*	*MEDIAN*	*STD.*	*SKEW*	*KURT*
CDS rates (bp)	207	0.0013	0.035	0.00465	0.0049	2.6053	8.7299

Table 3: *Summary statistics of CDS rates*

4.2. Explanatory variables

Rating

A credit rating is an opinion of the general credit worthiness of an obligor and its ability on the future to make timely payments on a specific fixed income security. The rating should reflect the financial position and performance of the company. The rating process includes financial analysis of the firm including quality of management, firm's competitiveness, financial reports and so on.

The credit rating of our data is provided by the popular rating agencies: Standards & Poors and Moody's. The rating used by Standards & Poors and Moody's are quite similar, although some differences of opinion in some ratings of the same debt investment. We will adopt the rating of Moody's since the majority of notation of our data is provided by Moody's. We use a numerical equivalent of credit rating as shown at Table 4.

Standards & Poors	***Moody's***	***Numerical value***
AAA	Aaa	**1**
AA^+	Aa1	**2**
AA	Aa2	**3**
AA^-	Aa3	**4**
A^+	A1	**5**
A	A2	**6**
A^-	A3	**7**
BBB^+	Baa1	**8**
BBB	Baa2	**9**
BBB^-	Baa3	**10**

Table 4: *Numerical value of rating note.*

Time to maturity

The maturity of the contract is an important characteristic between the seller and the buyer of the protection. Since the market is over the counter, we can find different maturities. We will adopt the number of week as a reference for measuring the maturities of all contracts.

Risk-free interest rate

As suggested, it became clear that credit risk could not be priced independently from market risks, especially interest rate risk. Cossin & Pirotte (2002) shows that credit risk exists because of the punctual commitment represented by the principal and interest payment owed to a particular class of claimholders, the debt holders. Then, the credit worthiness of the firm is linked to the strictness of this commitment.

We use the three-month Treasury bill yield. In the first case, we use the American three month Treasury bill yield. This choice is justified since the United State is considered as the most solvent country in the world. The source of this data is *THE U.S. GOVERNMENT SECURITIES MARKET*. In the second case, we use French three-month Treasury bill yield since all the reference entities for the credit default swap transactions are European contracts. The source of this data is "*Banque de france*".

We have daily observations and we apply the three-month Treasury bill yield for the day prior to the credit default swap transaction.

Slope of the yield curve

Extending the framework of Longstaff & Schwartz (1995), the short interest rate is governed by an *Ornstein-Uhlenbeek process* and is expected to mean-revert about the long rate. So, an increase in the slope of the yield curve should increase the expected short interest rate and as result, a decrease in credit spread. The slope of the yield curve can be interpreted as an indication of overall economic health. The slope of the yield curve is measured as the difference between the long and short term interest rate. We use the European long term government bond yield and the French short term interest rate. The data are obtained from the Web page (www.economagic.com).

Volatility of equities

In the entire structural models ((Merton (1974), Longstaff & Schwartz (1995), Leland (1994), Leland\&Toft (1996), Shimko et al (1993), Requejo & Santa-Clara (1999)) default event depend on the movement of the firm value. Therefore, they use the volatility of assets as the main driver of credit risk. We use the annual variance of equity return as a proxy of firm asset's volatility. The annual variance is calculated from the daily quotation of equities provided by "*Bourse de Paris*".

4.3. Model specification and empirical results

In this section, we test the impact of different variables defined in the previous section on the levels of credit default swap prices. The credit default swap price or premium is the periodic cost for protection against a default by the company. The buyer of the protection makes periodic payments to the seller and in return obtains the right to hedge against credit risk. We use a regression technique and we estimate all the equations as simple linear regression. We have corrected for heteroscedasticity using the White test.[7]

The influence of rating

We looks at the relationship between credit default swap rates (CDS) and credit rating of different reference entities. We consider the following regression:

$$\text{CDS} = \text{constant} + \alpha_1.\text{Rating} + \varepsilon \qquad \textbf{(1)}$$

where

CDS: credit default swaps rates;
Rating: credit rating;
ε : error term.

Results of the regression (1) and the coefficients test are presented in the following table:

[7] The problem of heteroscedasticity is presented generally in cross sectional models. There are many test for detecting the heteroscedasticity Gleisjer (1969), test of Goldfeld-Quandt (1965). We adopt the white test (1980).

Variables	Coefficients	t-student	Probabilities
Constant	-0.003078	-3.39	0.00
Rating	0.001593	8.37	0.00
Adjusted R^2 : 0.42 White test: * Number of observations: 207		F-statistic : 153.60 Prob (F-statistic) : 0.00	

Table 5 : *Results of estimation of the following regression:*
CDS = constant+ α_1*Rating +* ε

Credit default prices are regressed on a numerical equivalent of credit rating, an adjusted R^2 of 42% is obtained. We notice the important significance of the rating variable. The credit default swap prices for a company are related to its credit rating. The best the credit Rating (Aaa), the lower the credit default swap rate. Our finding confirms the result in the existence theory concerning the dependence between the default probability and the rating. Delianedis & Geske (1999) show the links between credit rating migrations and the changes in default probabilities. Duffie (1998) shows that the credit spread increases when the credit rating decreases. Elton et al (2001) use credit rating as a measure for default probability to study the relationship between corporate bond yield and credit risk. Cossin & Hrico (2002) explore the determinants of credit default swap spreads and shows that the company's credit rating is a significant factor for explaining the variation of credit default swap rates.

The use of numerical value of rating note can introduce a bias because we implicitly assume that the rating changes from different classes have the same influence on credit spread. We investigate this point using a set of dummy variables. We use a dummy variable for credits rating that have a notation equal and lower than A_2 (A_3, B_{aa1},B_{aa2}, B_{aa3})[8]. Then, we distinguish two rating classes (high rating for notation higher than A_2 and low rating for notation equal and lower than A_2). We consider the following regression:

$$CDS = Constant + \alpha_0 .dummy_1 + \alpha_1 .Rating + \alpha_2 .dummy_1{*}rating + \varepsilon \qquad \textbf{(2)}$$

where

dummy$_1$**:** dummy variable for credit rating equal and lower than A2.

The purpose of using a dummy variable multiplied by rating (dummy$_1$.rating) is to test the influence of credit rating with low notation on the levels of credit default swap prices. We obtain the following results as shown in Table 6.

[8] The choice of $A_2$is not based for statistic purpose, but to respect the balance of our sample. This dummy variable takes on a value of 1 if rating is equal and lower than A_2 and 0 otherwise.

Variables	Coefficients	t-student	Probabilities
Constant	0.000626	2.02	0.04
Rating	0.000691	9.65	0.00
dummy	-0.015364	-2.06	0.04
*dummy*rating*	0.002477	2.47	0.01
Adjusted R^2 : 0.50 White test: * Number of observations: 207		F-statistic : 70.36 Prob (F-statistic) : 0.00	

Table 6 : *Results of estimation of the following regression:*

$$CDS = Constant + \alpha_0 dummy + \alpha_1 .Rating + \alpha_2 .dummy*rating + \varepsilon$$

The results of the previous regression show the significance of the coefficients (t-student significant). Also, we note the increase of adjusted R^2 (from 42% to 50%). The deviation of rating class (high and low) is a significant factor for determining the levels of credit default swap rates. Also, we note the significance of the variable (dummy*rating). Downgrades cause credit default swap prices to jump up, while the price effect of upgrades is less significant. Our result is consistent with Li (2003) who find that changes in credit spreads of different ratings behave in different ways. As credit quality deteriorates, change in credit spread become dependent on the short end slope of the treasury yield curve. Avramov et al (2004) find that investment grade (high rating) and speculative bonds (low rating) behave differently. Dionne et al (2004) find that the estimated default risk proportion of corporate yield spreads is highly sensitive to default probability estimated for each rating class. For example, for A rated bonds, this proportion can jump from 15% to 36%. For BBB bonds, this proportion can jump from 32% to 79%.To justify these results, we use an additional regression to show the possible relationship between the levels of credit default swap prices and each class of rating.

$$CDS = Constant + Aa2*dummy + Aa3*dummy + Baa1*dummy + Baa2*dummy + \varepsilon \qquad \textbf{(3)}$$

The results of regression (3) are as follows:

Variables	Coefficients	t-student	Probabilities
Constant	0.005269	19.57	0.00
Aa_2	-0.000848	-6.25	0.00
Aa_3	-0.000548	-5.98	0.00
Baa_1	0.000582	3.40	0.00
Baa_2	0.000944	4.66	0.00
Adjusted R^2 : 0.40 White test : * Number of observations: 207		F-statistic : 34.20 Prob (F-statistic) : 0.00	

Table 7 : *Results of estimation of the following regression:*

$$CDS = Constant + Aa_2*dummy + Aa_3*dummy + Baa_1*dummy + Baa_2*dummy + \varepsilon$$

We note that each class of rating is a significant factor. The main conclusion from the previous table is the sign of coefficients. Credit default swap prices are negatively related to high class of rating (A_{a2} and A_{a3}) and positively related to low class of rating (Baa_1 and Baa_2). The best (worst) the credit rating is, the lower (higher) the credit default swap price.

The influence of maturity

A credit derivative is a derivative instrument whose payoff is affected by credit risk. The time to maturity is an important factor to specify a credit derivative contract. To test the possible relationship between credit default swap prices and time to maturity of the contract, we use the following regression:

$$CDS = Constant + \alpha_0 .\ dummy_1 + \alpha_1 .Rating + \alpha_2 .dummy_1{*}rating + \beta_1 .Maturity + \varepsilon \qquad \textbf{(4)}$$

Where

Maturity: time to maturity for credit default swap contract (expressed in weeks).

Results of regression (4) and the coefficients test are presented as follows:

Variables	Coefficients	t-student	Probabilities
Constant	-0.001679	-1.00	0.31
Rating	0.000627	7.49	0.00
dummy	-0.015635	-2.13	0.03
*Dummy*rating*	0.002531	2.56	0.01
Maturity	1.03E-05	1.42	0.15
Adjusted R^2 : 0.51 White test: * Number of observations: 207		F-statistic : 54.24 Prob (F-statistic) : 0.00	

Table 8: *Results of estimation of the following regression:*

$$CDS = Constant + \alpha_1 .Rating + \alpha_2 .dummy + \alpha 3.dummy{*}rating + \beta_1 .\ Maturity + \varepsilon$$

The obvious result lies in the no significance of the variable time to maturity with a stable adjusted R^2 from the previous regression. The principal reason might be coming from the fact that the majority of contracts have a maturity of five years. To investigate the possible relationship between credit default swap prices and time to maturity, we must use a sample data with different maturities. Our result is contradictory from the study of Christopher Finger (1998) that express the fair value of credit default swap with the health quality of the reference credit and the time to maturity of the contract. Similarly, Kamin & von Kleist (1999) show that the maturity of an instrument is an important determinant of the degree of uncertainty about repayment and is therefore related to the spread. Then, the greater the maturity of an instrument, the more likely it is that the creditworthiness of the borrower will change during the life of the instrument.

The influence of the risk-free interest rate

The problem of credit risk is intimately related to the risk free interest rate. One of the first studies that try to state the problem of risky debt in a context of stochastic interest rate is provided by Shimko, Tejima & Van Deventer (1993). To test the possible relationship of the credit default swap prices and the risk free interest rate, we use in the first regression the American three month Treasury bill yield.

In the second regression, we use French three month treasury ill yield since all the reference entities for the credit default swap transaction are European contracts. We use the following regression:

$$CDS = Constant + \alpha_1 Rating + \alpha_2 .dummy + \alpha_3 .dummy{*}rating + \beta_{1.} \text{ Interest} + \varepsilon \qquad \textbf{(5)}$$

where

Interest: free risk interest rate presented by three month Treasury bill yield.

We obtain the following results:

Variables	Coefficients (regression1)	
Constant	0.008904 (1.11)[♦]	0.039373 (5.14)
Rating	0.000648 (7.59)	0.000658 (6.93)
dummy	-0.016084 (-2.18)	-0.017087 (-2.61)
dummy*rating	0.002576 (2.59)	0.002660 (3.04)
Free risk interest rate (US)	-0.181237 (-1.35)	
Free risk interest rate (FR)		-0.774922 (-5.47)
	Adjusted R^2 : 0.52 White test: * Number of observations: 207 F-statistic : 44.64 Prob (F-statistic) : 0.00	AdjustedR^2 : 0.60 White test: * Number of observations: 207 F-statistic : 63.27 Prob (F-statistic) : 0.00

Table 9: *Results of estimation of the following regression:*

$$CDS = Constant + \alpha_1 Rating + \alpha_2 .dummy + \alpha_3 .dummy{*}rating + \beta_1 . \text{ Interest} + \varepsilon$$

The Variable "Interest" is not significant when we use American free risk interest rate. However, it's clearly significant when we use French free risk interest rate. We can explain these results with the differences in the economic conditions of American and European countries. Also, the use of free risk interest rate as an explanatory variable increase the total adjusted R^2 (pass from 50% to 60%). Similarly, we find that the variable free risk interest rate is negatively correlated to the levels of credit default swap prices. Longstaff & Schwartz (1995) find a dependency between default probability (respectively credit spread) and free risk interest rates. Hui, Lo & Lee (2001) shows that the credit spread is a decreasing function of interest rates in the three-factor model. Saá-Requejo & Santa-clara (1999) present a model for pricing default risky claims under a variety of models for interest rates and dependence between default risks and interest rates. Using a sample restricted to non-callable bonds, Duffee (1998) find negative relationship between interest rates and changes in credit spreads. Similarly, Duffie & Singleton (1999) and Lando (1998) assume that the intensity of default, in reduced form models, is a stochastic process that derives its randomness from a set of variables such as the short term interest rate.

♦ Values in brackets represent the t-student.

The influence of the slope of the yield curve

The slope of the yield curve represents the estimation of investors on the future movement of interest rate. Similarly, it reflects the information on the future economic conditions. We introduce a new variable "Slope" of different maturities (10, 7 and 5 years) to test the possible relationship with the levels of credit default swap. We use the following regression

$$CDS = Constant + \alpha_1 Rating + \alpha_2 .dummy + \alpha_3 .dummy*rating + \beta_1 \text{Interest} + \beta_2 . \text{Slope} + \varepsilon \quad \textbf{(6)}$$

where

Slope: slope of the yield curve of different maturities

Results and the coefficients test are presented as follows:

Variables	Coefficients (regression 1)	Coefficients (regression 2)	Coefficients (regression 3)
Constant	0.070124 (7.06)	0.064177 (6.76)	0.058018 (6.59)
Rating	0.000661 (5.86)	0.000669 (6.01)	0.000668 (6.12)
dummy	-0.017756 (-2.74)	-0.017751 (-2.74)	-0.017840 (-2.74)
dummy*rating	0.002703 (3.11)	0.002700 (3.12)	0.002720 (3.13)
Free risk interest rate (FR)	-0.547783 (-3.68)	-0.541954 (-3.65)	-0.549839 (-3.63)
European Slope of the yield curve (10 years)	-0.788518 (-4.71)		
European Slope of the yield curve 7 years)		-0.687099 (-4.49)	
European Slope of the yield curve (5 years)			-0.580566 (-4.05)
	Adjusted R^2 : 0.66 White test: * Number of observations: 207 F-statistic : 65.96 Prob (F-statistic) : 0.00	Adjusted R^2 : 0.66 White test: * Number of observations: 207 F-statistic : 64.89 Prob (F-statistic) : 0.00	Adjusted R^2 : 0.65 White test: * Number of observations: 207 F-statistic : 63.32 Prob (F-statistic) : 0.00

Table 10: *Results of estimation of the following regression*

$$CDS = Constant + \alpha_1 Rating + \alpha_2 .dummy + \alpha_3 .dummy*rating + \beta_1 .\text{Interest} + \beta_2 . \text{Slope} + \varepsilon$$

We find significance negative relationship between credit default swap prices and different slope of the yield curve. Fama & Bliss (1987) find that long rates had useful information for predicting short rate movements. Fama & French (1989) find that credit spreads are larger when economic conditions are weak.

The influence of volatility of equities

All the explanatory variables used in our regression are not directly related to firm specific conditions. Even if the rating reflects the situation of a firm, it remains a static measure. However, stock prices reflect rapidly all new information. Structural form models for pricing risky debt show that higher asset and equity returns, lower than credit spread.

The capital asset pricing model (CAPM) defines an empirical measure of an asset's systematic risk: the coefficient β_i defining the excess returns on the firm and excess returns on the market: $E(R_{it} - r_t) = \beta_{it} E(R_{Mt} - r_t)$ where R_{it} is the return on asset I and R_{Mt} is the return on the market portfolio and r_t is free risk interest rate or zero beta portfolio. R_{Mt} is approximated by an index market. With normally distributed returns and independent expectation errors, we obtain the following regression $R_{it} - r_t = \beta_{it}(R_{Mt} - r_t) + \varepsilon_{it}$. β_i is estimated by $\hat{\beta}_i = \frac{\sigma_{im}}{\sigma_m^2}$. In this paper, systematic risk is estimated using daily returns on all stocks of firms subject to credit default swap transactions. Equity betas are common measure of systematic risk. We investigate the relationships between the systematic risk of equity returns and the levels of credit default swap. We use the following regressions:

Regression 1:

$$CDS= Constant+\alpha_1 Rating + \alpha_2 .dummy+\alpha_3 .dummy*rating+\beta_1 .Interest+ \beta_2 . Slope + \beta_3 .. \sigma_a + \varepsilon \quad (7)$$

where σ_a : annual standard deviation of equities returns.

Regression 1:

$$CDS= Constant+\alpha_1 Rating + \alpha_2 .dummy+\alpha_3 .dummy*rating+\beta_1 .Interest+ \beta_2 . Slope + \beta_3 . \sigma_s + \varepsilon \quad (8)$$

where σ_s : systematic risk.

Results are presented as follows:

Variables	Coefficients (regression1)	Coefficients (regression2)
Constant	0.070171 (7.04)	0.068218 (7.05)
Rating	0.000650 (5.64)	0.000597 (5.27)
Dummy	-0.017754 (-2.73)	-0.018551 (-2.87)
Dummy*rating	0.002702 (3.10)	0.002782 (3.21)
Free risk interest rate (FR)	-0.554264 (-3.74)	-0.554666 (-3.78)
European slope of the yield curve (10 years)	-0.786803 (-4.66)	-0.770324 (-4.74)
Standard deviation on return σ_a :	0.010320 (0.47)	
Systematic risk (σ_s)		0.058548 (0.31)
	Adjusted R^2: 0.66 White test: * Number of observations: 207 F-statistic : 58.76 Prob (F-statistic) : 0.00	Adjusted R^2: 0.66 White test: * Number of observations: 207 F-statistic : 58.76 Prob (F-statistic) : 0.00

Tableau 7 : Results of estimation of the previous regressions

Table 11: *Results of estimation of the following regression*

$$CDS= Constant+\alpha_1 Rating + \alpha_2 .dummy+\alpha_3 .dummy*rating+\beta_1 .Interest + \beta_2 . Slope+ \beta_3 \sigma_a(\sigma_s) + \varepsilon$$

We notice that coefficients of systematic risk and standard deviations of returns are not significant. According to Fama & French (1992) "beta as the sole variable explaining returns on stocks is dead". Their findings have sparked renewed interest in the beta parameter and its applications in modern portfolio theory. However, Kothari et al.(1995) and Clare et al.(1998) found that beta still has an important role to play. Our result is not consistent with many researches. We think that rating used in our regression reflect the majority of firm specific information. Collin-Dufresne et al (2001) examine the determinants of credit spread changes and find that factors loadings on aggregate variables are more significant than firm specific variable. However, Avramov et al (2004) analyses changes of credit spread and find that low grade bond are more sensitive to firm specific variables rather than investment grade bonds that are more sensitive to market variables. Campell & Taksler (2003) use regressions for levels of the corporate bond spread. They find that firm specific equity volatility is an important determinant of the corporate bond spread. Li (2003) find that Fama & French systematic risk factors are significant to explain changes in credit spread. Bedendo et al (2004) find that interest rate variables, equity market returns and idiosyncratic equity volatility are significant determinants of credit spread level and slope.

5. Conclusion

Using a regression technique, we find that most of the variables have a significant impact on fixing the levels of credit default swap prices. Credit rating is considered as the most significant and first indicator of the credit risk and the cost of borrowing. This result is justified because the rating agencies undertake many issues in the analyze including the financial position of the firm, firm specific issues such as the quality of management, the survey of the industry as whole and competition of the firm. Similarly, we find that macroeconomic variables have a significant effect for exploiting the determinants of credit default swap prices. For luck of information, we think that other firm specific ratio like profitability, leverage may be significant in exploring the determinants of credit default swap. An important issue in the corporate bond market is the liquidity of the bonds. We think that using several proxies for liquidity (see Chakravarty & Sarkar (1999)), such as the amount issued, will explain the influence of liquidity on the credit default swap prices. Intuitively, we can argue that credit derivatives (especially credit default swap) are a much better proxy for credit risk since the majority of fundamental variables predicted by credit risk pricing theories have a significant influence on credit default swap prices.

References

Avramov, D., Jostova, G. and A. Philipov (2004) "***Corporate credit risk changes: common factors and firm level fundamentals***", Working paper, University of Maryland.

Bedendo, M., Cathcart, L. and L. El-Jahel (2004) "***The shape of the term structure of credit spreads: An empirical investigation***", Unpublished Working Paper, Business School, London.

Black, F., M. Scholes. (1973), "***The Pricing of Options and Corporate Liabilities***", Journal of Political Economics, V 81, p. 637-659.

Black, F. et J. C. Cox. (1976) "***Valuing Corporate Securities: Some Effects of Bond Indenture Provisions***", Journal of Finance, V 31, p. 351-367.

Blanchet-Scailliet and M. jeanblanc. (2003), « ***Hazard rate for credit risk and hedging defaultable claims*** », Finance and stochastics.

Bielecki, T. R., Jeanblanc, M. and M. Rutkowski (2003) "***Pricing and hedging of credit risk : Replication and mean-variance approaches***", Contemporary Mathematics.

Campbell, J.T. and G.B. Taksler (2003), "***Equity volatility and corporate bond yields***", Journal of Finance, 58, p. 2321-2349.

Cetin, U., Jarrow, R., Protter, P., and Y. Yildrim (2002) "***Modelling credit risk with partial information***", Working paper, Cornell University.

Chakravarty, S., and A. Sarkar (1999), "***Liquidity in US Fixed Income Markets: A Comparison of the Bid-Ask Spread in Corporate, Government and Municipal Bond Markets***", Working Paper, Purdue University and Federal Reserve Bank New York.

Choudhry, M. (2004), "***I.B.6 Credit Derivatives***", The PRMIA Handbook.

Clare, A.D., Priestly, R. and Thomas, S.H. (1998), '***Reports of Beta's Death are Premature: Evidence from the U.K.***', *Journal of Banking and Finance*, 22, pp. 1207-1229.

Collin-Dufresne, P., Goldstein, R. S and J. S. Martin (2001) "***The determinants of credit spread changes***", Journal of Finance 56, 2177-2208.

Cossin, D. and H. Pirotte. (2001), "***Advanced credit risk analysis***", JOHN WILEY & SONS, LTD, Wiley Series in Financial Engineering.

Cossin, D., Hricko, T. (2002) "***Exploring for the determinants of credit risk in credit default swap transaction data***", working paper, University of Lausanne (Switzerland).

Das, S. (1995), "***Credit risk derivatives***", Journal of derivatives, Vol 2, pp. 7-23.

Das, S., and P. Tufano (1996) "***Pricing credit sensitive debt when interest rates, credit ratings and credit spreads are stochastic***", Journal of Financial Engineering, 5 (2), June.

Delianedis, G., and R. Geske (2001) "***The components of corporate credit spreads: Default, Recovery, Tax, Jumps, Liquidity and market factors***", working paper, UCLA.

Dionne, G., Gauthier, G., Hammami, K., Maurice, M. and J. G. Simonato (2004) "***Default risk in corporate yield spreads***", Working paper, HEC Montréal.

Duffee, G. (1998) "***The relation between treasury yields and corporate bond yield spreads***", The Journal of Finance, 53 (6), December, p. 2225-2242.

Duffie, D et K. Singleton. (1999) "***Modeling term structures of defaultable bonds***", Review of financial studies 12, 687-720.

Duffie, D., and D. Lando (2001) "***Term structure of credit spreads with incomplete accounting information***", Econometrica, 69, p. 633-664.

Elton, E.J., M.J. Gruber, D. Agrawal and C. Mann (2001) "***Explaining the rate spread on corporate bonds***", The Journal of Finance, Vol. LVI, N°1, p 247-277.

Ericsson, J. and O. Renault (2000) "Liquidity and credit risk", London School of Economics, Working paper.

Ericsson, J., K. Jacobs and R.A. Oviedo (2004), "**The determinants of credit default swap premia**", CIRANO, Montréal, 2004s-55.

Fama, E. F., and R. R. Bliss (1987), "***The information in long maturity forward rates***", American Economic Review, 77, p. 680-692.

Fama, E.F., French, K.R. (1989) "***Business conditions and expected returns on stocks and bonds***", Journal of Financial Economics 25, p. 23-49.

Fama, E.F., French, K.R. (1992), '***The Cross-section of Expected Stock Returns***', *Journal of Finance*, 47(2), pp. 427-465.

Finger, C. (1998) "***Credit derivatives in credit metrics***", JP Morgan, Credit Metrics® Monitor, Third quarter 1998, p. 13-27.
Gatfaoui, H. (2002) "***Risk disaggregation and credit risk valuation in a Merton framework***", Journal of risk Finance, Vol. 4, n°3, p. 27-42.
Giesecke, K. (2002), "***Credit risk modeling and valuation: An introduction***", working paper, Humboldt-Universität zu Berlin.
Giesecke, K. (2003) "***Default and information***", Working paper, Cornell university.
Huang, J., and W. Kong (2003) "***Explaining credit spread changes: new evidence from option-adjusted bond indexes***", The Journal of Derivatives, Fall 2003, P 30-44.
Hull, J and A white. (2000), "***Valuing credit default swap I: No counterparty default risk***", Journal of derivatives, p. 29-40.
Hull, J., M. Predescu and A. White (2004), "***The relationship between credit default swap spreads, bond yields and credit rating announcements***", Working Paper, University of Toronto.
Jarrow, R., and S. M. Turnbull (1995), "***Pricing Derivatives on Financial Securities Subject to Credit Risk***", Journal of Finance, V 50, p. 53-86.
Jarrow, R., and S. M. Turnbull (2000), "***The intersection of market and credit risk***", Journal of Banking and Finance, 24 (1-2), p.271-299.
Jarrow, R., Lando, D., S. M. Turnbull (1997), "***A Markov model for the term structure of credit risk spread*** ", Review of financial studies, V 10, pp. 481-523.
Jarrow, R and F. Yu (2001) "***Counterparty risk and the pricing of defaultable securities***", The Journal of Finance, Vol LVI, n°5, p 1765-1799.
Jeanblanc, M., M. Rutkowski (1999), "***Modelling of default risk: an overview*** ", Mathematical finance: theory and practice, Jiongmin Yong and Rama cont, eds.
Kamin, S and K. Von Kleist. (1999) "***The evolution and determinants of emerging market credit spreads in the 1990s***", BIS working paper, n°68.
Kothari, S.P., Shanken, J. and Sloan, R.G. (1995). '***Another Look at the Cross-section of Expected Stock Returns***', *Journal of Finance* , 50, pp. 185-224.
Lando, D. (1998) "***On Cox process and credit risky securities***", Review of Derivatives Research 2, 99-120.
Leland H. (1994), "***Corporate debt value, bond covenants, and optimal capital structure***", Journal of Finance, Vol. XIIX, No. 4, pp. 1213-1252.
Leland H. and K. Toft. (1996), "***Optimal capital structure, endogenous bankruptcy, and the term structure of credit spreads***", Journal of Finance, Vol. II, No. 3, pp. 987-1019.
Li, Y. (2003) "***Treasury yields, equity returns and credit spread dynamics***", Working paprer, University of Toronto.
Liu, S., H. Qi and Ch. Wu (2004) "***Taxes, default risk and corporate bond yield spreads: a structural approach***", Working paper, Syracuse University.
Longstaff, F. A., E. S. Schwartz. (1995 (a)), "A ***Simple Approach to Valuing Fixed and Floating Rate Debt***", *Journal of Finance*, V 50, p. 789-819.
Longstaff, F. A., E. S. Schwartz. (1995 (b)), "***Valuing credit derivatives***", Journal of Fixed Income, V 5, p. 6-12.
Longstaff, F. A., S. Mithal and E. Neis (2004), "***Corporate yield spreads: default risk or liquidity? New evidence from the credit default swap market***", Forthcoming Journal of Finance.
Madan, D. (2000), "***Pricing the risks of default***", working paper, University of Maryland.
Merton, R. C. (1974), "***On the Pricig of Corporate Debt: The Risk Structure of Interest Rates***" Journal of Finance, V 29, p. 449-470.
Merrill Lynch. (1998), "***Credit derivatives Hand Book***", Publication by Merrill Lynch, Pierce, Fenner & Smith Limited, UK.
Norden, L. and M. weber (2004), "***The comovement of credit default swap, bond and stock markets: an empirical analysis***", Center for Financial Studies, Working Paper, No. 2004/20.
Rutkowski, M. (2001), "***First passage time structural models with interest rate risk***", working paper.
Saá-Requejo, J. and P. Santa-clara (1999) "***Bond pricing with default risk***", working paper, University of California, Los Angeles.
Shimko, D., N. Tejima and D. Van-Denenter (1993) "***The pricing of risky debt when interest rates are stochastic***", The Journal of Fixed Income, September, p. 58-65.

Skora, R. K. (1998) "***Rational modelling of credit risk and credit derivatives***", working paper, Skora & company.
Vaillant, N. (2001) "***A Beginner's guide to credit derivatives***", Debt Market Exotics Nomura International, Working paper.
Zhou, CH. (1997), "***A jump diffusion approach to modeling credit risk and valuing defaultable securities***", Working paper, Federal Reserve Board, Washington.