ARBITRAGE AND CREDIT SPREADS: A MACROFINANCIAL APPROACH FOR THE USA IN THE 90s

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Interest for corporate credit spreads is relatively recent in continental Europe and notably in France, as compared to the Anglo-Saxon tradition. The importance of sovereign debt issues on capital markets in continental Europe and the importance of banks in financing the corporate sector, mainly explain this difference until the beginning of the 90s.

Since then, the securitisation of public and private financing as well as policies aimed at reducing national debts have involved the rise of a new category of bond issuers in continental Europe, i.e. corporate firms. A major consequence of this new trend is that the arbitrage on capital markets is no longer a binary one (government bonds against equities). With corporate bonds, private issuers have created a new segment on the market. But this segment is a hybrid one: a corporate bond is a debt as well as a risky asset.

Consequently, the problem arises as to the pricing of such an asset: as it is not a property right but it involves high capital risk. Nevertheless, this new corporate bond market could not compete, in terms of liquidity, with the government bonds market. On the one hand, there are large differences in the capital requirement between corporate and public issuers ; on the other hand, investment funds, the main actors on the market must comply with legal rules and constraints in terms of assets and liabilities management.

From an empirical point of view, the small size of the new European corporate bond market (in terms of capitalisation and trading) has already created difficulties in pricing these bonds. Consequently it is not surprising that most of the literature devoted to the gap between rates offered on corporate bonds and those offered on government bonds has mainly highlighted the most obvious explanatory factors: counterpart risk, liquidity default, greater volatility of corporate bond prices relatively to government bond prices.

Two explanatory approaches are traditionally opposed[1]: the structural one versus the reduced one. However, they have two common fundamental characteristics: they assume, firstly, that the spread should be mainly explained (a priori) by the existence of a default risk and, secondly, that the other factors only constitute a residual factor compared to this default spread in the explanation of the total spread. Literature based on these two approaches is plethoric and arrives at a tentative conclusion: the default spread explains only a minor part of the observed spreads on the market. Theoretical and econometric debate has led to an over-sophistication in the methods of data analysis: bond rates have been reprocessed to make it possible to compare private and government bonds with the same theoretical characteristics, be they artificially homogenous.

These microeconomic approaches try to decompose the observed spreads in explanatory permanent factors. Nevertheless, the relevance of these approaches may be in doubt since the factors considered as explanatory variables are probably more or less strongly correlated. The market behaviour suggests that default risk, liquidity risk and volatility risk are

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[1] About this distinction between the two approaches, see Lubochinsky (2002).

not independent. Actually, this market behaviour shows that operators arbitrate in the various segments of the financial market. This gives support to the macro-financial approach developed in this paper. Namely, its relevance proceeds from its ability to explicitly take into account the systematic risk affecting the entire market, contrary to the above mentioned micro-financial approaches.

Without further discussion on the identification of factors which are constituent with of the observed spreads, our approach aims to connect their behaviour to the global process of capital markets. This process is based on a logic of arbitrage, and is related to the activity cycle and the monetary control of the central Bank.

This paper is organised in three parts. The first part points out the contents and the limits of the micro-financial approach and justifies our macro-financial approach. The second part - according to a multifactor methodology - develops this macro-financial approach by analyzing the arbitrage between government bonds, corporate bonds and stock markets. The third part breaks down the corporate spreads into two components: a "quality arbitrage" component, differentiating between corporate bonds according to their respective ratings, and a "private-public arbitrage" component, which distinguishes the spread between best rated corporate bonds and government bonds. A simple econometric analysis verifies the explanatory factors for the two components of the so split spreads. This empirical analysis was applied to the US case during the 90s, due to the availability of the data and their greater reliability.

1. FROM A MICRO-FINANCIAL APPROACH TO A MACRO-FINANCIAL APPROACH OF CREDIT SPREADS: TWO COMPLEMENTARY LOGICS

The credit spread is usually defined as the difference between the yield on bonds issued by private borrowers (whatever their qualities) and the yield on bonds (assumed to be riskless) issued by public borrowers. It is a measure of the credit risk, as compared to a default risk including a partial or total failure of the counterpart. Consequently, the analysis of the credit spread is limited to a market pricing of the default risk of the issuer. Such pricing can be analysed according to two approaches: the first approach, known as "structural" and initiated by Merton (1974), is founded on the Black and Scholes (1973) option pricing methodology ; the second approach, known as "reduced", relies on the calculation of the a priori default and recovery rates.

According to the "structural" approach[2], the purchase of a debt can be considered as the sale of a put on the firm assets valued at a strike price equal to the facial value of the debt at maturity. In these conditions, one must have equality between the value of a riskless debt and the value of a risky debt, augmented by the value of the put. Thus, a risky bond shows a higher rate than a riskless one, the difference resulting from the pricing of the default risk by the market.

According to the "reduced" approach[3], the pricing of the default spread corresponds to the excess return required by a risk-neutral investor in order to cover the risk of loss, so that this premium ensures the equalization of the expected returns of a risky bond and a riskless bond. This pricing requires a measure of the issuers' default probabilities and of the associated recovery rates.

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[2] About the structural approach, refer to Kim, Ramaswamy and Schwartz (1993), Shimko, Ejima and Van Deventer (1993), Longstaff and Schwartz (1995), Leland (1994). For a simple and synthetic presentation of the method, see Tampéreau and Teiletche (2002).

[3] About the reduced approach, refer to Jarrow and Turnbull (1995), Madan and Unal (1998), Jarrow, Lando and Turnbull (1997), Duffee (1999) and Duffie and Singleton (1999).

In the structural approach as well as in its reduced form (explicitly for the first and implicitly for the second), traditional option valuation factors are introduced: firm assets value (estimated by their stock market capitalisation), volatility of the stock market, maturity of the option, and risk-free interest rate. So, explicitly or implicitly, the links between the markets are invoked, through the arbitrage between equities, corporate bonds and government bonds, and thus for various maturities.

Empirical evidences (aggregated or differentiated according to sectors, ratings or maturities) for both approaches show the same characteristics: the estimated default spread represents only a minor part (about 5 to 20% (Lubochinsky (2002 p.97))) of the observed credit spread. So, one has to explain this "residual spread"[4], that is the difference between the observed spread and the theoretically explained spread through the sole counterpart risk. Then the "residual" spread itself is split into various premiums. Alongside with explanatory institutional factors (in particular the tax discrimination between private and public sectors in the American case[5]), other factors characterise the market dynamics and its possible inefficiency: liquidity (intensity of the transactions)[6], discontinuous jumps (in quotation or rating)[7], price and return volatility, variation in interest rates[8] and other systematic risks[9].

Beyond the difficulties of measuring the respective influence of these various factors (in particular the reprocessing of return data[10]), the regressions do not make it possible to show an unambiguous convergence for the definition and measure of the spread components, for the impact of their explanatory variables and for the evolution of the premiums according to the rating[11] or maturity (term structure of the spreads[12]). Even the decomposition of the spreads is hazardous. If, from an empirical point of view, default and liquidity premiums appear a posteriori[13], it is very hard to try to discriminate a priori between them at the theoretical level[14] ; that would suppose that one can postulate an independence between "flight to quality" and "flight to liquidity".

The growth of corporate bond issues leads us to consider the building of credit spreads from a different point of view. The segment of corporate bonds reinforces the continuity of capital

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[4] On the importance of this "residual spread", see Delianedis and Geske (2001), or Elton, Gruber, Agrawal and Mann (2001).

[5] On the effect of the differentials of taxation on the spreads in the USA, see Elton, Gruber, Agrawal and Mann (2001) or Delianis and Geske (2001).

[6] On the liquidity premium, see Brown (2000), Houweling, Mentink and Vorst (2002), Gatfaoui (2002b).

[7] On "jumps" phenomena, see Delianis and Geske (2001).

[8] On the effect of the interest rates on the the corporate bond spreads, see for example Longstaff and Schwartz (1995) and Duffee (1998).

[9] On the systematic nature of components explaining the " residual spread ", see Delianis and Geske (2001). See also for an allowance for systematic risk, Dychev (1998), Pedrosa and Roll (1998), Wilson (1998), Jarrow, Lando and Yu (2001), Elton, Gruber, Agrawal and Mann (2001), Gatfaoui (2002b).

[10] For a discussion about the choice and the calculation of the rates of return necessary to the definition and measurement of the spreads (duration, zero coupons), see Lubochinsky (2002). For an illustration of these questions, refer to Elton, Gruber, Agrawal and Mann (2001).

[11] On the difficulties linked to the procedures of rating, on the relevance and the instability of ratings, see Perraudin and Taylor (1999), Nickell, Perraudin, Varotto (1999), Hamilton (2002).

[12] On the theoretical or empirical analysis of the spread term structure, contributions are numerous and are often contradictory as for the profile of this structure (increasing, decreasing, flat, bell), especially when it comes to its links with the quality of issuers (rating).

[13] For empirical analyses of the effect of liquidity on the government bonds in the US, see Amihud and Mendelson (1991), Daves and Ehrhardt (1993), Grinblatt (1995), Rappoport (1999), Fleming (2000). For the effect on the corporate bonds, see the above quoted articles relating to the liquidity premium .

[14] On the correlation between default premium and liquidity premium, see for example, Ericsson &. Renault (2000), Gatfaoui (2002b).

markets, through the link between government bonds and private equities. We will consider here the analysis of the spreads under the view of the allocation process by a ‘non risk-lover’ investor using the whole spectrum of available assets, arbitraging between more or less risky equities, corporate bonds (with different qualities) and government bonds.

It will be noted that beyond this arbitrage, the link between the pricing of equities and that of corporate bonds goes through the evolution of the capital structure of the firm. For example, a rise in the share value - given the amount of debt - is equivalent to an improvement of the capital structure of the firm: at the same time, it decreases the default risk on the debt and thus contributes to the reduction of the required return on this debt. Such a mechanism is implicitly present in the "structural" approach of the credit spreads.

The macro-financial approach developed hereafter analyzes the results of this overall arbitrage for US, using monthly data from 1990 to 2002. We use aggregated data in order to represent the ex-post results of the arbitrage by a representative investor (if not the arbitrage through the "invisible hand" of the market), when the investor would have been led to arbitrage between the US national debt and corporate bonds of various qualities. This explicit arbitrage between assets constituting the bond segment of the market is integrated in a broader arbitrage including equities, and this in accordance with the logical view of the structural approach: insofar as the investment in a corporate bond can be compared to the sale of a put option, the reference to the value and volatility of the subjacent asset is essential, here represented by the firm assets value as traditionally measured by its market capitalization.

Portfolio selection according to a logic of differentiation of risks and returns leads us to highlight the representative investor's choices in terms of two hierarchical decisional levels: at the first level, the arbitrage confronts the so-called risk-free assets (i.e. government bonds) with assets including a minimal risk (i.e. best rated corporate bonds), whereas at the second level the arbitrage connects all risky assets between them, from the less risky to the riskiest ones (i.e. from best rated corporate bonds, so-called “investment grade”, AAA quoted, to riskier bonds (i.e. from AA quoted to the so-called “speculative grade” and "high yield" bonds).

Taking into account the institutional constraints binding the representative investor in his portfolio selection, as well as risk aversion and "preferred habitat", the assumption of an arbitrage between expected return and risk according to this two-level allocation process should make it possible to account for the determinants which appear to be relevant for each of these levels.

2. MACRO-FINANCIAL ANALYSIS OF THE SPREADS

Arbitrage between the three segments of the capital market (government bonds, corporate bonds and equities) is complex since that these segments are exposed to different kinds of risk. Thus they are not sensitive to the same risk factors.
In a multifactor methodology (APT), the return on segment I is expressed as a function of Fj factors in the form:

$$R_i = \sum_j \alpha_{ij} F_j$$

where α_{ij} indicates the sensitivity of asset i to the factor of macro-financial risk F_j.

Four main risk factors can be distinguished:

- macroeconomic environment, common to all markets (E) ;
- investors' time horizon (H) ;

- expectations about activity and profits of the private sector (A) ;
- climate of uncertainty relative to the private sector (I).

The equations describing the yields of public bonds (R_P), corporate bonds (R_N) and equities (R_A) can be written as follows:

$$R_P = \alpha_{PE}E + \alpha_{PH}H$$

$$R_N = \alpha_{NE}E + \alpha_{NH}H + \alpha_{NA}A + \alpha_{NI}I$$

$$R_A = \alpha_{AE}E + \alpha_{AH}H + \alpha_{AA}A + \alpha_{AI}I$$

This general theoretical representation makes it possible to derive an equation describing the spread between private and government bond returns. The operational transcription of this formulation requires an identification of the proxies for some of these risk factors:

- as for the macroeconomic environment, we consider the real growth rate of the economy (g), that is to say: E = E(g);
- as for the climate of uncertainty surrounding the private sector, we consider the volatility (standard deviation) of the return of the stock market index (σ), that is to say: I = I(σ).

The effect of the two other risk factors can be taken into account by substituting the relationship derived from the arbitrages among the three segments of the market:

$$H = \frac{1}{\alpha_{PH}}\left(R_P - \alpha_{PE}E(g)\right)$$

$$A = \frac{1}{\alpha_{AA}}\left(R_A - \alpha_{AE}E(g) - \alpha_{AH}H(R_P, g) - \alpha_{AI}I(\sigma)\right)$$

When linearizing, we get the expression of the spread:

$$R_N - R_P = a_0 + a_1R_A + a_2\sigma + a_3R_P + a_4g$$

Among the four variables selected here, we find the three main variables identified by the structural approach and by the reduced approach to explain the behaviour of credit spreads: the return on equities, the volatility of this return and the risk-free interest rate (for the same maturity as that of the corporate bond, in other words of the same maturity as that of the implicit put option).

The effects of the first two variables are unambiguous from a theoretical, as well as from an empirical, point of view. For both (structural and reduced) approaches, a decrease in the return on equities or a rise in the volatility of this return involves an increase in the probability of default from the borrower, which must generate an increase in the return required by the lender and thus a widening of the spread. The empirical analysis confirms this negative effect of the return on equities on the spread, just like the positive effect of its volatility.

If we consider the influence of these variables in terms of revision of the default probability of borrowers, we must expect that the sensitivity of the spreads to the movements of these global indicators differs according to the quality of the borrower. In relation to a degradation of the macro-financial situation, inducing a decrease in the return, or in relation to a rise in volatility, the estimated default probability of the borrower will be all the more high since he is already viewed as doubtful ; thus, the required excess return will be consequently increased.

For borrowers of high quality, the evolution of the total stock market return will not affect their default probability, at least as long as the time horizon of investment makes it possible to consider this probability as almost nil. The influence of equities return on the spread for bonds issued by these highly rated borrowers will be very weak (if there is any influence at all).

But an additional volatility risk premium may appear in the arbitrage between government bonds and corporate bonds. With regards to the first bonds, the absence of default risk is an easily acceptable assumption in the case of governments of countries having reached a high level of economic and financial development. Such is not the case for the second bonds. Whatever the quality of the private issuers, their default probability may change but it always remains positive. Under these conditions, even if the variations of the equities return do not induce significant changes of the (very low) default probability for the best rated issuers, the volatility of the return means an uncertainty which affects expected probability. This uncertainty can explain the existence of a risk premium included in the return of corporate bonds as compared with that of government bonds.

With regard to the interest rate, its relation with the spread goes through a variety of channels. This explains the diversity of the theoretical arguments and the contradictory empirical results, according to which the interest rate effect can be either positive, or negative.

Thus, according to the structural approach and the analysis in terms of pricing of a put option, an increase in the interest rate should lead to an increase in the firm share value and to a reduction of the expected default rate, implying a narrowing of the spread. For some versions of the reduced form, on the contrary, a rise in the interest rate should increase the vulnerability of the indebted firms and therefore their expected default rate: this will cause a widening of the spread. For other versions of the reduced form, there should not be an interest rate effect on the spread: the premium would be simultaneously integrated in the rate of return of both corporate and government bonds.

But why should the effect of a variation of the interest rate be the same for corporate and government bonds? It is quite possible that the increase in the debt burden, consecutive to a rise in the interest rate, is still "sustainable" (the government may use a fiscal policy instrument for this purpose). In this case the rating of the public borrower might not be significantly downgraded, which is never the case for a private borrower. Moreover, in so far as an increase in the interest rate triggers a negative effect on the price of bonds and thus a positive effect on their required return, it will more than likely induce a substitution effect in favour of public assets (the so-called " flight to quality"). This substitution effect will restrict the fall in the price of public bonds as compared to the fall of the price of private bonds: eventually, this will lead to an increase in the credit spread.

If the most indebted companies, and thus the most vulnerable to a rise in the interest rate, are to be ranked among the low quality issuers, the positive effect of the interest rate on the spread is more likely to appear for issuers with a lower rating.

Apart from these variables, the evolution of the spreads also depends on expectations relating to the global economic context which can be summarised by the rate of variation of the real GDP, i.e. the pace of economic growth. Fluctuations of the macroeconomic activity during the business cycle are associated with variations in the profits of indebted firms ; such variations exert an effect upon the evolution of the default risk[15]. Thus, a worsening of the

[15] Such an approach is followed by CreditPortfolioView. Since the economic situation on the whole is determined by macroeconomic factors, CreditPortfolioView suggests a methodology linking these macroeconomic factors to the probabilities of default and transition (Wilson (1997, 1998)).

economic situation and of profit prospects should lead to a widening of the spreads: this widening is more significant when the issuer's rating is low.

Admittedly if expectations were perfectly rational, the behaviour of the stock market return would already account for growth expectations. For example, an expected worsening of activity prospects would lead to a decrease in the equities return and this decrease would fully capture the upward effect of this expected worsening on the spread. However, the rationality of expectations is not directly testable, so we are led to suppose that the recent past and present of the business cycle are used by the investor to generate (adaptable) expectations about the prospective profits and possible failures of firms. Thus, a deceleration in the economic growth should contribute, via these expectations, to a widening of the spread. Moreover, even if expectations were perfectly rational, this would not imply that corporate bonds and equities should exhibit the same sensitivity to economic growth.

On the whole, the direct effect of the business cycle on the credit spread should be added to the indirect effect (already highlighted) operating through the evolution of the equities return. Furthermore, a wealth effect can be identified. All other things being equal, an increase in the total wealth leads to an increase in the demand for assets, but this change in demand is not necessarily homothetic. For instance, if the rise in total income is accompanied by a reduction of the risk aversion, the demand for riskier assets will be higher and this will lead to a reduction in the credit spreads.

3. DECOMPOSITION OF THE CREDIT SPREADS: AN EMPIRICAL ANALYSIS

To explain the total monthly spreads observed in the United States over the 1990/2002 period, four explanatory variables have been identified: the stock market index return, the volatility of this return, the economic growth rate and the risk-free interest rate.

Our definition of the spread is the traditional one: the credit spread corresponds to the difference between the return of a corporate bond and the return of a Treasury bond with same maturity (assumed to be riskless).
We will note:

RNM: the yield (expressed as a percentage) of the corporate bonds with rating N and maturity M.
RPM: the yield (expressed as a percentage) of the government bonds with maturity M.
SNM: the credit spread (expressed as a percentage) for the corporate bonds with rating N and maturity M.

The expression of the spread can be written as:

$$SNM = RNM - RPM$$

We will now consider two maturities, an intermediate one (M = 5 years) and a long one (M = 20 years). In both cases, the analyzed returns are the redemption yields. Yields and ratings are taken from Lehman Brothers (data bases: Moody's and Standard and Poors). We consider 7 ratings for the 5 years maturity, that is to say AAA, AA, A, BAA, BB, B and CCC ; and 3 ratings for the 20 years maturity (AAA, AA and A). For each maturity, these ratings are significant from the point of view of risk-pricing, considering the volume of transactions. The returns on government bonds (RPM) are the returns of Treasury bonds for both 5 and 20 years.

The operational form of the four explanatory variables is as follows:

RA: monthly return (expressed as a percentage), over one year, of the US stock market price index (as calculated by Datastream),
σ: monthly standard deviation of the monthly return of the US stock market price index, over one year.
g: monthly growth rate of the real GDP over one year (estimated from quarterly GDP data, Datastream).
RPM: risk-free interest rates on Treasury bonds of maturity M = 5 or M = 20

Total Spreads SMN

1990/2002	Cste	RA	σ	g	RPM	R^2
SAAA5	0.183 (1.158)	-0.002 (-1.101)	0.067 (4.048)**	0.011 (0.670)	0.016 (0.791)	0.130
SAA5	0.401 (2.664)**	-0.005 (-3.108)**	0.100 (6.338)**	0.010 (0.652)	-0.011 (-0.547)	0.351
SA5	0.879 (5.416)**	-0.009 (-5.003)**	0.156 (9.112)**	-0.021 (-1.288)	-0.061 (-2.928)**	0.606
SBAA5	1.925 (8.260)**	-0.018 (-7.068)**	0.194 (7.919)**	-0.068 (-2.834)**	-0.117 (-3.939)**	0.668
SBB5	2.633 (4.490)**	-0.035 (-5.506)**	0.240 (3.968)**	-0.344 (-5.839)**	0.249 (3.262)**	0.535
SB5	5.154 (7.422)**	-0.052 (-6.972)**	0.433 (6.063)**	-0.457 (-6.549)**	0.163 (1.807)	0.649
SCCC5	8.732 (5.495)**	-0.108 (-6.375)**	1.571 (9.605)**	-1.149 (-7.200)**	0.218 (1.056)	0.717
SAAA20	0.703 (3.186)**	-0.007 (-4.028)**	0.114 (6.600)**	0.018 (1.053)	-0.080 (-3.221)**	0.484
SAA20	0.562 (2.259)*	-0.004 (-2.113)*	0.180 (9.254)**	0.016 (0.845)	-0.063 (-2.259)*	0.522
SA20	1.133 (4.538)**	-0.008 (-4.174)**	0.176 (8.987)**	-0.013 (-0.679)	-0.089 (-3.174)**	0.595

Between brackets: the t-statistics for the coefficients

The effects of the return and the volatility of the stock market are consistent with our theoretical analysis. The signs are the expected ones and the hierarchy of the coefficients according to rating and maturity is in accordance with the expectations: Sensitivities of spreads to the return and volatility of equities increase when the rating is lower. Besides, the instability of the relationships between spreads, growth and risk-free rate must be noticed. Moreover, their significance is not always validated.

The total spread includes two hierarchical kinds of arbitrage: an arbitrage between riskless assets and the best rated corporate bonds and an arbitrage between risky assets of various qualities. Thus, the credit spread for the corporate bonds with rating N and maturity M can be reformulated as:

$$SNM = RNM - RPM = (RNM - RAAAM) + (RAAAM - RPM)$$

The first term (RNM - RAAAM) corresponds to a differential related to the rating: excess return between a corporate bond and the best rated bond with the same maturity M. We note with S1NM this spread is exclusively the function of the differences between ratings and which represents the "quality"arbitrage.

The second term (RAAAM - RPM) is also equal to the spread SAAAM, the credit spread of corporate bonds with AAA rating. It is the difference between the return of AAA corporate bonds and that of government bonds and should measure, at least for the shortest maturities, a preference for government bonds apart from traditional considerations about risk. This term, which will be noted S2NM, measures “corporate-government” or "private-public" arbitrage: it reveals preferences for government bonds and for high liquidity.

Then, we decompose the spread as follows: SNM = S1NM + S2NM
with S1NM = RNM - RAAAM
S2NM = RAAAM - RPM = SAAAM

Relations between the spread S and the components S1 and S2 for 5 years maturity

SNM	**Cste**		**S2NM**		**R^2**
SAA5	0.142	(6.921)**	0.990	(30.394)**	0.848
SA5	0.303	(6.467)**	1.150	(15.514)**	0.593
SBAA5	0.711	(8.174)**	1.497	(10.866)**	0.417
SBB5	2.109	(10.495)**	2.918	(8.929)**	0.347
SB5	3.705	(13.637)**	4.091	(9.259)**	0.364
SCCC5	6.888	(9.241)**	8.466	(6.983)**	0.245

The significance of the relation between the credit spread for 5 years maturity and its second component (premium for government bonds) is decreasing when the rating is lower. The reason - as the following table shows - is that the weight of the first component increases when the rating is lower.

SNM	**Cste**		**S1NM**		**R^2**
SAA5	0.561	(16.163)**	0.941	(5.056)**	0.134
SA5	0.491	(12.701)**	1.161	(14.555)**	0.562
SBAA5	0.408	(8.828)**	1.147	(28.140)**	0.828
SBB5	0.231	(4.075)**	1.097	(66.137)**	0.967
SB5	0.109	(1.690)	1.080	(94.900)**	0.984
SCCC5	0.242	(4.592)**	1.027	(233.998)**	0.997

It should be noted that the two components S1NM and S2NM are weakly correlated. From an empirical point of view, this justifies the relevance of our methodological decomposition of the total spread.

S1NM	Cste		S2NM		R^2
S1AA5	0.142	(6.921)**	-0.010	(-0.319)	0.001
S1A5	0.303	(6.467)**	0.150	(2.022)*	0.024
S1BAA5	0.711	(8.174)**	0.497	(3.609)**	0.073
S1BB5	2.109	(10.495)**	1.918	(5.869)**	0.187
S1B5	3.705	(13.637)**	3.091	(6.996)**	0.246
S1CCC5	6.888	(9.241)**	7.466	(6.158)**	0.202

For 20 years maturity, the second component (preference for government bonds) not only remains significant but its effect does not decrease when the rating is lower.

SNM	Cste		S2NM		R^2
SAA20	0.189	(9.277)**	1.086	(36.299)**	0.888
SA20	0.383	(17.871)**	1.187	(37.743)**	0.896

On the other hand, as for 5 years maturity, the total spread behaves as its intra-term component ("quality" arbitrage) when the rating is lower.

SNM	Cste		S1NM		R^2
SAA20	0.439	(8.171)**	1.549	(8.069)**	0.282
SA20	0.110	(1.350)	1.939	(12.272)**	0.476

Again the correlation between the two components of the total spread looks very weak.

S1NM	Cste		S2NM		R^2
S1AA20	0.189	(9.277)**	0.086	(2.860)**	0.047
S1A20	0.383	(17.871)**	0.187	(5.942)**	0.175

Explanatory Analysis of " private-public " arbitrage
(2nd component S2NM = RAAAM - RPM = SAAAM)

1990/2002	Cste	RA	σ	RPM	R^2
S2AAA5	0.279 (4.646)		0.071 (4.652)**		0.124
S2AAA20	0.852 (4.492)*	-0.006 (-4.193)**	0.110 (6.488)**	-0.093 (-4.042)**	0.495

For a relatively short time horizon (5 years) the explanatory power of the relationship is weak. This result is hardly surprising for a variable which measures the arbitrage between similar assets in terms of default risk. The spread may be explained by discriminating taxation

(positive constant term)[16] and by different degrees of liquidity on the markets for these assets (positive effect of volatility). In this respect, one must consider that, all other things being equal, the degree of volatility of a market implicitly depends on its degree of liquidity/illiquidity. Consequently, an increase in volatility on the stock market reveals an increase in the total risk on private assets, including corporate bonds. This may induce a "flight to quality " in favour of government bonds, which is equivalent to a decrease in liquidity and a widening of the spreads.

In the long run, the risk of a downgrading for the best rated issuers becomes highly significant[17] and has to be priced. The evolution of the spread can then react to the relevant variables explaining the arbitrage between risky and risk-free assets. Thus the estimates show a negative effect of the equities return and a positive effect of its volatility. As for the effect of the risk-free rate with the same maturity, it appears to be negative: this confirms an interpretation in terms of pricing the firm as is the case in the structural analysis.

Explanatory Analysis of "quality" arbitrage
(1st component S1NM = RNM - RAAAM)

1990/2002	Cste	RA	σ	g	R^2
S1AA5	0.041 (1.517)	-0.004 (-7.000)**	0.037 (6.809)**	0.003 (0.594)	0.513
S1A5	0.184 (3.996)**	-0.009 (-9.398)**	0.099 (10.773)**	-0.021 (-2.357)*	0.722
SBAA5	0.851 (9.881)**	-0.019 (-10.991)**	0.145 (8.433)**	-0.059 (-3.531)**	0.728
S1BB5	3.993 (15.243)**	-0.028 (-5.186)**	0.141 (2.694)**	-0.387 (-7.621)**	0.552
S1B5	5.947 (19.630)**	-0.047 (-7.592)**	0.346 (5.733)**	-0.488 (-8.307)**	0.692
S1CCC5	9.889 (12.830)**	-0.102 (-6.527)**	1.476 (9.612)**	-1.188 (-7.943)**	0.727
S1AA20	-0.003 (-0.074)	0.003 (4.169)**	0.062 (9.094)**	-0.005 (-0.826)	0.362
S1A20	0.354 (10.173)**	-0.001 (-1.760)	0.064 (9.199)**	-0.028 (-4.185)**	0.522

For 5 years maturity, the results confirm the analytical intuitions concerning the decomposition of the total spread. The signs of the coefficients for the stock market return, its volatility and the real growth rate of the economy are the expected ones and confirm the theoretical and empirical previous work. The "quality spread" is negatively related to the equities return - and positively to its volatility - and negatively to economic growth. Moreover the evolution of the estimated coefficients, when the rating is lower, is coherent with an increasing importance of these three factors. The sensitivity of the "quality spread" to the risk

[16] Some authors (Elton and alii (2001)) highlight the major role of tax discrimination in the explanation of the "private-public" spreads in the United States, during the same decade.
[17] The transition matrices, as calculated by Moody's, show that for firms initially AAA rated, the default risk is 18 times higher on a 20 years horizon than on a 5 years horizon (Moody's (2002)).

factors is even higher since the quality of the assets is low: this reveals a "flight to quality" process.

For the 20 years maturity, the results are less decisive. This is due to the difficulties in appreciating the quality differences between the best rated assets for a long-term time horizon. We know that, in the long run, the probabilities of downgrading or upgrading are high (for example, only 20% of AAA bonds keep the same rating over 20 years (Moody's (2001)).

CONCLUDING REMARKS

This paper has put forward a macro-financial approach for credit spreads, as a complement to the traditional micro-financial approach. This macro-financial approach is grounded on an arbitrage process between all segments of the financial market (equities, corporate bonds and government bonds). According to a multifactor methodology, the return on one or other of these segments is related to four main risk factors: macroeconomic environment, common to all the markets ; investors' time horizon ; expectations for activity and profits of the private sector ; uncertainty relative to the private sector. The spread is explained by four variables: equities return, volatility of this return, real growth rate, risk-free interest rate.

The empirical analysis confirms the relevance of a decomposition of the spread according to two terms. The first, is the difference between the return of the best rated corporate bonds and the return of government bonds. This spread measures a premium related to the preference for public bonds. The second, is the difference between the returns of corporate bonds with different ratings. It represents a “quality arbitrage " between private issuers.

Such a decomposition is validated by the empirical results. Each component finds its own explanation. On the one hand, when the default risk is a priori very low (5 years time horizon for the best rating), the "private-public" arbitrage does not appear to be dominated by the risk factors, except for those factors which are measured by the volatility of the stock market return. On the other hand, all the risk factors play a significant influence as soon as the default risk rises. This is particularly the case for the "private-public" arbitrage for a longer time horizon (20 years) and especially for that of the "quality" arbitrage. Thus, for 5 years maturity, the component of the spread corresponding to such an arbitrage depends negatively on the stock market return (and positively on its volatility) and negatively on the growth rate. Finally, as expected, the riskier an asset is (i.e. the lower its rating is), the more the quality component of the spread is sensitive to the risk factors.

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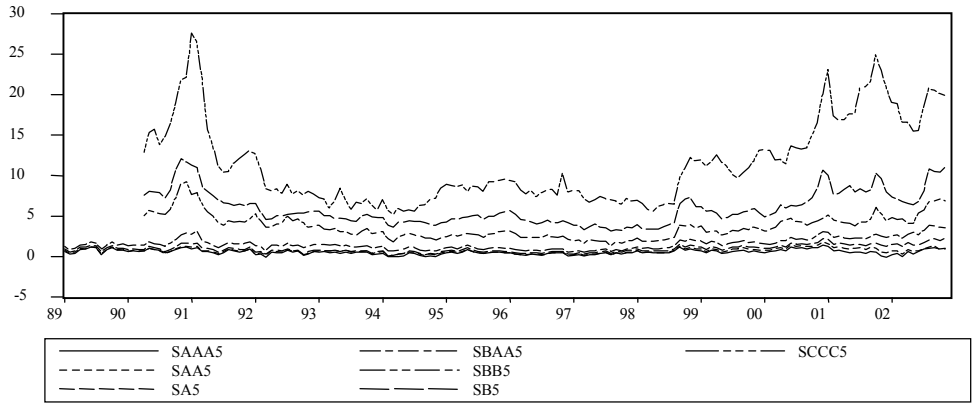
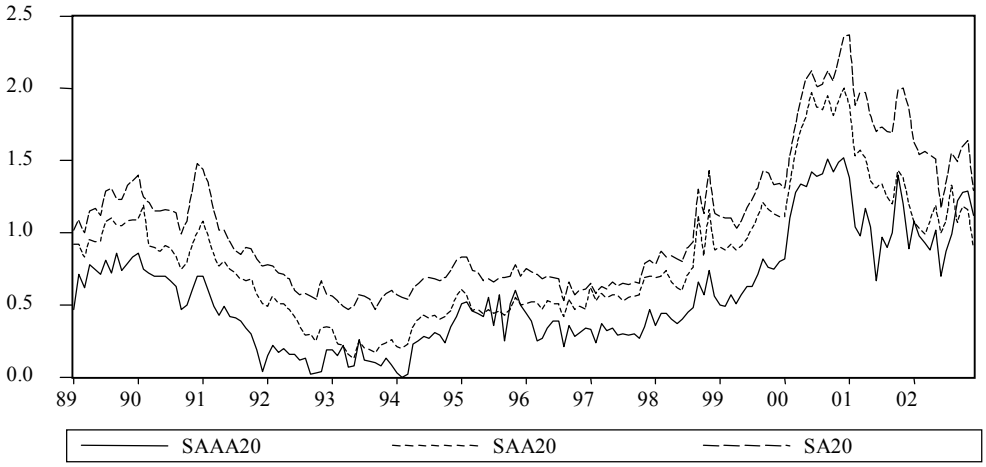
APPENDIX: STATISTICAL PROPERTIES OF THE SPREADS



1990/2002	**SAAA5**	**SAA5**	**SA5**	**SBAA5**	**SBB5**	**SB5**	**SCC5**
Moyenne	0.535921	0.677829	0.933553	1.554605	3.672171	5.897105	11.42546
Ecart type	0.302334	0.331872	0.471095	0.735052	1.497351	2.051034	5.167714

The structure according to the rating is increasing: the spread is wider when the rating is lower. If the average spread is increasing, so is its volatility (standard deviation of the spread).
The same mechanism is found for the 20 years maturity. When the rating is lower, the average spread and volatility increase.



1990/2002	**SAAA20**	**SAA20**	**SA20**
Moyenne	0.569226	0.806845	1.058274
Ecart type	0.374941	0.431886	0.470211

For the term structure of the spreads, the conclusions are less obvious. For a same rating, the term structure is increasing, but only on average.

1990/2002	**SAAA5**	**SAAA20**	**SAA5**	**SAA20**	**SA5**	**SA20**
Moyenne	0.552994	0.565928	0.689461	0.806228	0.938443	1.056886
Ecart type	0.305152	0.373617	0.327839	0.433111	0.455563	0.471280

On the other hand, this term structure for a same rating can be modified over time. Thus, for the AAA, at the beginning of the period, the 5 years spread exceeds the 20 year spread (decreasing term structure), then the structure becomes increasing as the spread up to 20 years is superior. The same behaviour can be observed for the lower ratings (AA and A). This confirms the ambiguity of the theories and explains the empirical controversies concerning the term structure of the spreads.