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The Basel Committee approach to risk - weights and external ratings: what do we learn from bond spreads?

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THE BASEL COMMITTEE APPROACH TO RISK-WEIGHTS AND EXTERNAL RATINGS: WHAT DO WE LEARN FROM BOND SPREADS?

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Abstract

The Basel Committee for Banking Supervision designed a system of risk weights (the so called "standardised approach") to measure the riskiness of banks' loan portfolios. Its ability to adequately reflect risk is empirically investigated in this paper, through an analysis of the economic capital allocations implied in corporate bond spreads. This is based on a unique dataset of issuance spreads, ratings and other relevant bond variables (such as maturity, face value, time of issuance and currency of denomination) including 7,232 eurobonds issued mostly by Canadian, European, Japanese and U.S. companies during 1991-2003. Three main results emerge. First, the spread/rating relationship is strongly significant with spreads increasing when ratings worsen. Second, the estimated spreads per rating class indicate that the risk/rating relationship might be steeper than the one approved by the Basel Committee. Finally the difference between the spread/rating relation of banks and non-financial firms appears quite blurred and statistically questionable. Following this empirical evidence, we underline some adjustments in the standardised approach risk-weights that might be considered for the future versions of the Basel Accord.

JEL classification: G15, G21, G28.
Keywords: eurobonds, credit ratings, spreads, capital regulation, banks.

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1. **Introduction**[1]

In June 2004, the Basel Committee for Banking Supervision released its reform of the capital adequacy framework originally introduced with the 1988 Accord. This reform is based on three mutually reinforcing pillars: (i) minimum capital requirements, (ii) supervisory review process, and (iii) market discipline[2]. As far as the first pillar is concerned, the new Accord is based on minimum capital requirements for credit, market and operational risks. Credit risk capital requirements, in turn, would be set according to a standardised approach or an internal ratings-based approach (IRB). In the standardised approach[3] the 1988 risk weights based on some broad borrower categories (sovereign, banks or non-financial corporations) are to be refined by reference to a rating provided by an external credit assessment institution, such as a rating agency. Column 2 of Table 1 reports the new risk weights for corporate loans (banks would be assigned a more favorable set of weights).

The risk weights approved in 2004 are slightly different from those originally proposed by the Basel Committee in 1999 (also reported in Table 1); those were criticized by Altman and Saunders (2001) because of the broad degree of granularity (only three buckets for rated corporate loans were envisaged). Using data on historical corporate bond defaults and losses per rating class to simulate expected and unexpected losses, those Authors showed that the three weights of 20% (AAA to AA-), 100% (A+ to B-) and 150% (below B-) were too broad to reflect the relative risk of unexpected losses in each bucket. Based on their empirical

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[1] This paper has been presented at a European Central Bank workshop with the Chairman and Secretaries of the Working Group on Banking Developments: we are grateful to Andreas Ittner and to other seminar participants for their useful comments. We also wish to thank Paolo Angelini, Dario Focarelli, Antonella Foglia, Fabio Fornari, Fabio Panetta, Alberto Pozzolo, Carmelo Salleo, Corrado Baldinelli and other participants to a Bank of Italy seminar for their helpful remarks. Finally, we are grateful to Mark Carey and Reint Gropp for their precious comments on an earlier draft of the paper.

[2] For an analysis of the relationship between capital requirements and market discipline, se Berger, Herring and Szego (1995).

[3] Under the IRB approach banks would be allowed to use their own estimates of a borrower's probability of default produced by an internal rating system, conditional on specific criteria and on validation by national supervisors. The IRB approach also confers varying degrees of independence to banks in setting the parameters determining risk weights: the 'foundation' approach entails less independence than the 'advanced' one. Under both the standardised and the IRB approaches the original 8% minimum capital to risk-weighted assets is maintained.

findings, Altman and Saunders (2000) recommended a revised risk-weighting scheme that included splitting the A+ to B- bucket into two separate buckets (A+ to BBB- and BB+ to), reflecting the distinction between investment and non-investment grade borrowers (see column 3 of Table 1)[4].

Following this and other comments, the final weighting structure approved by the Basel Committee in 2004 split the second bucket into three: A+ to A-, with a 50% risk weight, BBB+ to BB-(100%), and below BB- (150%, see column 2 of Table 1).

In this paper, we further investigate the appropriateness of this choice. Rather than historical loss rates per rating class, corporate bond spreads[5] are used to estimate the risk/rating relationship. More precisely, eurobond issuance spreads are used to estimate the implied economic capital allocations of different rating buckets. This empirical analysis is based on two separate exercises. First, "typical" credit spreads per rating class are estimated through a multivariate regression based on a sample of 7,232 eurobond issues completed by major corporations from some 90 developed countries between 1991 and 2003. Second, the estimated credit spreads are used to capture the amount of risk capital associated with different rating grades. This is done by estimating the amount of capital that is consistent with empirical spreads and a risk-adjusted loan pricing formula (like those used by most internationally-active banks with a credit value-at-risk – i.e., CreditVaR – model in place).

The use of a wide sample of Eurobond issues has two main advantages. First, contrary to historical losses, bond spreads are forward looking and reflect the actual risk associated to different rating classes, as perceived by the investors. Second, while default and loss rates provided by rating agencies mostly come from US dollar-denominated bonds issued by US firms in their domestic capital market, eurobonds are denominated in different currencies and internationally issued by companies from different countries. They therefore look as a more adequate empirical background for evaluating a regulation aimed at banks competing internationally on global markets.

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[4] Note that Altman and Saunders themselves mention that their revised risk-buckets underestimate risk for grades BB, B and below B-.

[5] By "spread" we mean the difference between a corporate eurobond's yield to maturity and that of a Treasury security with similar maturity, denominated in the same currency.

This study uses issuance spreads rather than secondary market ones: this, in turn, has two advantages. First, yields on new issues reflect actual transaction prices rather than brokers' "indicative prices", i.e., estimates derived from pricing matrices or dealers' quotes[6]. As such, they provide a more accurate measure of the actual risk premium demanded by investors. Second, primary market spreads represent a better measure of the actual cost of debt faced by bond issuers.

Using data from an eleven-year period (1991-2001) that includes at least one full economic and credit cycle allows us to get reliable estimates of the spread/rating relationship that are not biased by any particular state of the economy.

Three main results emerge from our empirical analysis. First, the spread/rating relation is strongly significant, with spreads increasing when ratings worsen. Second, the estimated spreads per rating bucket indicate that the risk/rating relationship might be steeper than the one proposed by the Basel Committee. Finally, while eurobonds issued by banks have a better average rating than those issued by non-financial companies, the difference between the spread/rating relation of banks and non-financial firms appears quite blurred and statistically questionable. This indicates that the distinction between banks and non-financial firms proposed in the Accord should be further investigated.

Following these empirical findings, three main areas of improvement emerge for the standardised approach. First, the distinction between banks and non-financial companies might be reconsidered, as far as the risk-weights already depend on ratings. Second, five rating buckets could be considered rather than the four (as proposed by the Basel Committee). Third, any future revision in the risk weights might be adjusted to reflect a steeper relationship between risk and rating.

This paper proceeds as follows. Section 2 presents the model and variables used in our empirical analysis. Section 3 describes the data sources and summarizes sample characteristics. Section 4 presents the empirical results. Section 5 elaborates on the

[6] Secondary market prices can even be misleading if dealers quote strategically. Assume a dealer does not want to buy a specific bond. She would quote a higher price which would in turn signal high demand and a lower spread. For more on the problems related to secondary market prices and spreads, see Hancock and Kwast (2001).

implications of our results for the system of risk weights proposed in the New Basel Capital Accord. Section 6 concludes.

2. Model and variables

The empirical analysis presented in this study is restricted to eurobond issues[7]; eurobonds were chosen for our empirical analysis mainly for three reasons. First, they are issued in relatively large amounts in a highly competitive market open to different kinds of investors (mostly institutional ones) from different countries. This enhances liquidity and minimizes the risk of price anomalies.

Second, the eurobond market is relatively unregulated: issues are not subject to queuing or other costly procedures, listing only occurs for a minority of the issued amount in order to meet institutional investors' needs, investors are not subject to withholding tax, and bonds are mostly in bearer form. These factors significantly enhance the possibility to compare different bonds' spreads.

Finally, eurobonds are denominated in different currencies and issued by companies from different countries. This makes them a more adequate database for evaluating the effectiveness and fairness of the internationally-adopted Basel weights.

Recent empirical studies indicate that several characteristics of corporate bonds, beyond rating categories, convey information about their pricing (Elton et al., 2000). These include maturity, coupon, time from issuance, trading volumes and face value. Our empirical

[7] "Eurobonds are purchased from the issuer by syndicates of investment banks that are formed on a case-by-case basis. The lead bank (the arranger) draws up the agreement and collects a management fee, which is shared with other syndicate members. The members purchase the issue according to a formula agreed upon in the syndication agreement. The participation fees are usually allocated in similar proportions. The lead bank negotiates conditions with the borrower. It prepares a "term-sheet" or "information memorandum" about the issue that is circulated to potential syndicate participants. It also prepares, with the customer, the necessary bond issue documentation. Once the information regarding the issue is finalized, the distribution agreement is drawn up" (Melnik and Nissim, 2003). See also Levich (2001) for further details and a general overview of the eurobond market.

analysis is largely consistent with these results, as it is based on cross-sectional regressions where maturity, coupon and face value all appear as independent variables[8].

The dependent variable of our regressions, “spread”, is the “nearest-on-the-run” spread (that is, the difference between the yield to maturity at issuance of each individual Eurobond and the yield to maturity of the Treasury bond denominated in the same currency and with the nearest maturity)[9]. The use of secondary market spreads is avoided because of the relatively poor liquidity of the secondary market for some minor eurobond issues. Using primary market spreads also permits the use of “fresher” ratings because new issues are rated near the time of issuance.

Issuance spreads reflect the issuer’s credit risk and the market conditions. As such, they are a function of eight main factors[10]: (1) the bond’s default and recovery risk, (2) the time to maturity of the issue, as this affects its default risk premium (Merton, 1974), (3) the issue amount, as this in turn is believed to affect secondary market liquidity, (4) the expected tax treatment to which investors will be subject, (5) the currency of denomination[11], (6) the efficiency of the bond’s primary market, (7) the bond market conditions at the time of the issue, and (8) the macroeconomic conditions of the country of the issuer.

The variables used to represent these eight factors are briefly outlined below.

(1) Default and Recovery Risk - Our empirical analysis is based on the use of Moody’s and Standard and Poor’s *issue* ratings as proxies of the bonds’ default and recovery risk:

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[8] Note that, since time from issuance equals zero for all corporate bonds in our sample, only trading volumes are missing, since they are not available when issuance spreads are used.

[9] Note that this spread is computed directly by our data provider (Dealogic Capital Data Bondware), and this makes it impossible for us to explore alternative ways to compute the spreads (such as spreads based on the Treasury’s constant-maturity series) and their effects for our empirical results.

[10] Despite the cross-sectional nature of the empirical analysis, some temporal variation is present as many companies issued eurobonds more than once over the sample period. Regressions with the inclusion of fixed effects are also estimated.

[11] The latter is a relevant factor because of the different credit standing and liquidity of Treasury securities. The spread of a eurobond issue is computed as the difference between the bond yield to maturity and the equivalent Treasury one. A U.S. dollar denominated eurobond issue could, other things being equal, have a higher spread than an Italian lira denominated one simply because the Italian Treasury security has a lower credit quality and liquidity than the U.S. one.

ISSBUC_01…ISSBUC_5 Rating dummies. Each dummy variable is equal to 1 if the average Moody's and Standard and Poor's (S&P) rating[12] falls into the corresponding "rating bucket" (see Table 2 for rating scales) and zero otherwise[13]. These dummy variables should capture the difference in both issuers' creditworthiness and bonds' seniority and security structures[14]. The rating buckets are the same as defined in the Basel Committee's standardized approach, except that an extra bucket was defined for BBB-rated debt, to avoid mixing investment-grade and junk exposures.

In addition to that, the following variables are used:

SUBO A dummy variable that equals 1 if the issue is subordinated, zero if it is senior. The expected coefficient sign is positive, as subordinated issues have a lower expected recovery rate in case of default than senior bonds and therefore require a higher return. However, its statistical significance could be poor as subordination is already reflected in the rating[15].

BANK A dummy variable that equals 1 if the issuer is a bank and zero otherwise. This variable should control for differences between banks and non-financial firms that motivated the use of two separate sets of weights in the Basel proposal. Such differences

[12] These are ratings assigned by one or both rating agencies to the single issue at the time of issuance. As such, they reflect both the issuing company's creditworthiness and the bond seniority and security structure.

[13] When the ratings assigned by S&P and Moody's differ, we proceed as follows: first, ratings are converted into a numerical value based on the scale shown in Table 2; second, the average value of the S&P and Moody's value is computed, rounding to the lower (less risky) value; third, the rating bucket is chosen based on this average value. An alternative based on the lower integer value has been tested and found to produce similar results.

[14] Since our analysis aims at assessing the appropriateness of the risk weights proposed by Basel Committee, which are in turn based on ratings, the latter represent the measure of credit quality on which we have to focus. However, ratings have been shown to present relevant limitations as leading indicators of credit quality. Using equity and liability data for US firms, Delianedis and Geske (1999), construct alternative credit risk measures and compare their forecasting performance to that of ratings. They find these accounting based measures to increase well in advance of rating downgrades and conclude that ratings are slow in reacting to new evidence. Comparing actual market values and ratings for a large number of dollar-denominated international bonds, Perraudin and Taylor (1999) report highly persistent inconsistencies between ratings and prices (a bond's price is defined as inconsistent with its rating if it is above/below the price it would have if it were valued using yields corresponding to a higher/lower rating category). However, these empirical studies are based on spread changes and tend to focus on the limitations of ratings as leading indicators of credit quality. Since our attention is focused on the cross-sectional variability of issuance spreads, these limitations should be much less relevant.

[15] Rating agencies tend to rate subordinated issues one notch below senior debt if the latter is investment grade and two notches below if it is speculative grade.

might be due, e.g., to the presence of implicit government guarantees, such as the too-big-to fail effect, that are not already incorporated into the issue rating.

AUT, BIS, BANK, CHE, COM, CON, ELE, ENG, FEB, FIN, GOV, HEA, HOT, IND, INS, MAN, MED, OIL, OTI, RET, TEL, TRA, UTI[16] – Industry dummies equal to 1 if the eurobond issuer's main activity is in the corresponding industry, 0 if not. These variables should capture investors' expectations concerning specific industries evolving economic conditions that are not already implicitly reflected in the average rating of those industries. A positive coefficient would indicate that investors' perception concerning the industry's prospects are worst than the ones implicit in the corresponding issues ratings, and viceversa.

(2) Maturity

MATU The time to maturity (in years) of the issue[17].

(3) Secondary Market Liquidity

AMOUNT The natural log of the bond issue US dollar equivalent amount (face value). A higher issue amount is generally believed to improve, ceteris paribus, secondary market liquidity. A negative coefficient is therefore expected for this variable[18].

(4) Tax Treatment

The following two variables are used to proxy for the different expected tax treatment of different eurobond issues:

COUPON The level of the annual coupon paid by the bond. The effect of this variable on the bond spread depends on the relative tax rates on capital gains and interest

[16] These represent: Automobile, Building Societies, Banks, Chemicals, Computers, Constructions, Electronics and Electrics, Food and beverages, Financial companies (excluding banks, insurers and building societies) and holding companies, Government-controlled concerns, Health and pharmaceuticals, Hotels and Leisure, Industrials, Insurance, Manufacturing, Media & Publishing, Oil and mines, Other Industries, Engineering, Retail, Telecommunications, Transportation, Energy and Utilities. The Other Industries (OTI) variable includes industries for which less than 20 observations were available.

[17] To avoid biases due to a couple of very long-term issues in our sample, all maturity above 20 years were truncated at that threshold.

[18] Another variable that is generally believed to affect a bond's market liquidity is its age. This measure rests on the belief that newly issued bonds are more liquid than bonds that have been in the market for a longer period of time (Elton et al, 2000). However, our sample bonds are all newly issued as the empirical analysis is based on issuance spreads.

income. In some countries these two rates are different; however, given the wide range of nationalities of eurobond investors, the a priori effect of COUPON on the bond after tax value is uncertain. In addition to that, as most eurobonds are in bearer form, avoiding tax is relatively easy for investors. Nevertheless, since in most countries capital gains are paid at the time of sale, bonds with lower coupons may be more valuable because some taxes are postponed until the time of sale and because the investor decides when these taxes are paid (tax timing option). A positive coefficient is therefore expected.

REG A dummy variable that equals 1 if the bond is a registered one and zero if it is in bearer form. A positive coefficient is expected as eurobond investors would find it easier to avoid tax payments in the case of bearer bonds[19].

(5) Primary Market Efficiency

The following four variables are used to proxy for the different primary market efficiency of different eurobond issues:

MANAGERS The number of financial institutions participating in the bond issuance management group (book runners, lead manager, any co-lead manager, and co-managers). A negative coefficient is expected as this would indicate that a larger syndicate is able to achieve, ceteris paribus, a larger number of potential investors. This would in turn result in a higher demand for the issuing bonds and in a lower spread[20].

PRIVATE A dummy variable that equals 1 if the bond issue is a private placement and zero if it is public[21]. Other things equal, private placements represent a less efficient issuance process as a smaller number of potential investors is directly reached. A negative coefficient is expected as investment banks are generally able to exploit a stronger placing/selling power in a private placement than in a public issue.

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[19] Only 22.98% of the sample eurobond issues (1,662 over 7,232) are registered (see Table 4).

[20] Note that an increase in costs associated to a larger number of syndicate members would already be captured by the FEES variable. Quite surprisingly, these two variables are not significantly correlated: their Pearson correlation coefficient is indeed low (0.306) and statistically not significant. Moreover, MANAGERS is not significantly correlated with AMOUNT: indeed, the correlation coefficient is negative (-0.114), indicating that larger issues are not associated with a higher number of managers.

[21] Only 120 of the 7,232 eurobonds in our sample were issued through a private placement (see Table 4).

FEES The amount of gross fees charged by the bond issuance syndicate to the issuer. These include underwriting fees, management fees and selling concession[22]. No clear theoretical *a priori* conclusion can be reached on the expected sign of this variable. A negative sign would indicate that issuers can translate the higher fees to the final investors through a lower spread. A positive one would suggest that issuers who are less appealing for the investors (resulting in a higher spread), also imply higher bookrunning costs, reflected into higher fees.

FIXED A dummy variable that equals 1 if the eurobond issue is a fixed-priced one and zero if it is an open-priced one. While in a fixed-priced issue the investment banks of the underwriting group set the issuing price according to their estimates of the demand for the bonds, in an open-priced one the final investors play a role in determining the actual price. As the investment banks participating in the management group take a higher underwriting risk with fixed-priced issues than with open-priced ones, a more efficient primary market is achieved in this kind of issues. This should in turn results in a lower spread. A negative coefficient is therefore expected.

(6) Currency

DEM, DFL, EURO, FFR, STG, USD, CAN, OTHERCUR – Currency dummies, with OTHERCUR grouping all currencies individually accounting for less than 2% of the total issues. Each dummy variable is equal to 1 if the issue is denominated in the corresponding currency and zero otherwise. These variables should capture both the different credit standing and liquidity of the national Treasury securities and eurobonds investors' currency preferences[23].

(7) Bond market conditions at time of issuance

[22] The selling concession is a fee paid by the issuer to the members of the selling group in the form of a discount on the price of the bonds.

[23] The OTHERCU dummy was dropped to avoid perfect collinearity

QI-91, QII-91, QIII-91, QIV-91, QI-92, …, QIV-01 – Quarterly dummies. Each dummy variable is equal to 1 if issue *i* has been completed during the corresponding quarter and zero otherwise[24].

BBB_SP – Spread over the risk-free rate earned by dollar-denominated, BBB-rated corporate bonds in the quarter when each eurobond in our sample was issued. This spread captures the variations in bond market conditions when the bonds were issued, in a more parsimonious way than quarterly dummies.

(8) Country

CAN, FRA, GER, JPN, NET, UK, USA, OTHERCOU[25] – Country dummies[26], with OTHERCOU grouping all countries individually accounting for less than 3% of the total issues. These should capture cross-country differences in macroeconomic conditions and regulatory frameworks[27].

3. Data Sources and Sample Characteristics

Our data come from two main sources: Capital Data BondWare and Moody's Corporate Default[28]. Capital Data reports information on the major debt and equity issues worldwide. As far as eurobonds are concerned, it provides information on both issuers (nationality, industry, etc.) and issues (Moody's and Standard and Poor's rating, currency, closing date, years to maturity, spread at issuance, issue type, face value, coupon, subordination, gross fees, number of managers, cross-default and other clauses). Moody's Corporate Default Database is a complete history of Moody's long-term rating assignments for both U.S. and non-U.S. corporations and sovereigns. Both ratings on individual bonds

[24] The QI-91 dummy variable has been dropped to avoid perfect collinearity

[25] The OTHERCOU dummy variable has been dropped to avoid perfect collinearity.

[26] Eurobond issues are often carried out by wholly owned subsidiaries located in fiscal havens such as the Cayman Islands or the Bahamas. In such cases, the parent company's country (as indicated by Capital Data BondWare and/or Moody's Corporate Default) was used.

[27] National regulations (mainly: differences in bankruptcy laws, see e.g. Appendix G in Gupton et al., 1997) might have an impact on Eurobond spreads through differences in expected recovery rates in the event of default.

[28] Moreover, risk-free rates on 10-year T-bonds, used to create the RF_10Y variable, are taken from Datastream.

and issuer ratings are included, as are some bond and obligor characteristics such as borrower names, locations, ultimate parent companies, bond issuance dates, original maturity dates, seniority, and coupon.

All bonds with special features (e.g. callable bonds, perpetual bonds, floating rate bonds) that would affect their price have not been included in our empirical sample. Spreads at issuance for all issues of fixed rate, non-convertible, non-perpetual and non-callable eurobonds during the 1991-2003 period were collected. This amounts to 7,232 bonds (see Tables 3 and 4). Bonds issued by companies of Less Developed Countries (LDC) or minor countries (such as Chile, Bulgaria, Malta and Mexico) and issued by central banks, supranational institutions, central or local governments were not considered.

This sample suffers from two potential selection biases. First, a relatively larger number of issues has been completed during the second half of the sample period. This is partly due to a general increase in the average number of eurobond issues, and partly the consequence of the availability of Moody's and Standard and Poor's ratings. This potential bias has been addressed by running separate analyses of the two sub-periods in our sample (see section 4.2).

Second, as companies tend to issue eurobonds when the market is more receptive, the number of issues is particularly low in the third and fourth quarter of 1998, when the Russian crisis occurred, and particularly high during 1999, during a low interest rate environment. However, this potential bias should have a limited impact on a sample period covering thirteen years.

Moody's and Standard and Poor's (S&P) ratings at issuance for these 7,232 issues are either from Capital Data BondWare or from the January, 2001 release of Moody's Corporate Default Database. Both Moody's and S&P ratings are available for 2,700 eurobond issues which represent 37.3% of the entire sample issues. For the remaining 4,572 issues (62.7% of the sample) only one of the two ratings is available. When both ratings are available, the corresponding numerical value is the same in 65.3% of the cases (1,763 issues), is different by one notch only in 26.2% of the cases (708 issues) and by two notches in 6.2% of the cases (167 issues)[29].

More information on sample characteristics is provided in Tables 5 and 6. As shown by Table 5, most of the sample issues have been completed by US, German, UK, French and Japanese companies. Together, they account for more than two thirds of the issues and almost three quarters of the total amounts. The average spread is significantly higher than the sample average for UK, Canadian and US issuers.

Table 6 reports the main features of the sample by rating category. Most of the issues fall into the first six notches (from AAA to A in the S&P scale and from Aaa to A2 in the Moody's' one). However, the remaining grades account for more than 1,800 bonds (that is, more than 25% of the total sample), with more than 500 speculative-grade issues. Therefore, we feel confident that the conclusions reached by our analyses still are reliable also for below-A borrowers. Average spreads per rating category increase almost monotonically with rating values, although classes below CCC+/Caa1, for which a limited number of issues is available, do not show any clear pattern. Note that banks are mostly concentrated in the top four rating classes (from AAA/Aaa to A+/A1).

Sample issues were also broken down by year of issuance, currency of denomination and industry of the issuer (results not reported to save room). As concerns time, the total amount issued per year has grown from 43 billion USD in 1991 to more than USD 430 billion in 2003, with the average issue growing from just over 200 million USD to more than 500 million USD. The average spread has significantly fluctuated over time, reaching a peak of 126 basis points in 2000, while the average rating has significantly worsened, from 2.7 (equivalent to AA+/AA in the S&P scale) in 1991 to 5.6 in 2003 (approximately equivalent

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[29] A difference of more than two notches is present in only 62 of the 2,700 issues for which both ratings are available (2.3% of the issues). We checked for these differences for the banks' issuers subsample too, in order to test whether a higher degree of uncertainty is present. Results appear similar to those of the entire sample. Indeed, of the total 3,698 bank issues, both ratings were available for 1,562 only. When both ratings are available, the corresponding numerical value is the same in 72.3% of the cases (1,129 issues), is different by one notch in 21.7% of the cases (339 issues), and is different by two notches in just 4.8% of the cases (75 issues).

to A).[30] As far as the currency of denomination is concerned, three currencies (Euro, British pound sterling and U.S. dollar) account for 64% of the issues and 80% of the amounts. Finally, the industry distribution of the sample issuers shows that more than half of the issues have been completed by banks (51%), while only two other industries (Telecommunications and Energy/Utilities) individually account for more than 5%. Significant differences emerge among industries' average spreads. These differences basically reflect differences in the industries' average ratings.

4. Empirical results

4.1 Regression analysis

Table 7 reports various estimates of our model coefficients and (White's heteroskedasticity-consistent) standard errors. Adjusted R^2s are shown at the bottom of the table, together with F-statistics.

Column (1) shows our basic regression: an adjusted R^2 of 0.84 indicates that ratings and other control variables explain a significant portion of the spreads' cross-sectional variability.

All rating dummies are statistically significant at the 1% level (the first bucket is omitted to avoid perfect collinearity, and can be thought to have a zero coefficient); the monotonic pattern of the coefficients indicates that spreads rise when ratings worsen. Not only are the dummy coefficients different from zero: what is more, the values assigned to adjacent rating buckets are always statistically different *from each other* at the 1% level, as shown by a set of Wald tests[31].

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[30] Note that such averages were computed based on the numeric scale reported in Table 2, where the distance between two adjacent grades is supposed to be constant (that is, the difference between AAA and AA+ is supposed to be equivalent to that between a BBB- and BB+). This does not apply to our regression results, where each rating class is represented by means of a separate dummy.

[31] F-tests are: 281.6 (ISSBUC02 versus ISSBUC03), 227.6 (ISSBUC03 versus ISSBUC04), 142.8 (ISSBUC04 versus ISSBUC05).

MATU and FEES both have significant coefficients with the expected signs[32]. SUBO also has a positive (although statistically weaker) effect, indicating that investors require a higher risk premium on subordinated bonds than the one implicit in the agency ratings. Quite surprisingly, AMOUNT is not statistically significant. This result is consistent with previous empirical evidence[33] and could be attributed to two main factors: (i) the liquidity of the eurobonds' secondary market is not affected by the size of the issues, (ii) eurobond investors tend to hold these securities to maturity and are therefore indifferent to their secondary market liquidity.

COUPON and REG have a positive, significant coefficient as expected[34], indicating that investors require a higher return on higher-coupon and/or registered issues due to their relatively worst tax treatment[35]. On the other hand, PRIVATE and FIXED do not appear statistically meaningful,

The BANK dummy lacks statistical significance. This means that, while eurobonds issued by banks do have a better average rating than those issued by non-financial companies, no significant difference emerges in the spread/rating relationship between banks and non-financial firms. This might have policy implications for the future work of the Basel Committee (namely, for any update in the "standardized" approach, in which banks presently

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[32] Fons (1994) shows that, although spreads increase with maturity for investment-grade bonds, the opposite is true for speculative issues. Hence, we tried to use estimate the effect of the "maturity" variable separately for junk bonds, by means of a multiplicative dummy. However, although a difference emerges between the two slopes, none of them is negative. This could be explained by the fact that Fons' regressions are univariate models, where maturity fails to be significant for most rating classes and the R-square never reaches 10%; our regressions, instead, use maturity as just one of the many drivers of bond spreads. In addition to that, our models are based on primary market spreads as a dependent variable, while Fons draws on secondary market data.

[33] Analyzing yield differences between corporate bonds and medium-term notes (MTNs), Crabbe and Turner (1995) find no relationship between size and yields of MTNs that have the same issuance date, the same maturity and the same issuer. Furthermore, they find that bonds and MTNs have statistically equivalent yields. This contrasts with the idea that large issues have larger liquidity and suggests that large and small securities issued by the same borrower are close substitutes.

[34] This empirical result is consistent with Elton et al. (2000).

[35] Based on the suggestion of an anonymous Referee, we also tested an alternative specification of our model including a set of multiplicative dummies representing the interaction between COUPON and the country dummies; by doing so, the impact of the COUPON variable was estimated separately for each country. Although most of the new dummies proved significant, they did not significantly affect the overall explanatory power of the model and the coefficients associated with all other non-country variables remain basically unchanged.

enjoy a more favorable weighting scheme), and we shall return to this result in our final remarks.

All reported currency dummies have significant positive coefficients, indicating that those currencies command higher spreads than the remaining ones. This result flows from the higher credit standing and liquidity of their Treasury issues[36], because spreads are computed by subtracting such Treasury yields from eurobond yields.

Country dummies also look significant: their joint F-statistic (not reported in the Table) is 22.68, with a p-value of less than 1%. This could be explained by national macroeconomic conditions, as well as by national bankruptcy codes affecting investors' expectations on recovery rates in the event of default.

[36] French or German governments Treasuries are used to compute Euro denominated bond spreads, according to which of the two closest government bonds has the closer maturity to the one of the eurobond issue.

Finally, the joint F-statistic for quarterly dummies[37] (63.8) is highly significant, suggesting that market conditions do affect Eurobond spreads. However, while quarter dummies help us achieve a better fit of *the past behavior* of the eurobond market, they become useless for simulation purposes. In other words, when one wants to use the model in Table 7 to infer what spreads the market would expect from differently-rated bonds, it is impossible to specify a value for the dummies associated with *future quarters*.

To address this issue, we scrutinized our set of quarterly dummies more carefully, and found out that they were strongly correlated (63.8%) with the average level of BBB-rated, US dollar-denominated corporate bond spreads[38]. We therefore substituted all quarterly dummies with just one variable, BBB_SP, expressing the value of the corporate bond spread in the week when each eurobond issue in our sample was completed. This makes our model (see column 2 in Table 7) much more parsimonious and transparent (it can now be used also to run simulations, provided that a value the average BBB-spread is specified), while reducing the adjusted R-square only slightly. BBB_SP has a positive coefficient, implying that each individual issue in our sample is directly affected by the overall “market mood” embedded in the BBB corporate bond spread.

The results for this alternative specification (Table 7, column 2) are very similar to our base model (note that the SUBO dummy, which used to be only 10%-significant, now looks even weaker). The model was further refined in column (3), where all variables that were not statistically significant were sequentially removed (and the regression’s R-square remained unchanged). This “reduced” model will be used as a basis for the simulations reported in § 5 of this paper.

4.2 Robustness checks

Starting from the complete model based on BBB- spreads (column 2), several robustness checks were carried out.

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[37] To save room, the individual values of the quarter dummies were not reported in Table 7. However, an F-statistic for their joint significance is reported in the bottom part of the Table.

[38] Spreads were computed as the difference between the seasoned BBB (Baa) corporate bond yields published by Moody’s and the 5-year Treasury constant-maturity rate released by the Board of Governors of the Federal Reserve System.

Separate sub-periods - Separate regressions were run for bonds issued between 1991 and 1998 (3,524 observations) and bonds issued between 1999 and 2003 (3,708 observations)[39], to test for any temporal evolution in the relevant factors. Results are reported in columns (4a) and (4b). The adjusted R^2 increased from 0.81 in the first sub-period to 0.86 in the second one, indicating that the independent variables improved their explanatory power over the Nineties.

Several differences emerge, between the two sub-samples, as far as the control variables are concerned: first, while FIXED and MANAGERS are not significant in the second period, they both have a significantly negative coefficient in the 1991-1998 sub-sample. Second, while MATU is not significant in the second period, it has a positive sign in the first one. Finally, the effect of AMOUNT switches from negative to (slightly) positive when moving forward in time; this might be explained through a supply-side effect (as the market grew tighter in the early 2000s, larger issues became harder to place and had to pay a relatively higher spread).

Note that, however, all rating dummies are statistically significant and the spread/rating statistical relationship, which is the focus of our analysis, remains strictly monotonic for the two sub-samples.

Banks vs. corporates - The second check regards the relevance of the issuer type ("BANK") dummy. This simple dummy variable may not adequately reflect the gap between financial institutions and other firms if investors evaluate these two types of issuers differently. Therefore, two additional checks were performed: first, the dummy coefficients associated with the various rating buckets were estimated separately for banks and non-banks, to see whether a different steepness of the spread/rating relationship (rather than a difference in the average level) is found; second, separate regressions were run for eurobonds issued by banks and for those issued by non-financial firms. Results are reported in columns (5) and (6) of Table 7.

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[39] Separating recession years from expansion ones is difficult because issuers from different countries have different economic cycles. A simpler separation criterion, based on the number of issues, has therefore been adopted.

As concerns column 5 (same model, different rating-bucket dummies), only some of the bank dummies are significantly different from their non-bank counterparts[40]; what is more, the difference between bank and non-bank spreads does not behave monotonically as rating buckets worsen: while banks seem to enjoy lower funding costs, compared to non-banks, on issues below BB, they appear to face comparatively higher spreads on bonds rated BBB or BB.

As concerns column 6 (different models), all rating dummies are statistically significant, explain a high portion of the spread and have monotonically increasing coefficients for both sub-samples[41].

These results suggest that no clear, monotonic difference emerges between the rating/spread relationship of banks and non-bank firms. A common scale of risk-weights per rating bucket should therefore be adopted for both banks and non-financial firms, while a separate treatment could be reasonable only for unrated exposures (as in the 1988 Accord).

Moody's vs. S&P's - Separate regressions using Moody's' ratings only (3,714 observations) and S&P's ratings only (6,218 observations) were estimated, to check for biases due to use of "average" ratings (using the average value of ratings coming from two different sources could produce misleading results if the agencies adopt significantly different criteria). Results are reported in columns (7) of Table 7: rating dummies are

[40] Pairwise t-tests between bank and non-bank dummies for the same bucket have shown that the null hypothesis that the two be identical cannot be rejected without an error margin (p-value) of 48.3% for bucket 2, 0.3% for bucket 3, 0% for buckets 4 and 5; moreover, the hypothesis that the two intercepts for banks and non-banks (which represent the case of borrowers belonging to bucket 1) are identical cannot be rejected without a 76.6% error.

[41] Some differences exist between the two sub-samples when looking at the control variables. While AMOUNT and FEES appear statistically significant for the non-bank subsample, they seemingly have no impact on bank spreads; the opposite is true for PRIVATE and MATU. Finally, SUBO is strongly significant, with a positive coefficient, only for banks. As mentioned before, rating agencies tend to downgrade subordinated issues by one notch: seemingly, investors view this practice as fair (given the expected recovery rates) only for corporate bonds: as concerns banks, subscribers are relatively more pessimistic than rating agencies. This result can be explained in two alternative ways. First, investors find it more difficult to evaluate the expected recovery rate in the case of bank-issued subordinated bonds because of a lower degree of disclosure and of the financial nature of most banks' assets: the higher degree of uncertainty gets then translated into a higher required risk premium. Second, given the interest rate sensitivity of most banks' assets, it is more likely for banks than for non-financial firms that the same systematic factors determining insolvency also cause a decrease in the recovery rate. In such a case, the banks' default probability would be negatively correlated with the recovery, leading to an increase in expected losses. This adverse phenomenon would obviously be particularly exacerbated for subordinated bonds.

statistically significant (with the expected sign) for both sub-samples and (as shown by the adjusted R^2 and by the "F-rating" test), in both cases explain a significant portion of the spreads' cross-sectional variability. Besides, the spread/rating statistical relationship is very similar for the two scales. The main difference between the two subsamples concerns SUBO, which is significant for Moody's only[42].

Issuer versus issue ratings - In an attempt to keep our sample as wide as possible, we based our analysis on issue ratings (which are more easily found for our data source); however, issuer ratings also play an important role within the Basel II standard approach. Accordingly, for the available data (which are less than 50% of the original sample) our basic model was estimated again using a set of buckets based on issuer rating. The results (not reported to save space) show that the spread-rating relationship remains strong and monotonic; the SUBO dummy becomes statistically significant, and has a positive coefficient; this represents an expected finding because facilities' characteristics, such as subordination, are not embedded into issuer ratings.

National models A robustness check of the model in column (2) has been performed by running separate regressions for each G5 country. The results, not reported to save space, showed that the spread/rating relationship is similar (and always statistically significant) for bonds issued by corporations of different countries. In addition to that, most rating dummy coefficients show a monotonic pattern, indicating that spreads increase when ratings worsen.

Industry dummies – The BANK dummy had to be dropped from the models in columns (1) and (2) because of its lack of statistical significance. However, one might object that it would turn out to be relevant when considered *inside a whole set of industry dummies* (covering all non-bank sectors on a one-by-one basis, instead of melting them into one undiversified pool). This was done by including into model (2) a set of 23 dummy variables, dropping the constant term to avoid perfect collinearity. The results (not reported) were the following: 1) 7 out of the 23 industry dummies turn out to be significant at the 5% level; among these, 6 (Financial and holding companies, Government-controlled concerns, Insurance, Telecommunications, Transportation and Energy/Utilities) individually represent

[42] Note that, to assess the effect of split ratings on our results, we also repeated our regression analysis after

more than 1% of the sample; 2) a joint LM test for the whole set of dummies leads to a F-statistic of 11.8, with a p-value close to zero; 3) however, the coefficients and statistical significance of the non-industry regressors remain approximately unchanged, as well as the regression's corrected R-square (79.6%); 4) moreover, the coefficient associated with the banking sector's dummy (7.07) continues not to be statistically different from zero at the 5% significance level.

We conclude that although some industries (such as insurance and telecoms) show a difference in the spread requested by the market (all other variables being equal), this is not the case for banks; therefore, the investors' assessment of a bank's riskiness seems to be fully captured by their comparatively better ratings, even when a whole set of industry dummies is considered[43].

Granularity of the rating scale –Throughout our estimates, we used only five dummy variables to summarize the rating spectrum shown by Table 2; this helped us make our results more robust and more consistent with the Basel Accord, where individual rating classes are grouped into larger "buckets". However, one might wonder whether our estimates would be affected by an increase in the "granularity" of the rating scale used: we therefore substituted our set of "compact" rating bucket-dummies with 21 rating dummies, describing all individual grades reported in Table 2.

The results of model (2) did not show any significant change[44]: most control variables remained virtually unchanged, in terms of coefficients and statistical significance. The coefficients associated with the more "granular" rating dummies were also statistically significant and generally increasing: however, a decrease in the value of the dummy variable took place for the 18th, 19th and 20th grade (corresponding to CCC, CCC- and CC) where our sample tends to be scarcely populated (about 5 observations for each grade); this – together with the fact that the R-square increases only marginally, from 79% to 81.4% - seems to indicate that our choice of working with a compact set of rating buckets was correct.

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removing all split ratings (937 observations). The results (not reported) looked basically unchanged.

[43] Including industry dummies into model (1) leads to similar results.

[44] To save room, the results are not reported in the paper, although they are available from the authors upon request.

Spread/rating relationship under tight market conditions – Market conditions are accounted for in our model in a very simple way, by means the BBB_SP variable which represents the spread between BBB bond yields on the secondary market and those on 5-year Treasury bonds; the effect of such a variable is assumed to be the same for all rating buckets. However, one would expect that tight market conditions exert different effects on different rating classes, implying that the spread/rating relationship becomes steeper when market conditions are more strained. To check this, for each rating bucket we defined a new dummy variable which takes a value of one if BBB_SP is above its long-term average of 2.6%. In this enhanced model (not reported to save room), such dummies are statistically significant, but their coefficients are not monotonically increasing when moving towards worse rating buckets; we therefore preferred to stick to our basic model.

5. Implications for the adequacy of the Basel Committee's proposed risk weights

5.1 Simulated spreads

Once the credit spreads required by the eurobond market have been decomposed into their main drivers, we can use our reduced model (Table 7, column 2) to simulate the spreads paid by a "standard" eurobond. This "simulated" bond has the following characteristics:

- it is issued by a group of ten managers (including co-managers, book-runners etc.) for a gross fee of 100 basis points (these values are close to the sample averages shown in Table 3), is denominated in US dollars[45] and pays a 6% coupon rate;
- it has a 8-year maturity, and is issued at a time when BBB-rated bonds pay a risk-premium of 2.6% over T-bonds (again, this mimics our sample averages; note, however that sensitivity analyses will be performed on this second array of parameters);
- like most issues in our sample, it is publicly issued and unregistered.

[45] As the coefficients of the two currency dummies (Table 7) suggest, euro-denominated bonds would lead to very similar results.

Table 8 shows the simulated spreads required on different "rating buckets". The standard eurobond described above is compared to some alternative cases, considering:

- shorter (5 years) and longer (10 years) maturities;
- a change in the currency in which the bond is denominated (euro vs. US dollar);
- different scenarios for the spread paid by BBB-rated bonds (ranging from 1.8% to 3.4%[46]).
- As can bee seen, spreads tend to remain mostly unchanged regardless of the working hypotheses used in our simulations. While maturity and currency exert a limited effect, changes in BBB-spreads induce a parallel shift in all values.

5.2 Capital requirements

In modern credit-risk literature[47], the optimal level of capital associated with the marginal acquisition of a loan or bond is a function of the maximum potential loss (at a given confidence level) that the investor could suffer over some specified time horizon (typically, one year).

Several approaches have been proposed, in the last years, to quantify such an optimal capital cushion, often referred to as "credit-VaR" (Value at Risk); one might recall, e.g., Gupton et al. (1997), Credit Suisse Financial Products (1997), Wilson (1997a, b)[48]. The correlation[49] among obligors operating in different geographic areas or industries plays a key role in such models, and has been estimated based on the common dependence on a number of "macroeconomic factors", or simply inferred from past history (Carey, 1998; Altman-Saunders, 2001) through a simulation/resampling approach. A simple credit-VaR model was also used by the Basel Committee to calibrate the risk weights in the "IRB-based approach

[46] This ranges amounts approximately to twice the variable's standard deviation.

[47] See e.g. Allen and Saunders (2002), Crouhy et al. (2000).

[48] See Gordy (2000), Allen and Saunders (2002) for a comparative analysis of such models.

[49] This could be default correlation (as in binomial, default-mode models like Credit Suisse Financial Products, 1997), as well as asset return correlation (leading to a joint distribution of credit rating migrations) as in Gupton et al., 1997.

[50]"; however, since the Accord aims at generating a portfolio-invariant capital requirement, the correlation structure implied by such a model is quite simple and general[51].

Based on credit VaR models financial institutions set the share (say, k) of their investments that has to be funded with equity capital. This choice also has implications for pricing: indeed, the spread required on a risky loan/bond can be seen as a function of the amount of capital associated to it[52].

More specifically, the spread s_i on a loan/bond to the i-th borrower is set in such a way that the expected proceedings from the loan (allowing for its expected losses) cover all expected financial costs (including the cost of the portion k that has to be funded with capital, thereby incurring an extra cost of s_k).

For a one-year loan, this amounts to imposing that

(1) $$(1+r_f+s_i)(1-p_{1i})+R\cdot p_{1i}=(1+r_f)(1-k)+(1+r_f+s_k)k$$

where: r_f is the risk-free rate, p_{1i} is the probability that the i-th borrower will default within one year, R is the recovery rate on defaulted exposures[53], k is the loan's implied capital ratio, s_k is the risk-premium the lender/investor has to pay on its shareholders' capital. Equation (1) simply states that the spread charged to a borrower depends on the risk-free interest rate (a proxy for the bank's cost of funds), the borrower's probability of default, the loan's expected recovery rate, the amount of economic capital allocated to the loan, and the excess return s_k required by the bank's shareholders on economic capital.

Note that, however, investors also incur screening and monitoring costs on risky exposures; such costs must be added to the financial costs (r_f) indicated in the right-hand side of (1). Let then C be the total cost ($r_f + c$, where c is the unit screening/monitoring cost). Equation (1) becomes:

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[50] Gordy (2003), Finger (2001).

[51] Pairwise correlations between borrowers depend on their size and credit rating, not on industries or geographic areas.

[52] See Ong (1999) and Saunders (1999).

[53] This is the nominal amount the bank will be able to recover for each dollar originally lent. We impose that the recovery takes place at the end of the year, so we need not multiply R by a capitalization factor.

(2) $$(1+r_f+s_i)(1-p_{1i})+R\cdot p_{1i}=(1+C)(1-k)+(1+C+s_k)k$$

Equations (1) and (2) postulate a risk-averse investor, requiring that the expected return on the risky investment (left-hand side) is not simply equal to r_f+c, but also includes a premium over the risk-free rate. Generally speaking, such a risk premium can be seen as a function of the amount of risk faced by the investor and the "fair" price of risk. More specifically, if such an investor is a bank, then the risk-premium can be thought of as the product between the amount of capital that must be held to offset risks (k) and the profit margin (s_k) on that capital deemed fair by the bank's shareholders[54]. In equations (1)-(2) (and in the next ones), we are assuming that no extra-profits (above this "fair" margin) are earned; in this sense, the market is thought to be pricing risk efficiently.

For two-year loans, equation (2) above becomes

(3) $$\begin{aligned}&(1+r_f+s_i)^2(1-p_{2i})+R(1+r_f)p_{1i}+R(p_{2i}-p_{1i})=\\&=(1+C)^2(1-k)+(1+C+s_k)^2k=(1+C)^2+k\left[(1+C+s_k)^2-(1+C)^2\right]\end{aligned}$$

where p_{2i} is the (cumulated) probability that the i-th borrower will default within two years[55].

The more general case of a n-year loan requires that

(4) $$R\sum_{j=1}^{n}\left(p_{j,i}-p_{j-1,i}\right)\left(1+r_f\right)^{n-j}+\left(1+r_f+s_i\right)^n\left(1-p_{n,i}\right)=\left(1+C\right)^n+k\left[\left(1+C+s_k\right)^n-\left(1+C\right)^n\right]$$

where $p_{j,i}$ is the (cumulated) probability that the i-th borrower will default within j years.

Equations (1)-(4) can be reformulated to calculate the level of k that is consistent with the average spreads required by financial intermediaries on different rating classes. Namely, (4) can be re-expressed as:

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[54] Note that, although investors in the Eurobond market are not limited to banks, the latter play a major role in the process of price-making (since most of the members of the issuing syndicate are commercial and investment banks, as shown, e.g., by Levich, 2001, p. 352). Indeed, as banks do underwrite most of the issues, they take most of the risk in the primary market, and set the price accordingly.

[55] To keep things simple, we are implicitly using a flat risk-free yield curve. The model could be easily generalized to non-flat rate structures. However, since our focus is not on risk-free rates, but rather on credit spreads, we feel that this extra complexity would not be compensated by any significant improvement in the accuracy of our conclusions.

(5) $$k = \frac{R\sum_{j=1}^{n}\left(p_{j,i} - p_{j-1,i}\right)\left(1 + r_f\right)^{n-j} + \left(1 + r_f + s_i\right)^n\left(1 - p_{n,i}\right) - \left(1 + C\right)^n}{\left(1 + C + s_k\right)^n - \left(1 + C\right)^n}$$

to estimate k when the spread s_i is known. This will be used to estimate the capital ratios implied by "typical" market spreads like those isolated in our regression analysis.

Such a methodology can be seen as complementary to other approaches that were used in previous studies to assess the correctness of the risk-weights proposed by the Basel Committee; in those studies, the historical pattern of defaults and default correlations experienced by some credit markets (e.g. the US bond market in Altman and Saunders, 2001) were used to estimate the level and variability of loss rates associated with different rating classes.

In our approach, past default rates are replaced by credit spreads, through which the "reverse engineering" performed by equation (5) infers the capital levels that were regarded as adequate by market participants[56] given the risk characteristics of different bond classes. Moreover, default correlations (although not explicitly measured in our model) are indirectly accounted for, since credit spreads also incorporate correlation risks as perceived by market participants[57]. In this sense, our approach uses an "average" correlation, valid for all investors accepting a given spread; this looks consistent with the Basel objective of defining a set of risk weights that do not depend on the specific portfolio composition of individual investors[58].

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[56] Note that this "optimal" capital might be influenced also by some "external" factors, that go beyond the risk content of the underlying assets. For example, a financial institution might want to hold a capital level in excess of credit VaR because of pressures from rating agencies, customer-relationship and market-share concerns, or regulatory constraints (in this sense, the "optimal capital" that we will use to assess the adequacy of Basel II might somewhat be affected by the "old" capital requirements valid under Basel I). However, non risk-based factors should affect all rating classes in the same way, thereby not distorting their relative capital-intensiveness.

[57] Elton et al. (2001) have shown that credit spreads do not reward only individual default risks, but also, for a significant share, a "systematic risk" component that investors cannot fully diversify.

[58] Basel capital ratios are "portfolio invariant", meaning that they are conceived in such a way that an asset will always require the same capital level, regardless of the degree of portfolio diversification achieved by different banks holding it.

To estimate equation (5), we must specify values for its parameters. We proceed as follows:

- spreads s_i will be taken from Table 8;
- n (maturity) will be consistent with the value (8 years) used to simulate spreads (alternative values of 5 and 10 years will also be tested);
- the matrix $\mathbf{P} = [p_{j,i}]$ of default probabilities (for different time horizons and rating buckets) will be based on the historical default rates recorded by Standard and Poor's[59] (see Table 9); note that using data by Moody's (taken, e.g., from Hamilton, 2002) would not affect our findings[60];
- r_f (risk-free rate) will be set at 5%[61], c (screening/monitoring costs) at 25.2 basis points[62], while R and s_k will be set according to the results of some recent research works. Therefore, R will vary between 45% and 55%[63] (see e.g. Altman and Kishore, 1996, Fons, 1994, Carty and Lieberman, 1996, Hamilton, 2002, Van de Castle and Keisman, 1999, Hu and Perraudin, 2002), while s_k will take a value of 4% (based on the results reported for a set of 12 large, industrialized countries, by Maccario et al., 2002) [64]. As regards the latter, however, to incorporate the fact that investors operating in the junk-bond market are perceived as riskier by their own shareholders, institutions underwriting non-investment grade bonds will have to pay a higher risk premium: s_k will gradually rise to 8%.

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[59] Our last rating bucket is based on the default rates for the CCC+/Caa1 rating class because no data is available from S&P's for other rating classes in the bucket.

[60] Table 9 reports default probability by rating class. Those were transformed into average PDs per rating bucket using the distribution of credit exposures reported in Catarineu-Rabell et al. (2003), Table 2; for some grades where the latter distribution was less granular than the one in Table 9, simple averages were used.

[61] Sensitivity analyses were performed, using values of 3% and 7%. The effects on our final risk weights were overall negligible.

[62] This represents the mean management fee for the 7,232 issues in our sample. Although one might expect management costs to increase as ratings worsen, no evidence of such a correlation was found in our data. A "flat" value of c was therefore used.

[63] This is a relatively prudent assumption. Recovery rates are generally lower in the bond market than for corporate loans.

[64] A sensitivity check was performed, considering an alternative value of 6%. No remarkable change took place in the risk weights reported in Table 10.

Before turning to the results, one must recall that the standardized capital levels proposed by the Basel Committee are supposed to cover *both expected and unexpected losses* arising from credit risks; on the other hand, the capital levels chosen by the investors, and inferred from credit spreads in (6), only cover unexpected losses, so they do not account for the whole capital buffer that banks are supposed to hold under Basel's standardized approach.

The outcomes generated by (6) are then adjusted accordingly, adding a measure of expected losses given by the product between the *n*-year average PD and the expected severity rate[65].

The results are reported in panel (a) of Table 10. Several findings appear noteworthy:

- The capital levels implied by the eurobond spreads look higher than 8%, even for some high quality bonds; this could follow from the fact that primary financial institutions (like those underwriting bonds on the Euromarket) tend to hold capital in excess of the minimum regulatory levels.
- Low quality investments tend to be financed with a high volume of capital. At first sight, the fact that in some cases the capital levels exceed the loss given default may look counterintuitive; however, one should remember that recovery rates only represent expectations of a stochastic variable[66]. The volatility of actual recoveries actually is one of the risk sources that capital is meant to cover.
- The capital levels decrease - and the risk-weight curve becomes less steep - for shorter-term investments. On the other hand, when market conditions get tighter (as indicated by a higher spread on BBB bonds) capital levels tend to increase as expected[67].

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[65] The *n*-year expected PD for a borrower of class *i* is based on the cumulative default probabilities (p_{ni}) taken from S&P transition matrices, and was computed as $1-(1-p_{ni})^{1/n}$.

[66] See e.g. Gupton et al. (2000), Van de Castle-Keisman (2000), Acharya et al. (2003).

[67] Furthermore, as recovery rates increase, capital levels become higher; this seemingly surprising result can be explained as follows. When we adopt a higher value of *R* in (6), a given spread can only be justified by a higher capital consumption. In other words, when investors require a given spread (like those estimated in Table 8 for different buckets) notwithstanding a higher recovery rate, this suggests that they are setting aside

In panel (b), raw capital ratios are converted into standardized risk weights. This is was made in two steps: first, capital ratios were multiplied by 12.5 to obtain the corresponding risk weights; second, they were multiplied by a constant scaling factor, chosen in such a way to ensure that, when applied to the distribution of banks' credit portfolios by rating buckets reported on panel (c) (as estimated by the Basel Committee[68]), they lead to a weighted average risk weight in line with the current 100% level. This is consistent with the objective of the New Capital Accord, as explicitly stated by the Basel Committee, not to alter the overall capital levels of the banking industry.

The resulting curves are steeper than those proposed by the Committee (panel "d"); this means that the degree of risk-sensitivity of the new requirements, although it marks an undoubted improvement over the "uniform" 100% risk weight currently assigned to all corporate loans, still lags behind the indications coming from market data.

In other words, the new risk weights, although they differentiate among loans and bonds of different credit standing, still seem to imply a relevant degree of "cross subsidization" among exposures, with investment-grade borrowers paying for a share of the risks originated by speculative-grade exposures.

5.3 Confidence intervals

As noted above, the risk-weighing curves reported on Table 10 look steeper than the one adopted by the Basel Committee. However, they are based on the point estimates of the coefficients reported in Table 7. One therefore must check whether this greater steepness survives, once the volatility in coefficient estimates is accounted for.

To do so, we "shocked" the estimates of the rating dummies' coefficients reported in Table 7 (column 3), by adding and subtracting twice their standard errors. For example, the

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more capital against unexpected losses. Although a higher R reduces expected losses, the net effect remains positive.

[68] See Catarineu-Rabell et al. (2003), Table 2. In their study, the estimated distribution of banks' portfolios is based on the results of a quantitative impact study (simulating the effect that the new Basel Accord proposals would have for a sample of banks), published by the Basel Committee in November 2001. The study includes weighted average information on the quality distributions of corporate, interbank and sovereign portfolios held by those banks. The results have been weighted inside countries by the capital of the banks and between countries by the relative importance of the international banking sector.

coefficient associated with bucket 1 (i.e. the constant term: -181.58) was both increased and decreased by twice 9.65, getting two values of -162.28 and -200.88 respectively. The same was done for the other rating buckets[69].

Those two sets of "shocked" values were then used to generate two alternative sets of risk weights ("upper" and "lower"), as shown in Figure 1. Here, the "central" values represent the "base case" weights of Table 10, while the grey steps on the background show the values adopted by the Basel Committee. The Figure shows that:

- the risk-weights associated to adjacent buckets remain different from each other even when one considers confidence intervals instead of point estimates;
- in the case of the best two rating buckets, our "confidence brackets" overlap with the values (20 and 50, respectively) indicated by the Basel Committee, suggesting that the difference between our estimates and the regulatory weights may not be statistically significant;
- however, this is not true for the last three buckets, where our confidence brackets do not cross the grey areas representing Basel's choices;
- as concerns the 100% regulatory weight, there is evidence that it overstates the riskiness of BBB-rated exposures, while seriously understating the risk of BB-rated issues, for which a 150 risk weight might be more appropriate;
- risk looks seriously understated also in the case of exposures below BB: although our coefficient estimates look comparatively more volatile than for low-risk grades, they indicate that a risk weight of at least 250% would be more consistent with market spreads.

6. Conclusions

The Standardised Approach of the New Basel Capital Accord was designed as a deliberately simplified framework, to increase its applicability to a wide array of financial

[69] For each bucket from 2 to 5, both the constant term and the rating bucket's coefficient were used; accordingly, the standard errors used to shock the central estimate were computed based on the (heteroskedasticity-adjusted) variances and covariance of the constant term and the rating bucket's coefficient.

institutions. Its simplicity, though making it less risk-sensitive than the internal ratings-based approaches, is by no means a shortcoming: actually, it represents a huge advantage, ensuring that this approach can be implemented effectively in a broad range of circumstances.

While embracing this simplified framework, this study has examined the ability of the Basel Committee's risk-weights to adequately reflect the risk-rating relationship. Issuance spreads on 7,232 eurobonds issued during 1991-2003 have been used in order to estimate the average spread per rating bucket and evaluate the risk-rating relationship. Three main results emerged from the empirical analysis. First, the spread/rating relation is strongly significant, with spreads increasing when ratings worsen. Second, the estimated spreads per rating class indicate that the risk/rating relationship might be steeper than the one approved by the Basel Committee. Finally the difference between the spread/rating relation of banks and non-financial firms appears quite blurred and statistically questionable. This indicates that the distinction between banks and non-financial firms proposed in the Accord should be further investigated.[70].

Following these empirical findings, three main possible enhancements should be considered in the future to the standardised approach risk-weights. First, the distinction between rated banks and non-financial companies might be made less compelling; a more favorable weight for banks would certainly be justified only for unrated entities. Second, the risk-weights per rating bucket might be adjusted in order to reflect a steeper relationship between risk and rating. Third, five rating buckets could be considered rather than the four

[70] One might argue that, for a given rating class, banks tend to show *higher* default frequencies than non-financial corporations, at least in the U.S. This was shown by Ammer e Packer (2000), by means of a probit model based on Moody's data, in which rating and vintage effects are separately accounted for: their results (see Table 4 in the paper) quantify in 2.14% the expected default frequency for banks, as opposed to 1.37% for non-financial corporations. This result was recalled by the Basel Committee itself, in its 2000 survey on rating sources (Basel Committee on Banking Supervision, 2000); however, Cantor and Falkenstein (2001), working on data for speculative-grade issuers, have shown that the gap between banks' and non-banks' historical default rates appears significant only if one assumes that default probabilities stay constant over time. When a more sophisticated framework is adopted (where default probabilities fluctuate over time because of short-term shocks, like the Savings & Loans crisis), no clear proof emerges that banks are to be considered more risky than non-financial firms in the same rating class. However, none of the above-mentioned studies ever hinted that banks should be considered *less* risky, as in the Committee's standardised approach.

currently proposed by the Basel Committee[71]. Namely, the third bucket including rating classes from BBB+ to BB- (from Baa1 to Ba3 in the Moody's' scale) could be split into two different levels.

Such revisions would make the standardised approach even closer to the markets' sentiment, thereby bridging a potentially dangerous gap between the first and the third "pillar" of the new regulatory architecture.

[71] Note that the real steepness of the rating-risk relationship might be somewhat understated, as risky issuers may be more likely to issue in good times. As concerns our sample, however, the relative incidence of junk issues seems to be influenced only marginally by the "tightness" of the market: although the correlation coefficient between the incidence of speculative issues on the total and the BBB_SP variable is slightly negative (-13%), it is not statistically different from zero; besides, the relative importance of junk issues remains unchanged at 7% both before January 2001 (when BBB_SP averages 219 b.p.) and afterwards (as the average BBB spread jumps to an average of 373 b.p.).

Tables

Table 1

PROPOSED RISK-WEIGHTS PER RATING BUCKET – STANDARDISED APPROACH

	(1) Basel 1999 proposed risk weight (%)	(2) Basel 2001 proposed risk weight (%)	(3) Altman-Saunders proposals (%)
AAA to AA- / Aaa to Aa3	20	20	10
A+ to A- / A1 to A3	100	50	30
BBB+ to BBB- / Baa1 to Baa3	100	100	30
BB+ to BB- / Ba1 to Ba3	100	100	100
B+ to B- / B1 to B3	100	150	100
Below B-/B3	150	150	150

Source: Altman and Saunders (2001), Basel (2001).

Table 2

RATING SCALES

#	1	2	3	4	5	6	7	8	9	10
Moody's	Aaa	Aa1	Aa2	Aa3	A1	A2	A3	Baa1	Baa2	Baa3
S& P's	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-
Our bucket	1	1	1	1	2	2	2	3	3	3

#	11	12	13	14	15	16	17	18	19	20	[illegible]
Moody's	Ba1	Ba2	Ba3	B1	B2	B3	Caa1	Caa2	Caa3	-	-
S&P's	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-	CC	[illegible]
Our bucket	4	4	4	5	5	5	5	5	5	5	[illegible]

Table 3

SAMPLE DESCRIPTIVE STATISTICS (CONTINUOUS VARIABLES)

	Spread	Rating	Amount	Maturity	Coupon	Managers	Fees
N	7,232	7,232	7,232	7,232	7,232	7,232	7,232
Mean	88.5	4.5	432.0	97.7	6.0	10.2	1.0
Median	52.6	4.0	256.1	72.0	6.1	8.0	0.7
Max.	1014.0	21.0	7000.0	1200.0	15.0	54.0	6.5
Min.	-23.50	1.00	0.10	12.00	0.00	1.00	0.00
Std. Dev.	115.9	3.7	564.8	75.0	2.4	8.9	0.8

Notes: SPREAD: "nearest-on-the-run" spread, i.e., difference between the yield to maturity at issuance of each individual Eurobond and the yield to maturity of the Treasury bond denominated in the same currency and with the nearest maturity. – MATURITY: the time to maturity (in years) of the issue. – AMOUNT: the U.S. dollar-equivalent amount of the issue (US$ m). – RATING: the equivalent value (see Table 2) of the average Moody's and Standard and Poor's issue rating. – COUPON: the annual coupon (percent). – MANAGERS: the number of financial institutions participating in the issuing syndicate. – FEES: the total gross fees (%) earmed by the eurobond issuing syndicate (underwriting fees, management fees and selling fee).

Table 4

SAMPLE DESCRIPTIVE STATISTICS (DUMMY VARIABLES)

	Subo	Reg	Cross	Pledge	Force	Private	Fixed	Bank
N. of issues for which data is available	7232	7232	4584	5106	4428	7232	7232	7232
N. of issues for which dummy = 1	419	1662	2864	3478	4388	120	5120	3698
% of Total available data	5.79%	22.98%	62.48%	68.12%	99.10%	1.66%	70.80%	51.13%

Notes: SUBO equals 1 if the issue is subordinated and zero if it is senior. – REG equals 1 if the bond is registered and zero if it is in bearer form. – CROSS equals 1 if the bond issue includes a cross-default clause and zero otherwise. – PLEDGE equals 1 if the bond issue includes a negative pledge clause and zero otherwise. – FORCE equals 1 if the bond issue includes a force majeure clause and zero otherwise. – PRIVATE equals 1 if the bond issue is a private placement one and zero if it is a public issue. – FIXED equals 1 if the bond issue is fixed priced and zero if it is open priced. – BANK equals 1 if the bond issuer is a bank, zero otherwise.

Table 5

SAMPLE DESCRIPTIVE STATISTICS -
CORPORATE EUROBOND ISSUES BY ISSUER'S COUNTRY

Country	Total # of issues	% Tot. # of Issues	N. of Bank Issues	% Bank Issues	Avg. Spread (b.p.)	Avg. Rating	Total Amount (US$ m)	% Tot. Amount Issued	Average Amount (US$ m)	Average Maturity (years)
Canada	286	4.0%	125	43.7%	97.5	5.5	85,835	2.7%	300.1	8.9
France	797	11.0%	378	47.4%	50.6	3.2	309,359	9.9%	388.2	9.1
Germany	1,031	14.3%	871	84.5%	45.6	2.2	473,918	15.2%	459.7	6.9
Japan	717	9.9%	178	24.8%	38.5	6.4	197,219	6.3%	275.1	7.3
Netherlands	572	7.9%	452	79.0%	55.7	2.8	202,371	6.5%	353.8	7.0
United Kingdom	912	12.6%	299	32.8%	104.6	5.1	346,879	11.1%	380.3	11.0
United States	1,412	19.5%	678	48.0%	100.4	4.4	1,065,020	34.1%	754.3	7.8
Other (57 countries)	1,505	20.8%	717	47.6%	151.6	6.3	443,823	14.2%	294.9	7.8
Total	7,232	100.0%	3,698	51.1%	88.5	4.5	3,124,423	100.0%	432.0	8.1

Table 6

SAMPLE DESCRIPTIVE STATISTICS –
CORPORATE EUROBOND ISSUES BY AVERAGE RATING CLASS

Rating Class	Total # of issues	% Tot. Number of Issues	N. of Bank Issues	% Bank Issues	Average Spread (b.p.)	Std. Dev. of Spread (b.p.)	Total Amount (US$ m)	% Tot. Amount Issued	Average Amount (US$ m)	Average Maturity (years)
AAA/Aaa	2292	31.7%	1670	72.86%	35.0	29.5	1,128,208	36.1%	492.2	7.3
AA+/Aa1	512	7.1%	366	71.48%	39.1	34.8	151,848	4.9%	296.6	6.9
AA/Aa2	680	9.4%	384	56.47%	46.8	32.8	227,619	7.3%	334.7	7.3
AA-/Aa3	762	10.5%	376	49.34%	53.0	44.5	314,685	10.1%	413.0	9.1
A+/A1	556	7.7%	233	41.91%	85.0	48.6	280,767	9.0%	505.0	9.6
A/A2	565	7.8%	268	47.43%	100.4	49.5	328,034	10.5%	580.6	9.0
A-/A3	402	5.6%	106	26.37%	110.4	66.4	199,085	6.4%	495.2	9.4
BBB+/Baa1	420	5.8%	100	23.81%	122.0	79.6	208,700	6.7%	496.9	9.7
BBB/Baa2	311	4.3%	56	18.01%	117.8	78.3	113,832	3.6%	366.0	9.0
BBB-/Baa3	189	2.6%	18	9.52%	158.7	119.1	61,575	2.0%	325.8	9.0
BB+/Ba1	84	1.2%	5	5.95%	193.3	142.7	17,436	0.6%	207.6	8.3
BB/Ba2	115	1.6%	16	13.91%	235.2	165.8	21,093	0.7%	183.4	6.6
BB-/Ba3	74	1.0%	19	25.68%	346.7	191.6	12,132	0.4%	163.9	6.1
B+/B1	121	1.7%	53	43.80%	438.1	152.5	23,380	0.7%	193.2	5.8
B/B2	67	0.9%	15	22.39%	538.3	177.3	15,741	0.5%	234.9	7.9
B-/B3	51	0.7%	12	23.53%	591.9	186.9	11,852	0.4%	232.4	8.5
CCC+/Caa1	6	0.1%	0	0.00%	594.4	147.1	2,130	0.1%	354.9	9.2
CCC/Caa2	7	0.1%	1	14.29%	563.4	132.1	977	0.0%	139.5	9.1
CCC-/Caa3	3	0.0%	0	0.00%	409.8	41.9	950	0.0%	316.7	8.3
CC/-	4	0.1%	0	0.00%	105.3	24.7	600	0.0%	150.0	14.3
D/-	11	0.2%	0	0.00%	362.9	219.4	3,779	0.1%	343.6	11.2
Total	7232	100.0%	3698	51.13%	88.5	115.9	3,124,423	100.0%	432.0	8.1

Table 7

LINEAR REGRESSIONS OF SPREAD

	Variable	(1) Quarterly dummies, full	(2) BBB spread, full	(3) BBB spread, reduced	(4a) 1991-98 issues	(4b) 1999-03 issues	(5a) Banks (separate dummies)	(5b) Corporate (separate dummies)	(6a) Banks (separate models)	(6b) Corporate (separate model)	(7a) Moody's only	(7b) S&P's only
	Constant	-253.54***	-178.91***	-181.58***	-72.45***	-257.65***	-173.28***	-173.85***	-82.07***	-272.1***	-138.34***	-185.08***
		(17.51)	(10.34)	(9.65)	(9.68)	(10.68)	(7.39)	(7.57)	(7.76)	(13.53)	(9.68)	(8.25)
Ratings	ISSBUC02	21.67***	29.47***	29.72***	24.94***	20.71***	27.92***	30.34***	28.78***	25.12***	34.43***	28.75***
		(1.38)	(1.40)	(1.37)	(2.37)	(2.05)	(2.62)	(2.31)	(2.11)	(2.67)	(2.38)	(1.86)
	ISSBUC03	56.73***	67.15***	66.57***	49.20***	56.19***	78.56***	64.15***	80.22***	54.74***	76.37***	65.51***
		(2.38)	(2.30)	(2.23)	(3.53)	(2.50)	(4.41)	(2.53)	(3.73)	(2.96)	(3.72)	(2.32)
	ISSBUC04	154.04***	172.46***	172.14***	227.23***	122.15***	222.65***	163.90***	268.22***	138.03***	228.61***	160.38***
		(6.85)	(7.08)	(7.02)	(5.16)	(4.53)	(8.73)	(4.12)	(6.93)	(4.92)	(6.91)	(4.00)
	ISSBUC05	282.44***	328.70***	328.71***	301.24***	280.78***	308.63***	338.92***	359.95***	283.41***	348.58***	342.60***
		(10.67)	(10.03)	(10.01)	(4.89)	(6.44)	(6.54)	(4.99)	(5.43)	(6.35)	(5.49)	(5.00)
Bond Features	SUBO	4.84*	3.05		4.86	1.94	3.50		15.49***	-0.98	10.54***	0.86
		(2.54)	(3.10)		(3.62)	(3.56)	(2.98)		(2.83)	(6.95)	(4.02)	(3.22)
	MATU	0.04**	0.08***	0.08***	0.06***	0.02	0.08***		0.13***	0.02	0.17***	0.05***
		(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.01)		(0.02)	(0.02)	(0.02)	(0.01)
	BANK	0.71	1.74		-1.88	3.52*					-0.01	2.77*
		(1.32)	(1.48)		(1.92)	(1.85)					(2.08)	(1.63)
	AMOUNT	-0.69	3.09***	3.57***	-5.33***	1.48	2.67***		0.63	6.14***	1.06	2.45**
		(0.95)	(1.04)	(0.93)	(1.42)	(1.13)	(0.99)		(1.07)	(1.59)	(1.29)	(1.05)
	COUPON	29.41***	19.88***	19.88***	11.28***	38.16***	19.69		9.59***	29.90***	14.40***	22.15***
		(1.66)	(0.93)	(0.93)	(0.56)	(0.81)	(0.50)		(0.53)	(0.82)	(0.62)	(0.55)
	REG	20.43***	27.43***	26.82***	23.58***	24.37***	26.64***		13.19***	34.97***	22.12***	26.46***
		(2.65)	(2.98)	(2.94)	(3.03)	(2.85)	(2.32)		(2.66)	(3.62)	(3.39)	(2.47)
	MANAGERS	0.11	-0.85***	-0.85***	-0.54***	-0.12	-0.84***		-0.52***	-1.31***	-0.65***	-0.94***
		(0.09)	(0.09)	(0.09)	(0.11)	(0.19)	(0.10)		(0.09)	(0.21)	(0.12)	(0.12)
	FEES	8.15***	5.84***	5.68***	5.80***	10.30***	5.29***		-0.67	10.11***	4.66***	4.00***
		(1.28)	(1.43)	(1.42)	(1.25)	(1.53)	(1.10)		(1.17)	(1.82)	(1.35)	(1.18)
	PRIVATE	-4.68	-4.85		6.92	7.57	-5.05		-20.00*	-4.34	-7.66	-7.92
		(6.25)	(7.72)		(5.20)	(8.16)	(5.08)		(11.42)	(6.09)	(7.89)	(5.23)
	FIXED	1.08	-2.62		-6.75***	-0.54	-3.00*		-3.56*	-2.55	-0.47	-4.81***
		(1.53)	(1.73)		(2.15)	(1.88)	(1.62)		(1.86)	(2.47)	(2.14)	(1.72)
	BBB_SP	-	28.50***	28.32***	21.68***	26.71***	28.21***		20.35***	35.95***	25.03***	29.45***
		-	(1.22)	(1.21)	(1.66)	(1.19)	(0.96)		(1.06)	(1.50)	(1.30)	(1.02)

(Table continued on next page)

	Variable	(1) Quarterly dummies, full	(2) BBB spread, full	(3) BBB spread, reduced	(4a) 1991-98 issues	(4b) 1999-03 issues	(5a) Banks (separate dummies)	(5b) Corporate (separate dummies)	(6a) Banks (separate models)	(6b) Corporate (separate model)	(7a) Moody's only	(7b) S&P's only
Currency	CAN	43.28***	25.28***	25.15***	24.80***	36.15***	25.72***		16.93***	30.54***	19.62***	29.09***
		(3.89)	(3.46)	(3.45)	(3.69)	(6.81)	(3.64)		(3.28)	(8.98)	(4.42)	(4.18)
	DEM	12.15***	2.85	2.92	11.34***	-5.95	3.13		-0.18	-8.98	-3.35	3.92
		(3.50)	(3.40)	(3.40)	(3.92)	(8.03)	(4.08)		(3.56)	(10.29)	(4.90)	(4.57)
	DFL	52.62***	14.57***	14.17***	17.80***		14.91***		0.07	35.11***	4.95	18.91***
		(4.78)	(4.02)	(3.98)	(4.76)		(5.07)		(4.34)	(13.47)	(6.17)	(6.00)
	EUR	59.25***	25.29***	25.22***	26.68***	81.94*	25.40***		7.84**	44.09***	13.32**	30.78***
		(5.10)	(4.23)	(4.22)	(4.21)	(46.60)	(4.41)		(3.92)	(10.79)	(5.40)	(5.14)
	FFR	37.02***	42.77***	42.88***	33.61***	43.75***	42.62***		13.98***	63.89***	28.45***	46.70***
		(4.81)	(4.37)	(4.32)	(6.46)	(6.76)	(3.98)		(3.69)	(9.26)	(4.84)	(4.48)
	STG	34.67***	-0.53	-1.27	11.05***		-0.37		-9.93**	5.35	-13.48***	2.94
		(4.37)	(3.76)	(3.72)	(4.20)		(4.24)		(3.95)	(9.69)	(5.13)	(4.83)
	USD	30.12***	23.73***	23.59***	13.41***	44.03***	23.81***		7.46**	35.55***	13.40***	28.60***
		(4.07)	(4.03)	(4.05)	(4.33)	(7.16)	(4.09)		(3.80)	(9.52)	(4.90)	(4.66)
	YEN	89.52***	54.85***	54.20***	58.04***	148.08***	54.41***		4.17	108.91***	41.27***	71.05***
		(10.06)	(7.26)	(7.24)	(11.55)	(8.71)	(5.80)		(5.88)	(11.61)	(8.85)	(6.43)
Country	CAN	-20.68***	-23.79***	-24.21***	-14.80***	-17.66***	-22.98***		7.97*	-47.10***	-0.92	-29.74***
		(3.92)	(4.86)	(4.87)	(3.88)	(5.62)	(3.67)		(4.30)	(5.45)	(4.91)	(3.86)
	FRA	-18.24***	-22.33***	-22.73***	-13.72***	-22.50***	-21.70***		-2.96	-33.04***	-7.39**	-23.62***
		(2.11)	(2.32)	(2.31)	(3.18)	(3.39)	(2.68)		(2.93)	(4.26)	(3.43)	(2.88)
	GER	-13.81***	-10.15***	-9.89***	-7.78***	-14.26***	-9.49***		-1.50	-3.86	2.85	-14.43***
		(2.12)	(2.39)	(2.34)	(2.78)	(2.98)	(2.38)		(2.26)	(5.34)	(2.81)	(2.63)
	JAP	-33.16***	-44.66***	-44.94***	-12.78***	-53.73***	-44.38***		-20.60***	-51.23***	-11.63**	-50.18***
		(3.33)	(3.80)	(3.79)	(4.73)	(4.95)	(3.88)		(4.61)	(5.94)	(5.64)	(4.18)
	NL	-17.23***	-10.85***	-10.68***	-6.53*	-19.76***	-10.32***		1.49	-24.50***	-0.17	-13.27***
		(2.22)	(2.40)	(2.35)	(3.56)	(3.44)	(2.87)		(2.71)	(6.21)	(3.32)	(3.06)
	UK	-11.67***	-14.02***	-14.07***	-0.08	-15.56***	-13.73***		4.66	-30.89***	-4.63	-18.70***
		(2.30)	(2.65)	(2.66)	(3.08)	(3.10)	(2.52)		(3.00)	(3.79)	(3.19)	(2.69)
	USA	-15.28***	-8.50***	-8.50***	-6.69**	-19.29***	-7.83***		17.45***	-24.16***	6.36**	-13.08***
		(2.08)	(2.44)	(2.42)	(2.75)	(2.67)	(2.17)		(2.46)	(3.35)	(2.88)	(2.31)
	N	7232	7232	7232	3524	3708	7232		3698	3534	3714	6218
	R-squared	0.839	0.790	0.790	0.808	0.864	0.793		0.778	0.813	0.797	0.793
	Adj. R-squared	0.837	0.790	0.790	0.806	0.863	0.792		0.776	0.811	0.796	0.792
	F-statistic	464.24***	905.57***	1044.19***	488.9***	834.4***	808.5***		443.4***	524.4***	483.7***	789.7***
	F-rating	1285.12***	1598.80***	1615.36***	1112.5***	529.6***	691.2***	1285.5***	1293.7***	542.4***	1062.6***	1300.1***
	F-quarter	63.83***										

*Note: Reported are regression coefficients and standard errors (in parenthesis) – F-rating (-quarter, -country) denotes the F-statistic for the null hypothesis that the coefficients of all rating (quarter, country) dummies jointly equal zero. – ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively*

Table 8

ESTIMATED SPREADS PER RATING BUCKET

	AAA to AA- / Aaa to Aa3	A+- to A- / A1 to A3	BBB+ to BBB- / Baa1 to Baa3	BB+ to BB- / Ba1 to Ba3	Below BB- /Ba3
Base case	52.3	82.0	118.9	224.5	381.0
5-year maturity	49.4	79.1	116.0	221.5	378.1
10-year maturity	54.3	84.0	120.8	226.4	383.0
Euro-denominated	54.0	83.7	120.5	226.1	382.7
BBB-spread at 1.8%	29.9	59.6	96.5	202.0	358.6
BBB-spread at 3.4%	75.2	104.9	141.8	247.3	403.9

Table 9

AVERAGE CUMULATIVE DEFAULT RATES BY RATING GRADE (BASED ON STATIC POOLS, 1981-99)

Year	1	2	3	4	5	6	7	8	9	10
AAA	0.00%	0.00%	0.03%	0.06%	0.10%	0.18%	0.26%	0.40%	0.45%	0.51%
AA+	0.00%	0.00%	0.00%	0.10%	0.21%	0.33%	0.47%	0.47%	0.47%	0.47%
AA	0.00%	0.00%	0.00%	0.03%	0.09%	0.16%	0.30%	0.42%	0.50%	0.60%
AA-	0.03%	0.09%	0.23%	0.35%	0.49%	0.69%	0.86%	0.99%	1.07%	1.16%
A+	0.02%	0.07%	0.15%	0.33%	0.46%	0.61%	0.79%	0.93%	1.15%	1.40%
A	0.05%	0.11%	0.17%	0.22%	0.37%	0.51%	0.62%	0.79%	0.99%	1.17%
A-	0.05%	0.17%	0.30%	0.48%	0.73%	0.96%	1.28%	1.53%	1.73%	1.89%
BBB+	0.12%	0.29%	0.56%	0.87%	1.18%	1.64%	1.98%	2.20%	2.29%	2.38%
BBB	0.22%	0.52%	0.74%	1.12%	1.50%	1.76%	2.00%	2.27%	2.56%	2.89%
BBB-	0.35%	0.71%	1.12%	2.09%	3.02%	3.93%	4.81%	5.53%	6.05%	6.53%
BB+	0.44%	1.21%	2.75%	4.08%	5.22%	6.51%	7.48%	7.89%	8.66%	9.51%
BB	0.94%	2.59%	4.62%	6.04%	7.34%	8.72%	9.57%	10.72%	11.45%	11.80%
BB-	1.33%	4.28%	7.42%	10.47%	13.00%	15.65%	17.18%	18.58%	19.77%	20.70%
B+	2.91%	7.74%	12.08%	15.44%	17.92%	19.66%	21.38%	22.80%	23.79%	24.75%
B	8.38%	16.01%	21.00%	23.73%	25.73%	27.59%	28.79%	29.79%	30.84%	31.85%
B-	10.32%	18.27%	23.32%	27.02%	29.40%	31.03%	32.79%	33.74%	34.51%	34.78%
CCC	21.94%	29.25%	34.37%	38.24%	42.13%	43.62%	44.40%	44.82%	45.74%	46.53%

Source: Standard & Poor’s (2001).

Note: this table represents the transposed of matrix **P** in the paper)

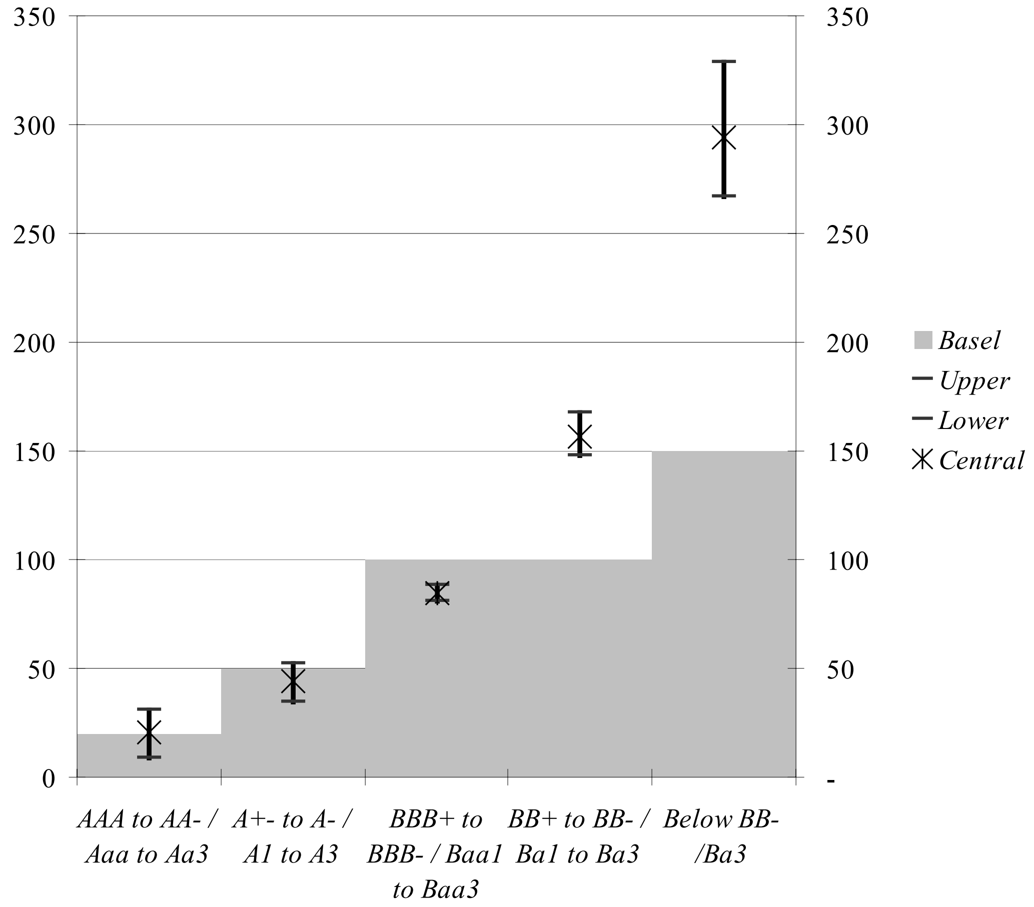
Table 10

ESTIMATED CAPITAL RATIOS AND
PROPOSED RISK WEIGHTS PER RATING BUCKET

	AAA to AA- / Aaa to Aa3	A+- to A- / A1 to A3	BBB+ to BBB- / Baa1 to Baa3	BB+ to BB- / Ba1 to Ba3	Below BB- /Ba3
(a) Simulated capital ratios (%) (recovery rate of 45%, unless otherwise specified)					
Base case	7%	14%	27%	49%	92%
5-year maturity	5%	13%	22%	34%	69%
10-year maturity	7%	15%	30%	56%	96%
Euro-denominated	7%	14%	27%	49%	93%
BBB-spread at 1.8%	2%	9%	22%	47%	91%
BBB-spread at 3.4%	12%	19%	32%	52%	94%
Recovery of 45%:	6%	13%	25%	42%	75%
Recovery of 55%:	7%	14%	28%	54%	100%
(b) Our risk-weights (% - 100% means that risk-weighted assets equal unweighted assets)					
Base case	21	44	85	157	294
5-year maturity	22	53	91	143	288
10-year maturity	21	43	85	161	277
Euro-denominated	22	45	85	156	292
BBB-spread at 1.8%	6	33	80	170	334
BBB-spread at 3.4%	33	54	89	146	263
Recovery of 45%:	23	49	89	152	271
Recovery of 55%:	20	42	84	159	300
(c) Portfolio structure by rating grade used to compute our risk-weights					
	9.2%	26.8%	30.0%	28.6%	5.4%
(d) Basel Committee risk weights					
	20%	50%	100%	100%	150%

Figure 1

CONFIDENCE INTERVALS FOR OUR RATING BUCKETS RISK WEIGHTS



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