Market discipline in the banking industry. Evidence from spread dispersion

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Abstract

Do bond investors put additional screening effort for more opaque issues? Do the price-setting mechanism and the syndicate concentration affect the degree of additional information impounded in bond spreads? This paper addresses these questions by using a sample of bond issued by European banks. I employ a heteroscedastic regression model to empirically examine the factors affecting the spread dispersion unexplained by easy-to-observe issue characteristics (ratings, size, maturity, etc.). Three main results emerge from the empirical analysis. First, variables that predict quite accurately the spread for the typical bond loose their explanatory power for worse-rated, subordinated bonds with smaller face value and longer maturity, indicating a deeper investors' screening for more complex and opaque issues. Second, spread unexplained dispersion decreases with the number of banks involved in the syndicate. Third, spread unexplained dispersion increases for open-priced offers, indicating that this price-setting mechanism generates additional information relative to the fixed-price approach.

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1. INTRODUCTION

During the last two decades academic and regulatory economists have been suggesting that supervisory authorities should rely on market discipline to improve banking prudential supervision. Even the Basel Committee on Banking Supervision has recognized the role of market discipline in supplementing traditional supervisory methods. In the New Basel Capital Accord market discipline is one of the three pillars on which the future banking oversight should be based. While the first two pillars focus on capital regulation and national banking supervision, the third pillar is aimed at improving banks' disclosure for an effective market discipline. Moreover, the objective of increasing reliance on market forces by supervisors underlies several calls for a mandatory subordinated debt component as part of bank capital requirements. Subordinated debt is generally viewed as an ideal instrument for providing bank market discipline for two main reasons. First, subordinated debt investors have strong incentives to discipline bank risk-taking. They are exposed to loss that exceeds bank's equity capital, but their potential upside gains are limited. Hence, they have incentives similar to those of deposit insurer. In contrast, equity has an option-like payoff, which might benefit shareholders from higher risk. Second, among bank liabilities, subordinated debt is junior to all claims other than equity and so is more risk-sensitive.

Market discipline can be either direct or indirect. The market disciplines banks *directly* if their funding cost is a direct function of their risk profile. Banks can also be disciplined by market forces *indirectly*, via the supervisors' response to signals provided by debt yields. Among others conditions for an effective market discipline (both direct and indirect), investors should have complete information on bank risk and promptly impound this information into its debt. This condition is not necessarily true. Banks act as delegated monitors (Diamond 1984) financing relatively illiquid and informationally opaque loans, which hence are hard to monitor by bank outsiders. Also trading assets, which tend to be more liquid and transparent, might be another source of opaqueness. Trading assets are indeed easy to change and banks cannot commit to specific trading positions (the paradox of liquidity of Myers and Rajan (1998)). Three papers address the question of whether banks are relatively more opaque than other firms, with contradictory results. Morgan (2002) and Iannotta (2006) use disagreement between rating agencies (split ratings) as a proxy for opaqueness, finding that rating agencies disagree more often over bank issues than over non-bank issues. In contrast, Flannery, Kwan, and Nimalendran (2004) use market microstructure properties and analysts' earnings forecast to assess whether banks are relatively more opaque than non-banks, finding no evidence that banks are more opaque.

Notwithstanding the potential undermining of market discipline due to opaqueness, extensive evidence supports the idea of a tight relationship between bank bond spreads and several measures of bank risk during the last 15 years (Flannery and Sorescu (1996), DeYoung, Flannery, Lang, and Sorescu (2001), Jagtiani, Kaufman, and Lemieux (2002), Jagtiani and Lemieux (2001), Allen, Jagtiani, and Moser (2001), Covitz, Hancock, and Kwast (2004), Morgan and Stiroh (2001), Sironi (2002, 2003)). Most of these studies use the same proxies for bank risk: either ratings or accounting measures. In general, credit ratings seem to impound relevant information. Berger, Davies, and Flannery (2000) find that supervisory authorities and rating agencies both have some information that help the other group predicting changes in bank condition. In other words, supervisors and raters complement one another. Indeed, credit ratings appear an important determinant of bank yield spreads. Beside ratings, spreads also reflect several other issue characteristics such as maturity, size, currency of denomination, etc. However, investors' reliance on these variables might change from bond to bond. In other words, for less transparent issues spreads might reflect more information, due to higher investors' screening effort. Depending on its nature, this additional information can have a positive or negative effect on spreads. Morgan (2002) finds that some issue characteristics affect bond opaqueness. Split ratings are more frequent for worse-rated issues. Moreover the likelihood of a split rating increases with bond maturity, whereas it decreases with issue size. Iannotta (2006) finds that subordinated bonds have more split ratings than senior bonds. It is possible that for more opaque issues (worse rating, longer maturity, smaller face value, lower seniority) investors put an enhanced screening effort.

Beside specific bond characteristics, two features of the issuing process can also affect the degree of additional information impounded in yield spreads: the price-setting mechanism and the syndicate concentration. Two main mechanisms to price and distribute corporate bonds are used in the European market: i) open price (or book-building), ii) fixed price[1]. In open-priced offerings underwriters (i.e. syndicate members) canvas potential investors and then set an offer price. In contrast, in fixed-priced offerings the offer price is set prior to requests of bonds being submitted. Benveniste and Spindt (1989) suggest the open price approach is designed to induce investors to reveal their private information in return for preferential allocations of stocks. While no previous research tests this theory for bond issues, Cornelli and Goldreich (2001) examines equity IPOs, finding that investment banks award more shares to investors who provide information in their bids. Also the concentration of the underwriting syndicate might be related to information production. Corwin and Schultz (2005) analyze equity IPOs and find evidence of information production by syndicate members. They find that offer prices are more likely to be adjusted up (down) in response to positive (negative) information when the underwriting syndicate is less concentrated (i.e., more banks are involved). The empirical literature on the role of price-setting mechanisms and syndicate structure focus on equity offerings because that market is expected to suffer from a higher degree of information asymmetry. However the potential role of pricing mechanism and underwriting syndicate in generating information might hold for bond markets too.

Do bond investors put additional screening effort for more opaque issues? Do the price-setting mechanism and the syndicate concentration affect the degree of additional information

[1] Auction is also a price setting mechanism. In auctions a market clearing price is set after bids are submitted. However, auctions are never used in the European corporate bond markets.

impounded in yield spreads? This paper addresses these questions by using a sample of bond issued by European banks. I employ a heteroscedastic regression model to empirically examine the factors affecting the spread variance unexplained by easy-to-observe issue characteristics (ratings, size, maturity, etc.). I interpret higher predictive power (i.e. lower unexplained variance) as greater investors' reliance on these variables. In contrast, lower predictive power is associated with greater investors' screening effort. Primary market spreads allow the use of "fresher" ratings, because issue ratings reflect the agencies' assessment near the time of issuance. This paper is among the first to investigate this topic and, to the best of my knowledge, the only one employing the heteroscedastic regression methodology.

Three main results emerge from the empirical analysis. First, variables that predict quite accurately the spread for the typical bond loose their explanatory power for worse-rated, subordinated bonds with smaller face value and longer maturity, indicating a deeper investors' screening for more complex and opaque issues. Second, spread unexplained dispersion decreases with the number of banks involved in the syndicate. Third, spread unexplained dispersion increases for open-priced offers, indicating that this price-setting mechanism generates additional information relative to the fixed-price approach.

This paper proceeds as follows. Section 2 presents the methodology of the empirical analysis. Section 3 describes the data source. Section 4 presents the empirical results, while Section 4 concludes.

2. RESEARCH METHODOLOGY

Bond spreads over Treasury bonds with corresponding maturity and currency reflect primarily issue ratings. Issue ratings impound the information about the issuer's default risk as well as the bond seniority and structure. Even though issue ratings should incorporate the information about maturity, issue size, seniority, etc. these variables prove to be additional source of information for pricing bonds (Morgan and Stiroh (2001) and Sironi (2002, 2003)). Moreover, yield spreads are also related to macroeconomic or bond market conditions, which is why time, country, and currency fixed effects are usually employed as control variables. The price-setting mechanism and the syndicate structure might also affect the spreads: Gabbi and Sironi (2004) suggest that these controls have additional (albeit limited) explanatory power. Using a sample of Eurobond they find that ratings and other issue characteristics can explain up to 90% of the spread variance. Using similar explanatory variables for a sample of US bonds, Morgan and Stiroh (1999) obtain a R^2 of 87%. Similarly, Livingston and Miller (2000) find an R^2 of 85%.

However, if investors' screening effort is constant across issues, the unexplained spread dispersion should not vary for different bonds. In other words, two issues identical in terms of issue ratings and control variables should pay the same spread. In contrast, if investors put additional "due diligence" effort for more complex or opaque issues, then the two bonds might have different spreads, settled according to the information not captured by rating and other controls. The nature of the additional information could be either positive or negative, thus affecting the spread unexplained dispersion.

To determine the factors affecting spread dispersion, I employ the heteroscedastic regression model proposed by Harvey (1976). Cerqueiro, Degryse, and Ongena (2007) use this approach to identify the determinants of the dispersion of loan rates. As they suggest, one may think of this model as of two equations, the first explaining the mean of the dependent variable, while the second one explaining the residual variance of the dependent variable. The spread at issuance is the dependent variable of the first equation with ratings and other issue characteristics used in previous research as explanatory variables. I will refer to this equation as to the *spread equation*. The second equation determines the factors affecting the precision of the spread model; it is therefore called the *variance equation*. Since the parameters of the spread and variance equation are uncorrelated, it is possible to treat the two equations separately as far as variable selection and interpretation.

The spread equation is the following:

SPREAD=f(*Default, Liquidity, Tax, Process, Control*)+ μ

Where:

SPREAD	The difference between the bond yield at issuance and that of a Treasury security with same maturity and currency.
Default	The default risk of the issue and the expected recovery rate in case of default.
Liquidity	The expected secondary market liquidity.
Tax	The expected tax treatment.
Process	Characteristics of the issuing process.
Control	Control variables.

Detailed variable description is reported in Appendix.

The spread equation is estimated with and without the inclusion of issuers' fixed effects. Fixed effects control for omitted firm characteristics that remain constant over time. I do not report the mean equation of the heteroscedastic model. However, to evaluate the variables' explanatory power in term of R^2, I report the mean equation estimated with standard OLS.

More relevant for the purpose of this paper is the variance equation of the heteroscedastic regression model:

SPREADVAR=f(AVGRATING, MATU, AMOUNT, SUBO, COLLAT, MANAGERS, OPEN, *Control*)+ ε

The dependent variable is SPREADVAR, that is the spread variance unexplained by the spread equation. AVGRATING is the average of Moody's and S&P issue ratings converted into a numerical scale (AAA/Aaa is 1, AA+/Aa1 is 2, etc.)[2]. MATU is the years to maturity of the issue. AMOUNT is the natural log of the US dollar equivalent amount (face value) of issue. SUBO is a dummy variable equal to 1 if the bond is subordinated and zero otherwise. COLLAT is a dummy variable equal to 1 if the issue is collateralized and zero otherwise. MANAGERS is the number of banks involved in the syndicate. OPEN is a dummy variable that equals to 1 if the issue is open-priced and zero if it is fixed-priced. Finally, *Control* is a set of variables which includes year, country, and currency fixed effects.

Morgan (2002) and Iannotta (2006) find that opaqueness increases for worse-rated bonds with longer maturity, smaller face value, and lower seniority. If investors' screening effort increases with bond complexity or opaqueness, AVGRATING, MATU, and SUBO should positively affect the residual variance, whereas AMOUNT should have a negative effect on the residual variance. Previous studies do not test the effect of collateral on opaqueness. However, it is possible that the presence of collateral decreases the incentive to deeper screening, thus reducing the spread unexplained variance.

Corwin and Schultz (2005) find that offer prices are more likely to be revised in response to information when the syndicate has more banks involved. If this result holds for bond issues, less concentrated syndicates should result in more information and thus in a lower accuracy of the spread equation. A positive coefficient sign for MANAGERS would result in this case. On the other hand, if more banks are involved a coordination problem might emerge, thus inducing banks to rely on a common source of information (i.e., issue ratings and other easy-to-observe issue characteristics). A negative coefficient would result in this case.

A fixed-priced offer has the offer price set prior to requests of bonds being submitted by investors. Thus, there is no way for the book-runner to get information by prospective investors. In contrast, in an open-priced offer the book-runner canvas potential buyers and then set an offer

[2] As a robustness check I estimate the variance equation using rating dummy variables rather than the AVGRATING variable. Results are unchanged.

price. As such, the open price mechanism should convey more information: OPEN is therefore expected to be positive.

I also report a measure of economic significance. Specifically, I estimate the R^2 change in the spread equation when a given explanatory variable in the variance equation increases from its 10^{th} percentile to its 90^{th} percentile, holding all other variables at their median level. For dummy variables, this estimated R^2 change is computed when the variable increases from zero to one, holding all other variables at their median levels.

As for the spread equation, the variance equation is estimated with and without the inclusion of issuers' fixed effects.

3. DATA

The data are from Capital Data Bondware, which reports information on issuer (nationality, industry, etc.) and issue (spread at issuance, Moody's and S&P ratings, maturity, size, currency, etc.). I collect spreads at issuance for all European bank issues of fixed rate, non-convertible, non-perpetual, and non-callable bonds during the 1999-2007:Q2 period. This sample has 1,497 bonds issued by 108 banks.

When comparing issues from different countries a possible concern is related to institutional differences that may affect the results. For this reason I employ country fixed effects in all regressions. However, it should be noted that many authors document the convergence of the European countries toward a single financial system (Rajan and Zingales (2003), Pagano and Von Thadden, (2004)). This evolution can be primarily attributed to the integration process both at the European level (culminated with the European Monetary Union, EMU) and at a global level. To summarize, it seems that the European bond market can be regarded as a single one and no institutional difference among European countries affect the results.

Table1 provides information on sample characteristics.

4. EMPIRICAL RESULTS

4.1. Descriptive analysis

As shown in Table 1 the standard deviation of spreads increases as credit quality worsens, indicating a greater spread dispersion for worse-rated bonds. This result is consistent with Elton et al. (2001).

Table 2 compares the mean and standard deviation of spreads and ratings across several dimensions. I perfom t-tests for equality of mean and Levene's test for equality of variance. I compare mean and standard deviation for sub-samples of issues with rating below and above the sample median (2, that is AA+/Aa1). Not surprisingly, the average spread is remarkably lower for better-rated bonds relative to worse rated-bonds (29.91 b.p. versus 87.62). Also the spread dispersion is lower for better-rated bonds: this result might be explained by the lower standard deviation of rating. The difference in rating dispersion could also explain the different spread dispersion when comparing sub-samples with maturity and number of managers below and above the sample median. No difference emerge between issues with large face value (above the median) compared to issue with small face value (below the median).

Interestingly, the spread dispersion for subordinated bonds is much higher that that for senior bonds, but there is no difference in terms of rating dispersion. An analogous result emerges for open-priced issues compared to fixed-priced issues. These results support (albeit on an unconditional basis) the idea that investors rely less on rating when the bond is subordinated or open-priced.

4.2. Which factors affect bond pricing?

Table 3 reports different specifications of the spread equation estimated with OLS. In column 1 only issue ratings are employed as explanatory variables. All rating dummy variables (with the exception of AA+/Aa1) are significant at the 1% level and show a monotonic pattern, indicating that spread rises as rating worsens. Ratings alone explain more than 50% of the spread variance. Consistent with previous research (Gabbi and Sironi (2004), Sironi (2003, 2002), Livingston and

Miller (2000), Morgan and Stiroh (1999)) issue rating proves to be the most relevant variable in pricing bonds. When including year, country, and currency fixed effects (Column 2) the R^2 jumps to 68.3%. Among other proxies for default risk and recovery rate only MATU and SUBO are strongly statistically significant and with the expected sign (Column 3). In particular, the result on SUBO indicates that investors require subordinated bonds a higher risk premium than the one implicit in the downgrading applied by rating agencies[3]. Notice that the R^2 further increases to 81.2%. AMOUNT is not significant (Column 4). It is therefore possible that investors do not expect the bond liquidity to be affected by the issue size. Both COUPON and REGIST (the proxy for tax treatment) have a positive statistically significant coefficient, indicating that investors require a higher return to higher coupon issues and registered bonds due to their relatively worse tax treatment. When including these variables the R^2 is equal to 83.3% (Column 5). The issuing process variables (MANAGERS and OPEN) are both significant at the 1% level, but the R^2 increases only to 83.9%. Finally, when issuer fixed effects are employed the results are virtually unchanged and the R^2 is equal to 86.2%.

4.3. Does the issue credit quality affect unexplained spread dispersion?

Column 1 of Table 4 reports results for the variance equation of the heteroscedastic regression model. AVGRATING is positive and strongly significant, thus indicating greater unexplained variance for worse-rated bonds. This result supports the hypothesis that investors discriminate more as the quality of the issue worsens. Investors might put additional "due diligence" effort on lower quality bonds. This result could also be due to the rating process: agencies assign a given rating category to each issue. Is it possible that worse rating categories are broader, i.e. they include more heterogeneous issues than top rating categories. In either case the result supports the idea that the market does not just rely on ratings and other easily observable issue characteristics when pricing worse-rated bonds. In other words, a bad rating is

[3] Agencies tend to rate subordinated issues by subtracting one notch from the corresponding issuer senior debt rating if this is investment grade. If the senior debt rating is speculative grade two notches are subtracted.

less “informative” than a good rating. The result is also economically significant: worsening rating from AAA/Aaa (1, i.e. the 10th percentile) to A/A2 (6, i.e. the 90th percentile), reduces the estimated R^2 of the mean equation of 18.89 percentage points.

4.4. Does unexplained dispersion depend on issue size and maturity?

Spread residual variance appears to depend also on issue maturity and amount. As expected, MATU is positive and strongly significant (Column 1 of Table 4), thus indicating a lower accuracy of the spread equation for longer maturity. This result is most likely the consequence of additional information collected for long-term bonds, which tend to be more complex or opaque. Interestingly, increasing the maturity from 2.7 years (the 10th percentile) to 40 years (the 90th percentile) reduces the estimated R^2 of about 46 percentage points. Although this value decreases when other variables are included in the model, MATU is the single variable with the largest effect on the accuracy of the spread equation.

As expected, AMOUNT is negative and significant at the 1% level (Column 1). This results might be due to the fact that ratings are more informative for larger issues (e.g., rating agencies' effort is higher for more important issues). A change from €102 million (the 10th percentile) to €1,500 million (the 90th percentile) causes an increase in R^2 of 3.72%.

4.5. Do seniority and collateral affect spread residual dispersion?

Column 2 of Table 4 reports results when the subordination dummy variable is included. As expected, SUBO is positive and strongly significant. The accuracy of the spread equation is lower for subordinated bonds, supporting the hypothesis of additional information impounded in the spread of more opaque issues, such as those with lower seniority. The estimated R^2 is 13.45% lower for subordinated bonds compared to senior issues. This result is of particular interest as far as market discipline is concerned, because all the reform proposals call for a mandatory *subordinated* debt requirement for banks. Including the SUBO dummy variable reduces the estimated R^2 change for AVGRATING and MATU to about -10% and -30%, respectively.

COLLAT is negative but not significant (Column 3). The spreads of collateralized bonds are not less dispersed than non-collateralized bonds. The presence of collateral might be already captured by the average rating. Indeed, when AVGRATING is dropped (Column 4) COLLAT becomes strongly significant.

4.6. Do price-setting mechanism and syndicate structure account for unexplained spread dispersion?

The MANAGERS variable is significant, but negative (Columns 5 and 6). More banks involved in the syndicate increases the accuracy of the spread equation. When the number of syndicate members increases from 2 (the 10th percentile) to 12 (the 90th percentile) the estimated R^2 increases of about 2 percentage points. It is a possible that a greater number of banks, rather than conveying additional information, "certify" the rating information. It could also be that more transparent issues are easier to place and thus attract more banks.

As expected, the price setting mechanism seems to be a relevant factor in explaining the spread residual variance. OPEN is positive and significant at the 1% level (Column 6 of Table 4). This result indicates that the predictive power of the spread equation decreases with open-priced offers. The estimated R^2 change is -2.68%. This is consistent with the idea that the open-price mechanism can convey more information, allowing investors a better discrimination among issues.

4.7. Including issuers' fixed effects

The underlying assumption of the empirical analysis is that greater spread residual dispersion means higher investors' screening effort. For more complex or opaque issues investors might look at other issue and issuer characteristics. In both cases the predictive power of the spread equation would be reduced. For example, spreads of subordinated issues might be more dispersed because banks issuing subordinated bonds are more heterogeneous than other banks. The SUBO dummy variable would then capture investors' ability to discriminate among subordinated bond issuers. The same reasoning applies to all other variables of the variance equation. The results might depend on unmeasured bank characteristics that remain constant over time. To test this hypothesis I include issuer's fixed effects in the *spread equation*. Results are reported in Column 7 of Table 4. The main results in the *variance equation* hold, thus indicating that the spread dispersion do not depend on omitted issuer characteristics. In Column 8 I also include issuers' fixed effects in the variance equation. The results are unchanged, with one exception. AMOUNT is not significant anymore.

4.8. Economic significance

The estimated R^2 changes reported in Table 4 are the marginal effects of each explanatory variable of the variance equation. To have an idea of a possible combined effect, I estimate the R^2 of the spread equation for two hypothetical bonds. Bond A is collateralized, non-subordinated, and is a rated AAA/Aaa. The maturity is equal to 2.68 years while the face value is €1,500 million. It is a fixed-priced bond, placed by a syndicate of 12 banks. The unexplained variance for a bond with these characteristics would imply an R^2 of 95.29%. Bond B is non-collateralized, subordinated, and is rated A/A2. Maturity and face value are 40 years and €102 million, respectively. The issue is open-priced by a syndicate with 2 banks involved. The estimated R^2 for Bond B is about zero. Admittedly, it is an extreme example. However, it helps understanding how the variables that explain spreads for the typical bond are virtually useless for more opaque issues.

4.9. Robustness checks

Although I control for macroeconomic and bond market conditions by using year, country, and currency fixed effects, as robustness check I also include the GDP quarterly growth rate. This variable is not significant. All other results hold (not reported). I also use quarter fixed effects (rather than year) both in the spread and variance equations, with no change in the results.

The results about syndicate concentration might depend on the book-runner's reputation. For example, larger syndicates might be led by more reputed banks. As a result the MANAGERS variable would just capture a reputation effect. I estimate the variance equation including three different measures of reputation: i) the market share (in the corresponding year) of the book-runner in the European bond syndication market, ii) a dummy variable equal to one if the book-runner is among the top three banks of the league table for European bond syndication (in the corresponding year) and zero otherwise, and iii) a dummy variable equal to one if the book-runner is a US investment bank and zero otherwise. Results, not reported, indicate the reputation (with either proxy) is not a relevant factor in explaining the spread residual variance. Moreover, all the other results are unchanged. Results are unchanged even including the different measure of reputation in the spread equation, where they turn out to be not significant.

Finally, I run regressions replacing MATU and BANKS, with the natural log of years to maturity and number of banks. All results hold.

5. CONCLUSIONS

Three main results emerge from the empirical analysis. First, variables that predict quite accurately the spread for the typical bond loose their explanatory power for worse-rated, subordinated bonds with smaller face value and longer maturity, indicating a deeper investors' screening for more complex and opaque issues. Second, spread unexplained dispersion decreases with the number of banks involved in the syndicate. Third, spread unexplained dispersion increases for open-priced offers, indicating that this price-setting mechanism generates additional information relative to the fixed-price approach. These results have important policy implications for any proposal which aims at strengthening the market discipline of banks.

Rating is the single most important factor affecting the spread level. Nonetheless, excessive reliance on rating agencies' opinion can be dangerous. Several times in the past rating agencies proved to be late or inaccurate in revising their opinion (e.g., Enron, Parmalat, and more recently, the case of sub-prime mortgages crisis). If spreads mostly depend on credit ratings, then what is called market discipline would rather be a "rating agencies' discipline". Supervisors would be sharing the burden of banking oversight with raters, not with investors. My results appear encouraging, as they support the idea that investors increases their screening effort for worse rated-bonds. While a good rating predicts fairly accurately the yield spread of a bond, a bad rating appears much less informative. More in general, the market seems able to go beyond easy-to-observe variables such as rating, maturity, face value, etc., and do it so especially when it is more needed.

The results also suggest some possible features of a formal mandatory subordinated debt policy. Spreads of bonds with longer maturity and smaller size incorporate additional information. Moreover, an open-price approach allows a better market screening. The ideal issue for market discipline purposes would therefore be an open-priced subordinated bond, with long maturity and small face value.

APPENDIX

The spread equation is the following:

SPREAD=f(*Default, Liquidity, Tax, Process, Control*)+ μ

where:

SPREAD The difference between the bond yield at issuance and that of a Treasury security with same maturity and currency.

Default The default risk of the issue and the expected recovery rate in case of default.

Liquidity The expected secondary market liquidity.

Tax The expected tax treatment.

Process Characteristics of the issuing process.

Control Control variables

I employ the following proxies for default risk:

Rating It is the Moody's and Standard and Poors (S&P) issue rating. In the regression ratings are employed as dummy variables, each equal to one if the issue falls in the corresponding rating category and zero otherwise. The coefficient on each dummy variable measures the spread difference between that rating and the top rating (AAA/Aaa), which is the excluded category. Dummies should capture non-linear relationship between ratings and spreads.

MATU Years to maturity of the issue. A positive coefficient is expected as longer maturity bonds require a higher spread.

SUBO A dummy variable equal to 1 if the issue is subordinated and zero otherwise. Since subordinated bonds have lower recovery rate, the expected coefficient sign is positive. However, the effect of lower seniority should be reflected in the issue rating. The statistical significance of the coefficient might thus be poor.

COLLAT A dummy variable equal to 1 if the issue is collateralized and zero otherwise.

Given the higher recovery rate, collateralized bonds should have lower spreads. As for seniority, however, the presence of collateral should be already captured by the issue rating.

CROSS A dummy variable that equals 1 if the bond issue has a cross-default clause and zero otherwise. The cross-default clause avoids the possibility of selective default on the part of the issuer. If the issuer is insolvent on one loan or bond issue, it is automatically considered as insolvent on all other loans and obligations. This clause is beneficial to investors: a negative sign is therefore expected.

NEGATIVE A dummy variable that equals 1 if the bond issue has a negative pledge clause and zero otherwise. The negative pledge clause avoids the possibility for the issuer to use part of its assets as collateral for future debt obligations. A negative sign is thus expected.

As a proxy for secondary market liquidity the following variable is used:

AMOUNT The natural log of the Euro equivalent amount (face value) of issue. Larger face value should enhance liquidity. A negative sign is therefore expected.

The following variables are employed as proxies of tax treatment:

COUPON The coupon rate. 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 holder of the bond has control over the time when these taxes are paid. A positive coefficient is therefore expected.

REGIST A dummy variable equal to 1 if the bond is registered and zero if it is in bearer form. It is easier to avoid or minimize tax payments for bearer bonds. Moreover, bearer bonds tend also to more liquid. A positive coefficient sign is therefore expected.

The following issuing process characteristics are employed:

MANAGERS	The number of banks involved in the syndicate. A less concentrated syndicate should be able to tap a broader investor base. The resulting higher demand should lower the spread. A negative coefficient sign is then expected.
OPEN	A dummy variable that equals to 1 if the issue is open-priced and zero if it is fixed-priced. The investment banks involved in the syndicate take a higher underwriting risk with fixed-priced issues than with open-priced ones. To minimize this risk, the syndicate might set a lower price in fixed-priced offerings, thus increasing the spread. A negative coefficient sign is therefore expected. On the other hand, the open-price approach might be used for issues with weaker demand, which in turn would result in a higher spread. A positive sign would result this case.

Control is a set of control variables which includes:

D99, D00, …, D07	Year dummies. Each dummy variable is equal to one if the issue has been completed during the corresponding year and zero otherwise.
Austria, Belgium, Denmark, Ireland, France, Germany, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden, United Kingdom, Othercou	Country dummies. Each country dummy variable is equal to 1 if the issuer nationality is that of the corresponding country and zero otherwise.
EUR, STG, USD, NKR, YEN, AUD, CAD, Othercur	Currency dummies. Each dummy variable is equal to 1 if the bond issue is denominated in the corresponding currency and zero otherwise.

The D99, Othercou, and Othercur dummy variables are dropped to avoid collinearity in the data[4].

[4] The Othercou and Othercur dummy variables include currencies and countries for which less than 10 observations are available.

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Table 1 – Sample Descriptive Statistics (by Rating Categories)

Rating	N. of Issues	Spread (b.p.)		Maturity (years)	Amount (Euro, m)	Coupon (%)	N. of Managers	Subo.	Collateral	Cross-default	Neg. Pledge	Registered	Open
		Mean	Std. Dev.	Mean				(N. of Issues)					
AAA/Aaa	698	29.91	20.77	6.26	710.46	4.38	6.84	1	566	134	120	63	183
AA+/Aa1	109	31.74	33.40	5.96	877.04	4.03	8.69	7	79	15	13	17	40
AA/Aa2	142	52.89	30.85	7.90	453.78	4.89	6.85	22	22	62	36	8	36
AA-/Aa3	121	63.29	32.95	12.26	505.58	4.96	6.98	55	8	35	29	9	25
A+/A1	196	103.86	61.45	21.03	425.66	5.77	5.68	134	1	61	65	21	38
A/A2	124	109.79	61.74	19.17	450.37	5.70	5.10	90	0	37	34	21	38
A-/A3	63	145.72	81.76	25.52	443.65	6.22	4.00	53	1	7	5	17	18
BBB+/Baa1	32	174.68	74.36	34.18	427.63	6.02	3.69	29	3	4	6	11	5
BBB/Baa2	10	205.47	94.25	27.52	316.60	6.50	2.30	8	0	2	2	3	1
BBB-/Baa3	2	289.50	98.29	40.00	414.47	7.00	2.00	2	0	0	0	0	0
Total	1,497	60.52	58.81	11.47	603.65	4.87	6.46	401	680	357	310	170	384

Table 2 – Sample Descriptive Statistics – (by Issue Characteristics)

		Rating		Maturity		Amount		Subordinated		Collateral		N. of Managers		Open-priced	
		Below	*Above*	*Below*	*Above*	*Below*	*Above*	*Yes*	*No*	*Yes*	*No*	*Below*	*Above*	*Yes*	*No*
N. of Issues		748	749	748	749	748	749	401	1,096	680	817	748	749	384	1,113
Spread	Mean	29.91	87.62	31.72	89.35	60.97	60.44	130.97	35.00	26.45	89.22	80.22	42.48	66.64	58.66
	(t-test)	(0.000)***		(0.000)***		(0.863)		(0.000)***		(0.000)***		(0.000)***		(0.037)**	
	Std. Dev.	20.77	67.51	22.54	68.79	58.59	59.12	66.20	25.67	16.82	65.72	70.69	36.66	67.12	55.58
	(Levene's test)	(0.000)***		(0.000)***		(0.466)		(0.000)***		(0.000)***		(0.000)***		(0.000)***	
Rating	Mean	1.00	4.45	1.86	3.81	2.90	2.79	5.41	1.90	1.22	4.19	3.45	2.27	2.70	2.89
	(t-test)	(0.000)***		(0.000)***		(0.327)		(0.000)***		(0.000)***		(0.000)***		(0.148)	
	Std. Dev.	0.00	1.78	1.44	2.30	2.17	2.14	1.48	1.50	0.73	2.02	2.37	1.75	2.11	2.17
	(Levene's test)	(0.000)***		(0.000)***		(0.978)		(0.695)		(0.000)***		(0.000)***		(0.313)	

Below and *Above* indicate sub-samples for which the corresponding variable is below and above the sample median, respectively. Reported are the t-test (p-value) for equality of mean and the Levene's test (p-value) for equality of variance. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively

Table 3 – OLS Regression of SPREAD on Issue Characteristics

Reported are regression coefficients and p-values (in parenthesis). The dependant variable is the difference between the bond yield at issuance and that of a Treasury security with same maturity and currency. Detailed information about the explanatory variables is reported in Appendix. F denotes the p-value of the F-test for the null hypothesis that all coefficients jointly equal zero.

	1	2	3	4	5	6	7
AA+/Aa1	1.824	4.002	4.026	3.809	5.424**	4.990*	10.671***
	(0.670)	(0.262)	(0.153)	(0.177)	(0.043)	(0.060)	(0.001)
AA/Aa2	22.928***	0.308	3.579	3.650	4.088	3.361	4.307
	(0.000)	(0.929)	(0.264)	(0.255)	(0.177)	(0.262)	(-8.685)
AA-/Aa3	33.354***	22.295***	5.416	5.306	4.795	4.462	4.864
	(0.000)	(0.000)	(0.122)	(0.130)	(0.147)	(0.172)	(0.275)
A+/A1	73.907***	57.830***	20.080***	20.199***	17.692***	16.931***	17.643***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
A/A2	79.805***	62.864***	28.247***	28.377***	23.628***	21.936***	27.901***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
A-/A3	115.792***	93.544***	44.174***	44.463***	37.633***	36.051***	41.218***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BBB+/Baa1	144.749***	136.635***	68.847***	69.291***	61.062***	59.803***	71.724***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BBB/Baa2	175.399***	163.799***	103.530***	104.423***	90.090***	89.090***	101.869***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BBB-/Baa3	259.499***	232.640***	155.208***	155.688***	144.393***	145.111***	53.618**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.024)
MATU	-	-	1.966***	1.943***	1.531***	1.574***	1.660***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SUBO	-	-	23.018***	23.177***	22.038***	21.008***	21.038***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
COLLAT	-	-	-3.941	-4.366	-1.846	-3.989	-1.933
			(0.243)	(0.199)	(0.566)	(0.209)	(0.653)
CROSS	-	-	-3.586	-3.697	-1.409	-2.504	-4.123
			(0.271)	(0.257)	(0.648)	(0.410)	(0.201)
NEGATIVE	-	-	-4.581	-4.339	-5.132	-3.222	-1.396
			(0.188)	(0.213)	(0.119)	(0.322)	(0.700)
AMOUNT	-	-	-	1.032	1.132	0.264	0.085
				(0.229)	(0.171)	(0.766)	(0.926)
COUPON	-	-	-	-	11.828***	11.243***	10.031***
					(0.000)	(0.000)	(0.000)
REGIST	-	-	-	-	10.662***	9.856***	10.283***
					(0.000)	(0.000)	(0.000)
MANAGERS	-	-	-	-	-	-0.552***	-0.659***
						(0.001)	(0.000)
OPEN	-	-	-	-	-	10.558***	10.358***
						(0.000)	(0.000)
Obs.	1,497	1,497	1,497	1,497	1,497	1,497	1,497
F	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.504	0.683	0.812	0.812	0.833	0.839	0.862
Year, Country, and Currency Fixed Effect	NO	YES					
Issuer Fixed Effect	NO						YES

***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively

Table 4 – Heteroscedastic Regression of SPREADVAR on Issue Characteristics

Reported are regression coefficients and p-values (in parenthesis). The dependant variable is the spread variance unexplained by the spread equations reported in Table 3 (Columns 6 and 7). Equations are estimated with heteroscedastic regression model. χ^2 denotes the p-value of the chi-square test for the null hypothesis that all the coefficients jointly equal zero. The value in square brackets is the R^2 change in the spread equation when the explanatory variable in the variance equation increases from its 10^{th} percentile to its 90^{th} percentile, holding all other variables at their median level. For dummy variables, this estimated R^2 change is computed when the variable increases from zero to one, holding all other variables at their median levels.

The explanatory variables are defined as follows:

AVGRATING	The average of Mooyd's and Standard & Poors issue ratings.
MATU	Years to maturity of the issue.
AMOUNT	The natural log of the Euro equivalent amount (face value) of issue.
SUBO	A dummy variable that equals one if the bond is subordinated and zero if it is senior.
COLLAT	A dummy variable that equals to 1 if the issue is collateralized, zero otherwise.
MANAGERS	Number of banks involved in the syndicate.
OPEN	A dummy variable that equals to 1 if the issue is open priced and zero if it fixed.

I also control for year, country, and currency fixed effects. I do not report these variables' coefficient for ease of exposition.

	1	2	3	4	5	6	7	8
AVGRATING	0.275***	0.181***	0.177***	-	0.169***	0.169***	0.162***	0.168***
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.001)
	[-18.89%]	[-10.20%]	[-10.08%]		[-10.25%]	[-7.59%]	[-4.95%]	
MATU	0.056***	0.045***	0.045***	0.053***	0.043***	0.045***	0.049***	0.054***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[-46.70%]	[-29.59%]	[-30.25%]	[-73.16%]	[-30.66%]	[-24.01%]	[-19.72%]	
AMOUNT	-0.161***	-0.139***	-0.138***	-0.135***	-0.087*	-0.148***	-0.101**	-0.054
	(0.000)	(0.003)	(0.003)	(0.004)	(0.073)	(0.004)	(0.047)	(0.811)
	[3.72%]	[3.14%]	[3.16%]	[5.40%]	[2.15%]	[2.74%]	[1.28%]	
SUBO	-	0.963***	0.954***	1.100***	0.966***	0.912***	1.002***	1.079***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
		[-13.45%]	[-13.45%]	[-29.40%]	[-14.87%]	[-10.13%]	[-8.05%]	
COLLATERAL	-	-	-0.032	-0.592***	-0.090	-0.118	-0.072	-0.139
			(0.837)	(0.000)	(0.568)	(0.453)	(0.648)	(0.511)
			[0.27%]	[6.56%]	[0.78%]	[0.76%]	[0.32%]	
MANAGERS	-	-	-	-	-0.031***	-0.030***	-0.044***	-0.071***
					(0.002)	(0.002)	(0.000)	(0.000)
					[2.72%]	[2.24%]	[1.96%]	
OPEN	-	-	-	-	-	0.332***	0.282***	0.414***
						(0.001)	(0.003)	(0.000)
						[-2.68%]	[-1.52%]	
Obs.	1,497	1,497	1,497	1,497	1,497	1,497	1,497	1,497
χ^2	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pseudo R^2	0.257	0.259	0.259	0.258	0.260	0.261	0.270	0.309
Fixed Effect (Spread Eq.)	NO						YES	
Fixed Effect (Variance Eq.)	NO							YES

***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively