Subordinated Debt as Instrument of Market Discipline: Risk sensitivity of sub-debt yield spreads in UK banking

Zhichao Zhang[a] Wei Song[a] Xin Sun[a,*]

[a] Durham University Business School, Green Lane , Durham University, Durham, United Kingdom DH1 3LA

Abstract

This paper empirically examines whether yield spreads of subordinated debt issued by UK banks are sensitive to bank risks, with a dataset that includes spreads, ratings, accounting measures of bank risks and market condition indexes in the sample period between 1997 and 2009. The results show that Moody's and S&P traditional ratings have significant and negative impacts on spreads, and investors have exercised sensible discrimination between different risk profiles of UK financial institutions. However, accounting measures show an absence of the explanatory power of the spreads. Market condition indicators, particularly those related to European markets, also have significant influence on credit yield spreads. The findings indicate that, in the UK, sub-debt spreads do reflect the issuing banks' risk-taking, hence satisfying a critical precondition for sub-debts to be an instrument of market discipline in banking.

Jel classification: G21; G28; L51

Keywords: UK banking industry; Market discipline; Subordinated debt; Yield spreads;

Financial regulation.

[*] Postal Address: Durham University Business School, Green Lane Durham University, Durham, United Kingdom DH1 3LA. Tel.: +44 777 558 8152. Email address: xin.sun@durham.ac.uk

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1. Introduction

The financial crisis has exposed underlying deficiencies of the current banking supervision. The growing size and complexity of banks makes it increasing difficult for regulators to monitor and control banks' excessive risk-taking through traditional means. Policy designs such as the deposit insurance scheme and the too-big-to-fail problem as highlighted by government bailouts in recent years further compound the situation. This leads to rekindled interests in considering involving market discipline in reform of bank regulation (Evanoff, Jagtiani and Nakata, 2011).

An essential element in the proposals for promoting market discipline in the banking industry is the mandatory issuance of subordinated debts (sub-debts) by large banks at regular intervals. Success of the sub-debt proposals however is crucially dependant on whether yields on sub-debts are correlated with banks' risk-taking (Evanoff and Wall 2001; Goyal 2005). Defined as the difference between the yields on sub-debt and the yields on a Treasury security issued in the same currency with similar maturity (Balasubramnian and Cyree, 2011), the sub-debt spread could embed information about financial conditions of the bank if it is found to reflect a bank's risks. Then based on the spreads, market participants could evaluate investment in the banks concerned. Banking supervisors could also benefit from monitoring the spreads since the market information conveyed by the spreads have proved to be as good as or even better than the information extracted from the traditional off-site monitoring practice at predicting the riskiness of banks (Evanoff and Wall, 2001, 2002). It can

therefore also facilitate early detection of stressed banks (Jagtiani and Lemieux, 2001), and hence better allocation of regulatory resources.

While several studies show that sub-debt spreads reflect bank risks (Hancock and Kwast, 2001, Morgan and Stiroh, 2001, and Sironi, 2003), there are reports indicating that evidence of the existence of a risk-spread relationship is either weak or insignificant, casting doubts on the usefulness of sub-debts being deployed as a channel for market discipline. Evanoff et al. (2011) suggest that the quality of market signal is an evolving process; it may improve when the same country shifts to a new environment where the sub-debt market becomes deeper. This research contributes to the debate with evidence from a different country than the U.S.A but also has a well-developed banking market and comparable sub-debt market.

We in this study examine the risk sensitivity of UK banks' sub-debt spreads. Previous research mainly concerns the US banks, and to a lesser extent European and Japanese banks. Our study complements the plethora of prior empirical studies by analysing the UK market. British banks have their particular attractions as a case for studying desirability and feasibility of subordinated debt as an instrument of market discipline.

In the global subordinated debt market, the British banks have been very active. According to the Basel Committee of Banking Supervision (2003), in terms of amounts issued, the British sub-debt market is no smaller than the US market. In terms of sub-debt issued through public placement, the UK market is even greater than all other European markets putting together. However, the existing literature is largely silent about this very important UK market. Moreover, most of the debt securities issued by the UK banks are publicly placed, hence the scope for and depth of the working of market discipline via sub-debts could be substantial in the UK

banking industry, as compared to privately issued debt, as is the situations in Germany and Japan.

To investigate the risk-spread relationship in the UK, a dataset is constructed over the period of 1997 – 2009, which contains spreads, ratings, accounting measures of bank risks and market condition indicators. Our empirical evidence confirms that the UK banks' sub-debt spreads are related to risk measures assigned by traditional rating agencies. Particularly for Moody and S&P ratings, when ratings worsen, spreads rise. Furthermore, sub-debt investors seem to have rational discriminations between different risk profiles of UK credit institutions. Some accounting measures of bank risks show an absence of explanatory power of spreads, hence there is a lack of evidence that the spreads reflect the risk indicators in terms of accounting measures. Market conditions, especially European market indicators, have a significant impact on the yields.

These findings confirm that, in the UK, sub-debt spreads are sensitive to the issuing bank's risk-taking behaviour and its strategic decisions. Given this, market participants have incentives to extract information from the spread and allay information asymmetry. As a result, they can require appropriate premiums according to banks risk levels, implying that the risk-sensitive spreads can promote the market (sub-debt holders) to exert discipline on banks through the cost effect. By revealing evidence on influences of different components of the risk-spread nexus, this research also provides a wider-ranging understanding of the role of the spread in the market discipline mechanism, hence advances the existing knowledge on the relevant factors that affect the risk-spread relationship and feasibility of sub-debt as an avenue for market discipline (e.g. Sironi, 2003; and Caldwell, 2007).

The structure of this paper is organized as follows: section two presents a review

of prior studies. The econometrical formations of the model to be estimated and methodology used in this research are outlined in section three. In section four the data sources are explained and sample characteristics are described. Interpretations of the empirical results are shown in section five, while section six concludes the paper.

2. Related Literature

Earlier studies find a general lack of sensitivity of the spreads to bank risks Avery, Belton, and Goldberg (1988) find no significant effect of balance sheet risk measures on the spreads, and conclude that market investors do not discipline and control bank risk-taking in the usual manner. Gorton and Santomero (1990) regress the implied asset volatilities on the risk indicators, only to find virtually no relation between a bank's risk measures and its implied asset volatility. This led them to believing that there is little support for the presence of market discipline in the subordinated debt market. But these finds are based on data from the early 1980s.

Significant evidence however emerges in later empirical investigations, particularly after 1991 when the Federal Deposit Insurance Corporation Improvement Act was enacted. Flannery and Sorescu (1996) and DeYoung, Flannery, Lang and Sorescu (2001) show that, the spreads are correlated with the riskiness of American banks. Jagtiani and Lemieux (2000) confirm that bond markets differentiate banks with different levels of risk exposure. Morgan and Stiroh (2000) investigate the disciplinary role of markets using the spreads, ratings, and bank portfolio data on bond issues including nearly 600 of those issued by banking organizations between 1993 and 1998. They find that the market prices bank risk efficiently and banks contemplating a shift into riskier activities would expect to pay higher spreads as a result. According to them, that is market discipline. Fan, Haubrich, Ritchken,

Thomson (2003) find that credit spreads on both sub-debts provide relatively clean signals of bank risk that are not unduly influenced by non-risk factors. Other research that has found a significant risk-spread relationship can be found in Allen, Jagtiani, and Moser (2001), DeYoung, et al. (2001), Jagtiani and Lemiexu (2001), Jagtiani, Kaufman, and Lemineux (2002), Flannery and Nikolova (2003), Sironi (2003), Hamalainen, Howcroft and Hall (2007, 2010), Hamalainen, Pop, Hall and Howcroft (2012), Evanoff, et al. (2011). Research by Evanoff and Wall (2001, 2002) additionally show that sub-debt spreads can even be better at identifying problem banks than traditional off-site monitoring measures used by U.S. bank supervisors.

Despite the growing evidence of a positive risk-spread relationship in sub-debt, concerns persist about the existence of some influences that may impede the efficacy of the spreads as a signalling device of market discipline (Blum, 1999, 2002). Flannery and Sorescu (1996), for example, point out that the "too-big-to-fail" (TBTF) perception may mislead sub-debt creditors into believing that they would not suffer credit losses on debt issues of the largest banks. Hence, this can (and will) distort the risk-spread relationship. While the Federal Deposit Insurance Corporation (FDIC) imposed losses on sub-debt holders at failed large banks in the late 1980s and passed the least-cost resolution provisions in 1991 as part of Federal Deposit Insurance Corporation Improvement Act (FDICIA), the TBTF mentality is hardly dispelled among debt-holders, hence the continuation of the distortion. Recognizing the usefulness of the sub-debt yield in supervisory monitoring, Hancock and Kwast (2001) underscore the need of careful judgment when interpreting the spreads, since the risk-spread relationship could be affected by factors such as relative issuance size, age of the issuer, and size of the issuing banks. Krishnan, Ritchken and Thomson (2005) maintain that both yield spread levels and changes should reflect risk along the entire

yield spread curve. They find that, over 1994 – 1999, changes in yield spreads do not reflect changes in default risk, although yield spread levels do reflect firm-specific risks. Similar scepticism about the information contents and quality of the spreads can be found in Board of Governors (2000), Bliss and Flannery (2001), Birchler and Hancock (2004), among others.

Balasubramniam and Cyree (2011) argue that three factors are omitted in previous research: (1) The reduction in the default risk after introduction of trust-preferred securities in 1996; (2) Enhanced TBTF perception of debt-holders after bailout of the Long Term Capital Management in 1998, which reduces the risk sensitivity of the spreads. (3) The increase in idiosyncratic volatility. The paradigm changes following the LTCM bailout cause some traditional determinants of yield spreads to become irrelevant. On the other hand, the firm-level volatility becomes a critical determinant of banks' default risk. Plugging these factors into the same regression model used by previous research (together with the tax effect) and examining the full sample from 1994 – 1999, they find that the level of sub-debt spread reflect firm-specific default risks. In response to criticism about the quality of sub-debt signal, Evanoff et al. (2011) argue that previous studies evaluated the spreads when the sub-debt market was underdeveloped. With a fully implemented sub-debt program, the signalling quality may change. They present evidence to show a superior risk-spread relationship when the sub-debt market has greater liquidity and transparency, such as the one surrounding the period of new debt issuance.

International evidence about the risk-spread relationship in the sub-debt market is diverse as well. In Canada, Caldwell (2007) develops a dynamic model of banking competition to compare which capital instrument is most effective in disciplining Canadian bank's risk choice. Recognizing that sub-debt spreads can reflect the issuing

bank's riskiness, the research finds that equity weakly dominates sub-debts and uninsured deposit, with sub-debt weakly dominating uninsured deposit in discipline banks. Imai (2007) shows that the sub-debt spreads can differentiate banks in terms of the level of risk they take. Investors are found to punish risky banks by requiring higher return rates. Such sensitivity of yield spreads in Japanese banks increases dramatically after the removal by the Japanese government of implicit guarantees. However, evidence of the relationship between spreads and accounting indicators of bank risk is weak.

Bruni and Paterno (1995) were among the first to empirically investigate into the risk-spread relationship in European banks. They find some evidence of sensitivity of sub-debt yields to Moody's ratings, suggesting the spreads can reflect European banks' riskiness. But their research is restricted to only one day price information of 28 bonds.

Sironi (2001, 2003) provides a comprehensive analysis of whether private investors discriminate between the risks taken by large European banks. The work centres on testing the risk sensitivity of European banks' at-issue sub-debt spreads. He finds evidence that investors in the primary sub-debt market are sensitive to bank risk and the sensitivity to measures that excludes implied governmental guarantees is on the rise for the second half of the 1990s. However, sub-debts issued by public banks, i.e., government owned or guaranteed show no such sensitivity.

Gropp, Vesala and Vulpes (2006) tackle the informativeness of the spreads from a different angle. Using a sample of EU banks, they test for the predictive performance of the spreads, along with the distance to default, and find that the spreads are reliable early-warning signals but only shortly before the material downgrading of the traditional ratings. Additionally, they find that the predictive power of spreads will be

weakened by implicit safety nets.

Birchler and Facchinetti (2007) finds mixed evidence on information content of the sub-debt spreads in Switzerland banks. For non-state-owned banks, sub-debt spreads are informative as the spreads react to changes in the risk profile of the issuer. But for cantonal banks, this sensitivity disappears mainly because liabilities of these public banks are guaranteed by the state hence distorting investors' perception of the riskiness of the issuing banks. Furthermore, there is little evidence that information from the spreads is useful to Swiss banking supervisor as early warning indicators. The sub-debt market does not seem to have more timely information about individual institutions than the banking supervisor.

Pop (2009) recently complements Sironi's (2003) research by focusing instead on the secondary market yield spreads. On the whole, the research findings suggest that credit spreads are sensitive to the financial conditions and risk profiles of bank issuers, as reflected in traditional credit ratings and especially Moody's Bank Financial Strength and Fitch-IBCA Individual ratings. But the relation between the spreads and various accounting measures of bank risk and performance is weaker.

Research into the UK case is quite thin (Baumann and Nier, 2003; Hamalainer, et al. 2003; Hamalainen, et al. 2007, 2010; Hamalainen, et al. 2012). Hamalainen et al. (2003) focus on examining the mandatory subordinated debt policy in the UK and assessing the suitability of introducing into UK banking regulation the mandatory subordinated notes and a debentures policy. Furthermore, the authors explore the issuance of sub-debts and their characteristics at the firm level of a bank and, uniquely, considered them in relation to regulatory, structural and economic events that are either specific to the UK or otherwise affect international banking. The findings are that sub-debt spreads are able to reflect banks' financial health as

measured through balance-sheet or other market indicators. The UK evidence is important since, in value terms and for public placement, the UK sub-debt market is the second largest after the US. However, compared to the numerous studies on the US sub-debt market, the UK case is much under-researched.

In the previous literature, using rating indicators assigned by different rating agencies appears to be intuitive. Sironi (2003) employs the Moody's Banking Financial Strength (MBFS) and Fitch IBCA individual (FII) ratings to analyze data concerning issuers, investors, markets and securities structure. The research has a unique comprehensive browse through the market of banks' subordinated notes and debentures in Europe.

The use of accounting variables in previous research is quite common. Flannery and Sorescu (1996) hypothesize that a bank's spread should increase relative to the level of risk implied by its accounting reports as measured by loan quality, leverage, interest rate risk exposure, and profitability. In addition, debt-holders could monitor banks' risk through these accounting indicators. Benink and Benston (2005) claim that the present regulatory structure of European banks is unlikely to achieve banking stability in the future based on the record of and changes in EU banking regulation, new data on bank capital/asset ratios in ten European countries and an analysis of market and technological changes.

Very few studies have considered market condition variables. But Park and Perostiani (1998) do use several market variation control variables, intending to test the presence of depositor discipline, including local banking wage and state population growth.

3. Empirical Models and Methodology for the Risk-Spread

Relationship

As in the previous literature, this study also correlates the yields to maturity spread of subordinated debt to observable risk measures in the UK banking industry. Previous proposals have recommended using subordinated debt yield spreads as a trigger for supervisory discipline. Evanoff and Wall (2001) provide the first empirical analysis of the relative accuracy of various capital ratios and subordinated debt spreads in predicting a bank's condition, suggesting that the performance of sub-debt yield spreads satisfy an important pre-requisite for using sub-debt as a trigger for regulatory action, which is known in the USA as Prompt Correct Action (PCA). The main reason for this is that some capital ratios, including the summary measure currently used to trigger PCA, have almost no predictive power. However sub-debt yield spreads of US banks perform slightly better than the best capital measure, the Tier – 1 leverage ratio.

For the UK banking industry, we estimate the following baseline regression equation:

$$SPREAD = f(RISK, MATU, AMOUNT, CURR, \text{Market conditions}) + \varepsilon_i \quad (1)$$

The spread is calculated as the difference between the yields to maturity of sub-debt at launch of issuance and the yield to maturity of corresponding currency Treasury security with a similar maturity. Maturity, amount and currency are sub-debt features. The maturity measured as the time to maturity (in years) of issue, the amount in the log of the US dollar equivalent amount of issue, and the currency adopted is the currency of denomination of issuance. The risk variable is captured by two alternative measures of the default risk of the issuing banks: the rating risk and bank risk, where:

Rating Risk = (S&P ratings, Moody's ratings, Fitch ratings, Moody's Long Term ratings) (2)

Bank Risk = f (Leverage, Profitability, Asset Quality, Liquidity) (3)

In addition, the following bank-specific accounting variables are employed:

LEV: the ratio of total (book) liabilities to the book value of equity. Higher leverage indicates higher default risk.

ROA: the ratio of annual net income to the average of the proceeding and current year-end total assets.

NLTA: the ratio of net loans to total assets.

EITA: the ratio of equity investments to total assets.

LIQ: the ratio of liquid assets to customers' deposits and short term funding.

LLRGL: the ratio of loan loss reserves to total loans.

FEST 100, FETS Euro, Nikkei, NASDAQ, Libor3M and Euro Libor 3M are used as market condition variables, to examine whether the blooming of sub-debt is because issuers realize that subordinated debt is a promising instrument of market discipline, or simply because the issuing banks and investors want greater portfolio investments.

Control variables used in the four alternative specifications include:

MATU: the time to maturity of issue.

AMOUNT: the natural log of the US dollar-equivalent amount of the issue.

STG, EURO, USD, OTHERCUR: currency dummies, i.e. pound sterling, the euro, US dollar and other currencies.

Size: a control variable for the size of the issuing bank. It is calculated as a natural log of issuing bank's total assets.

Ratings given by the Standard & Poor, Moody's and Fitch for each single issue are used as a measure of the default risk. These are the ratings assigned by one or all three rating agencies to a single issue at the time of issuance. Meanwhile, they can also reflect both the issuing bank's default risk and the facility's seniority and security

structure. In addition to the single issue ratings, Moody's Long Term issuer ratings, which focus on the role of the issuing banks' default risk, address the possibility that a financial obligation will not be honoured as promised. Such ratings reflect both the likelihood of default and the probability of a financial loss suffered in the event of default. Since Moody's Long Term ratings were introduced more recently, they are only available for a smaller subset of issues. Dummy variables allow more flexibility than would result from imposing a linear specification, therefore, ratings are represented by dummy variables in both two ratings-based specifications, with each dummy variable equal to 1 if the issue or issuer has the corresponding grade and 0 otherwise.

In contrast to most of the studies on market discipline conducted using US banks' subordinated notes and debentures data, this study is based on UK's primary market spreads. The liquidity of the secondary market for European banks is generally quite poor, therefore, the use of secondary market spreads is avoided. Furthermore, yields on newly-issued bonds can reflect actual transaction prices, rather than "indicative prices", which are estimated by brokers and derived from pricing matrices or dealers' quotes. At the present time, from a bank's point of view, yields of subordinated debt can provide a more accurate measure of actual cost, and also satisfy investors because of the provision of a more sophisticated measure of the risk premium measure. Another significant reason for using primary market spreads in this study is that the rating reflects the rates' assessment near the time of the initial issuance (Federal Reserve System Study Group on Subordinated Notes and Debentures, 1999).

All these specifications are estimated by fixed and random effects to reveal whether variation in independent variables within a bank affects the spreads differently than it does between issuers. The White method is used in covariance

matrices for the intention of correcting the heteroscedasticity problem in estimation. The Hausman test is used to compare the random and fixed effects of the estimated coefficients. The result is used to help decide which of the two models is more appropriate for adoption in the empirical investigation.

4. Data Sources and Sample Characteristics

The data is mainly taken from Moody's Credit Report, Thompson One Banker and Datastream. Spreads of issued subordinated debt are fixed-rate, subordinated notes and debentures issued by UK banks. The sample period is between 1997 and 2009, covering 631 issues of subordinated notes and debentures.

For this sample from 1997 to 2009, two pronounced surges of sub-debt issuance need to be noted. First, in the late 1990s and early 2000s, especially around the period from 1999 to 2001, a relatively large number of subordinated debt issues was completed, compared with previous years. There are several possible reasons. Partly, the European banks' sub-debt issues showed a general increase in the average number, indicating that European banks tended to issue subordinated debt when the market was more receptive (Sironi, 2003). The Russian financial crisis in 1998 is another reason for the larger number of issues during this period, since the banks were in a great need to replenish their capital

Sub-debt issuance saw another upsurge around 2005 and 2006. This was largely the consequence of the launch of the New Basel Capital Accords (Basel II), which are recommendations for banking laws and regulations drafted by the Basel Committee on Banking Supervision. The initial purpose of Basel II, published in June 2004, was to create an international standard for banking regulators when writing regulations about how much capital banks need to put aside in order to guard against the types of

financial and operational risks they face. However, this new recommendation consequently spurred banks to issue sub-debts to top up their capital

That the sample period happened upon these episodes of sub-debt upsurges should not limit adequacy of our sample as a basis for answering the key questions of this study. The upsurge in the first episode largely reflects the usual responses of banks to changing economic and market conditions. The second spike of sub-debt issuance results from the Basel II Accords' establishment of the market discipline as the third pillar of banking regulation. Neither case would erode the validity of research into the signalling effect of sub-debts as a practical instrument of market discipline.

Moody's rating at issuance for these 631 issues are either from Moody's rating watch list, or from Thompson One Banker. The former list is a relatively complete history of Moody's long term rating assignments for both individual bonds and issuers, and for U.S and non-US corporations and sovereign bonds, including issuer names, locations, ISIN (International Securities Identification Number), bond issuance dates, maturity dates, ratings and coupons. The latter list provides detailed reports about subordinated bond issues in the primary market, including the basic information mentioned above, along with ratings from S&P and Fitch II, yields of new issuance, basis point spreads between benchmark securities, underwriters, etc. The market-index data are from DataStream, which provides a complete list of all index variables which have been employed for the sample period. Ratings classification is shown in Table 1, and detailed information on sample characteristics is provided in Tables 2 to 4.

<Table 1 about here>

<Table 2 about here>

<Table 3 about here>

<Table 4 about here>

Table 5 presents pair-wise correlations between employed variables. In panel A, which displays the correlations between subordinated debt characteristics, spreads have low correlations with issuing amount (0.0933) and maturity (0.0485). Panel B reports the relationss between ratings from three major rating agencies, and results indicate that each agency issues relatively independent ratings towards issued sub-debts and issuers. Correlations between accounting variables are low, with the exceptions of correlation between NLTA (the ratio of net loans to total assets) and EITA (the ratio of equity to total assets) with a value of 0.5646, and correlation between LIQ (the ratio of liquid assets to customers' deposits and short term funding) and ROA (the ratio of returns on assets), with a value of 0.5357. Market condition variables have relatively higher correlations between variables. This result is not coincidental since stock markets are highly liquid and shocks to the stock markets tend to be contagious.

<Table 5 about here>

5. Empirical Results

5.1 Impacts of Traditional Ratings on Sub-debt Spreads

This section examines whether the ratings on sub-debt at launch assigned by traditional rating agencies (S&P, Moody's and Fitch in our study) impact on sub-debt spreads. Column 1 of Table 6 displays estimates all rating dummies (except Rating =5 which is omitted) for S&P in regression, Column 2 reports estimations with Moody's rating dummies, estimated coefficients on Fitch rating dummies are displayed in

Column 3.

All rating dummies are statistically significant at the 1% level, except the Fitch ratings and Rating =4 in both S&P ratings and Moody's. The monotonic pattern of dummy coefficients on S&P and Moody's ratings indicates that spreads rise when ratings worsen. High ratings in Fitch (Rating =1, 2 and 3) fail to show significant relations with spreads, while Rating =4 shows a positive and 1% statistically significant coefficient.

Amount has a negative coefficient in all alternative specifications. This result is different from previous results. Sironi (2003) examines the issuing amount's impact on sub-debt spreads issued by European banks, and finds that the amount has a positive and statistically significant coefficient. A possible reason for this outcome is the rise of European banks sub-debt capital in two principle ways: private retail clients via distribution networks with private placements, which has a smaller average size and less bargaining power, and the targeting of institutional investors via public issues. Therefore, European investors may be less sensitive about sub-debt issuing spreads. On the contrary, our results imply that the sub-debt market in the UK has higher liquidity and wider issuance than the European market, excluding the UK. Furthermore, small issuance is usually made by smaller banks which raise capital less frequently than large banks; therefore investors might associate a higher portfolio diversification value with a smaller size sub-debt issuance and price them accordingly.

STG (British pound) and USD (US dollar) are the only currency dummy variables which show positive and 1% level statistically significant coefficients. The results indicate that sub-debts issued in sterling and US dollars have higher spreads than other sub-debts denominated by other currencies. Potentially, it may be because Treasury securities in British pounds and US dollars pay lower yields and result in

higher sub-debt spreads, calculated by subtracting Treasury yields from sub-debt yields which tend to be higher.

<Table 6 about here>

For each regression ,White's tests for heteroscedasticity are conducted. Fixed and random effect models are also used to calculate coefficients in order to reveal whether variation in the independent variables within a bank affects the spreads differently than it does between issuers. The results under both fixed and random effects are shown in Table 7. Moreover, Hausman test statistics, carried out to ascertain the appropriateness of random effects, are reported at the bottom of Table 7.

Estimated coefficients, calculated by Fixed and Random effects models are displayed in Table 7 along with Chi^2 of Hausman tests for choosing between fixed and random effects. Test statistics fail to show significant signs of rejection of Hausman test's null hypothesis, indicating that the random effects estimator is consistent. Upper classes of ratings (rating =1, 2 and 3) from S&P and Moody's are negatively related to the spreads with statistically significant signs. Fitch rating dummies show an insignificant relation to spreads. However, the R^2 statistics are relatively small, indicating that ratings and sub-debt characteristics variables explain a slim portion of subordinated debt spreads' cross-sectional variability. These results differ from the results estimated under standard OLS.

<Table 7 about here>

5.2 Sensitivity of Sub-Debt Investors to UK Banks' Risk Exposure

From the empirical evidence of the UK banking industry, we can conclude that the relation between spreads and ratings of Moody's, S&P and Fitch do provide reasonably strong evidence that sub-debt investors are sensitive to default risk. Next,

we look at in detail sub-debt investors' sensitivity to the issuing banks' general exposure to risks.

The fourth specification of Equation (2) uses Moody's Long Term issuer rating to test to what extent sub-debt investors react to banks' general risk exposure. Column 4 of Table 6 shows estimates when issuer ratings are used to predict movements of spreads. Results of issuer ratings are quite similar to issuance ratings. One possible explanation is that issuer and issuance ratings are highly correlated (correlations among ratings are reported in Panel B of Table 5).

Column 4 of Table 7 shows results calculated by fixed effects estimation and Column 8 estimates parameters under random effects. The Hausman test rejects the hypothesis that a random effects estimator is consistent. The first two rating dummies have negative and insignificant coefficients. Other ratings (R3 and R4) show positive signs with spreads, without statistical significance at any reported level.

These results indicate that for the sub-debts that have been assigned high ratings, when ratings on issues worsen, spreads rise. Contrary to traditional issuance rating, MATU has a positive and 5% level statistically significant coefficient, implying that issuer ratings have more influence on investors when they are concerned with sub-debt maturity. Unsurprisingly the STG and USD, two currency dummies, have positive and statistically significant coefficients.

The R^2 under all estimations for MLTR ratings are not significantly smaller than other specifications, unlike the results in previous studies (e.g. Sironi, 2003). These results not only indicate that subordinated debt investors are sensitive to the issuing banks' risk exposures and price the risk accordingly, but also strongly support the hypothesis that subordinated debt investors can discriminate between the risks taken by banks.

5.3 Variability of Sub-debt Spreads and Accounting Measures of Bank Risks

Other empirical studies in the field do not use the link between sub-debt and accounting-variables as an indicator of market discipline; they tend to only show that regulators and/or investors pay attention to accounting measures of risk. When comparing banks in different periods, two findings arise.

First, many of the balance-sheet variables used as proxy for bank risk are not available for all the sub-debt issuing banks in the sample (such as LLRGL). Because of this problem, bivariate linear regressions have been conducted between sub-debt spreads and individual accounting variables. The results are shown in Table 8.

Second, not all banks' accounting data are available for all observation years in the sample period. A number of banks, building societies and bank holding companies were simply not in existence for some years of the sample. Due to this problem, our samples are selected from 1997 onwards, for which large portions of banks' annual reports are available. Another reason is that certain banks co-funded a program to raise sub-debt capital. In such occasion, only the leading bank, or the one which invested the most in order to have an absolute control right (over 50%) is chosen as the observed bank.

From our investigation, three important results emerge.

First, accounting proxies of banks' risk have little explanatory power regarding movements of UK banks' sub-debt spreads. None of the estimated coefficients obtained from bivariate linear regressions on accounting measures, as reported in Panel A of Table 8, is significant. Moreover, small values of Adjusted R^2 indicate that accounting measures explain only a small portion of variation of sub-debt spreads.

<Table 8 about here>

Second, consistent with the results obtained from the stand-alone bilateral models based on accounting measures (Table 8), size, a natural log of issuing banks' total assets, fails to display as statistically significant at any reported level. One potential explanation for this result is that, besides the economic advantages such as a higher portfolio diversification, more importantly, large banks have regulatory advantages, namely "too-big-to-fail" (TBTF) guarantees (Sironi, 2003; Balasubramnian and Cyree, 2011). Therefore, size fails to be a significant factor in explaining market participants' expectation of variation of the spreads.

Finally, accounting variable are still relatively poor in explaining the variation of sub-debt spreads. Column 2 of Table 9 reports estimated coefficients under fixed effects and Column 3 of the table outlines results estimated by random effects models. Due to negative values of Wald Chi^2 of the Hausman test, we conduct Swamy-Aroara Hausman to distinguish the appropriateness between fixed and random effects models. The test statistics (reported at the bottom of Table 9) indicate that results under random effects are more reliable. The R^2 statistics of random effects are greater than the Adj-R^2 of OLS.

However, individual accounting variables generally present unexpected coefficient signs. This may caused by the heterogeneous nature of the empirical sample of sub-debt issues as showed in Sironi (2003), who examines the sub-debt issued by European banks. The sample used in the present research includes 631 issues completed by 135 UK banks and banking holding companies with an average number of issues per bank of 4.67. However, of the total 135 financial institutions, 58 only issued once, while 42 banks issued less than four times during the 12 year period. The heterogeneous nature of the sub-debt issues of our sample is thus inevitable.

<Table 9 about here>

5.4 Market Conditions and Sub-debt

In this section a range of financial variables is employed to capture the influence of general economic and financial market conditions since sub-debt spreads may be affected by changes in the general business conditions. The FTSE100 index captures the performance of the UK stock market, while the FTSEuro index indicates the European stock markets' fluctuations. Also, the NASDAQ share index is used to represent the US market since the US dollar is the key sub-debt issuing currency, and use of the NIKKEI index is to indicate business conditions of the Japanese market. On top of these stock market indexes, LIBOR-3M and EuroLibor-3M are also used to capture the effects of interest rates.

Table 10 shows results of bivariate regressions of spreads on a matrix of market indexes. All market condition variables have positive impacts on the spreads. FTSE100 is statistically significant at 5% and FTSEuro significant is at the 1% level, while the coefficient on NIKKEI is significant at 10% and NASDAQ does not show any significant signs. For the interest rate indicators, the London inter-bank lending rate LIBOR has no significant relation to spreads. However, the coefficient on the Eurocurrency market rate EUROLIBOR appears positive with a 5% level of statistical significance. These results indicate that spreads are affected by the developments of global stock markets and when the stock market levels out, sub-debt issuing spreads rise. Moreover, spreads are also impacted by credit market conditions. Interestingly, sub-debts issued by UK banks are more sensitive to Eurocurrency market movements

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<Table 10 about here>

Table 11 shows the estimated coefficients calculated by OLS, and models of fixed effects and random effects. Different with results of rating dummies in previous regression analysis, amount fails to show significant signs. But STG and USD, the two main issuing currencies, appear positive with 1% level statistically significant signs, which is similar to the case where the regression analysis involves the rating dummies （Tables 6 and 7）. The results under fixed and random effects are similar to that estimated by OLS. The Hausman χ^2 which is reported at the bottom of table 11 suggests that the use of the fixed effects model is more reliable. FTSEURO index has a positive coefficient and significant at 10%, while other market condition variables show no sign of significant influence on sub-debt spreads.

The possible reason for this outcome may chiefly be that the sub-debt market is less liquid than stock markets. With this, the result can be interpreted as market investors considering sub-debt as a highly-diversified investment instrument. Since most sub-debts are long term, investors are sensitive to issuers' risk portfolios and take yield spreads as an effective instrument for monitoring issuing banks.

<Table 11 about here>

6. Conclusions

Success of the sub-debts as an instrument of market discipline is crucially dependant on whether the spreads between yields on sub-debts and on the corresponding Treasury bills are correlated with banks' risk-taking. If they are found to be related, the sub-debt spreads contain useful information about financial conditions of the bank and market participants can adjust their investment in the bank accordingly.

Using a sample that covers 631 issues of sub-debts by UK banks during 1997 to 2009, we investigate the risk-spread relationships in the UK banking industry. We find that the UK banks' sub-debt spreads co-vary with risk measures assigned by traditional rating agencies. Particularly for Moody and S&P ratings, when ratings worsen, spreads rise, and vice versa. Furthermore, sub-debt investors seem to have rational discriminations between different risk profiles of UK credit institutions. However, some accounting measures of bank risks show an absence of explanatory power of the spreads, hence there is a lack of evidence that the spreads reflect the risk indicators in terms of accounting measures. Market conditions, especially European market indicators, have a significant impact on the yield spreads.

These findings show that, in the UK, sub-debt spreads are sensitive to the issuing bank's strategic decisions and risk-taking behaviour. The UK evidence confirms that, market participants can have incentives to extract information from the spreads, allay information asymmetry and require premiums according to banks risk levels. This implies that the risk-sensitive spreads can promote the market to discipline banks

through the cost effect. By revealing evidence on influences of different components of the risk-spread nexus, this UK research also provides a fresh understanding of the role of sub-debts in the market discipline mechanism, advancing the current knowledge of sub-debts as an avenue for market discipline.

Despite the facts that the spreads are proved to be an effective indicator of bank conditions containing timely and useful information on issuing financial institutions' risk portfolios and that sub-debt issuance in the UK is more active and more liquid than in the European markets, there are obstacles in the UK for market discipline to work. Although empirical analysis shows an absence of significant TBTF effect, more than 72% of subordinated debts in our sample are issued by median- or large-sized financial institutions. The magnitude of coefficient on the total assets indicates the significant size effect and yield spreads reflect the market's perception that all large banks in the UK will be bailed out when default occurs.

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Table 1
Rating Classes

Rating	Moody's	S&P	Fitch	MLTR
1	Aaa	AAA	AAA	Aaa
2	Aa1,Aa2,Aa3	AA+,AA,AA-	AA+,AA,AA-	Aa1,Aa2,Aa3
3	A1,A2,A3	A+,A,A-	A+,A,A-	A1,A2,A3
4	Baa1,Baa2, Baa3	BBB+,BBB,BBB-	BBB+,BBB,BBB-	Baa1,Baa2,Baa3
5	Lower ratings	Lower ratings	Lower ratings	Lower ratings

Table 1 reports the rating classification based on Moody's, Standard & Poor (S&P), Fitch and Moody's Long Term issuer ratings (MLTR). Ratings are sorted from 1 to 5 according to the rating scales where rating 1 represents the highest rating while rating 5 refers to the lower ratings and will be excluded in the model regression estimation.

Table 2
Summary of Sample Descriptive Statistics by Rating Classes

		Spreads (b.p)					Amount (USD mil)	
Rating Classes	No. of issuance	Mean	Median	Min	Max	Standard Deviation	Total	Average
Panel A. Standard & Poor's issue ratings at launch								
1	19	50.50	35.00	0.00	325.00	73.59	5442.85	286.47
2	111	74.14	48.00	0.00	290.00	69.58	55811.58	502.81
3	279	112.37	94.00	0.00	659.00	103.34	156007.83	561.18
4	98	158.28	162.50	0.00	565.00	104.77	18017.16	183.85
5	124	181.27	99.00	0.00	933.00	212.43	22227.59	180.71
Panel B. Moody's issue ratings at launch								
1	15	50.73	29.00	0.00	325.00	83.30	5815.61	387.71
2	212	99.07	72.50	0.00	659.00	92.31	131176.57	618.76
3	182	106.51	85.00	0.00	633.00	100.56	80438.86	444.41
4	96	145.30	141.50	0.00	565.00	110.08	18147.54	189.04
5	126	185.94	117.50	0.00	933.00	209.37	21928.42	175.43
Panel C. Fitch issue ratings at launch								
1	8	78.44	35.75	0.00	315.00	104.22	3563.76	445.47
2	137	111.74	67.50	0.00	659.00	113.78	108220.84	789.93
3	75	106.80	100.00	0.00	438.00	81.97	27796.63	370.62
4	57	167.44	165.00	0.00	491.00	106.34	7566.64	132.75
5	354	127.23	83.50	0.00	933.00	150.68	110359.13	313.52
Panel D. Moody's long term issuer rating								
1	34	72.29	55.00	0.00	236.00	71.54	14713.20	432.74
2	288	110.46	75.00	0.00	659.00	111.14	154079.54	536.86
3	177	114.85	95.00	0.00	633.00	106.69	68685.99	390.26
4	30	201.17	175.00	0.00	933.00	199.77	5862.89	195.43
5	98	175.14	120.00	0.00	896.00	193.66	13749.99	140.31

Table 2 shows the sample descriptive statistics distributed by rating classes over the period 1997-2009. Panels A, B, C and D indicate statistics summaries for Standard & Poor's issue ratings at launch, Moody's issue ratings at launch, Fitch issue ratings at launch and Moody's long term issuer rating, respectively.

Table 3
Sample Descriptive Statistics Summary by Year and Currency

		Average rating at launch				Spreads(bp)				A
Panel A. Distribution by Year										
Year	No.	S&P	Moody	Fitch	MLTR	Mean	St.dev	Min	Max	T
1997	24	3.71	3.42	5.00	3.04	109.25	127.47	0.00	550.00	38
1998	23	3.83	3.48	4.87	3.00	202.30	249.01	0.00	933.00	33
1999	42	3.38	3.31	4.79	3.17	198.16	176.58	0.00	707.00	13
2000	71	3.31	3.32	4.28	2.77	127.63	108.41	0.00	445.00	11
2001	106	2.96	3.23	4.01	2.96	117.14	108.34	0.00	515.00	25
2002	97	3.33	3.29	3.94	2.86	110.23	122.62	0.00	896.00	17
2003	46	3.13	2.59	3.83	2.65	76.88	87.57	0.00	445.00	25
2004	33	3.30	3.09	3.97	2.55	94.00	122.76	0.00	594.00	20
2005	44	3.64	3.32	2.93	2.67	97.27	117.56	0.00	450.00	24
2006	50	3.48	3.12	3.58	2.66	94.43	85.50	0.00	315.00	26
2007	57	3.39	3.00	3.33	2.68	130.73	132.14	0.00	659.00	44
2008	30	2.93	2.53	2.67	2.20	184.47	131.87	0.00	450.00	35
2009	8	3.88	3.88	4.00	3.00	266.75	265.05	0.00	633.00	59
Panel B. Distribution by Currency										
Currency	No.	S&P	Moody	Fitch	MLTR	Mean	St.dev	Min	Max	T
STG	288	3.35	3.31	4.17	2.96	147.16	121.56	0.00	638.00	89
USD	152	3.36	3.05	3.73	2.68	137.81	172.43	0.00	933.00	85
EURO	156	3.31	3.19	3.86	2.65	87.13	106.03	0.00	600.00	77
Others	35	2.80	2.43	3.86	2.51	45.83	45.32	0.00	225.00	76

Panels A and B in Table 3 report the descriptive statistics of alternative measurements of the default risk: S&P, Moody's, Fitc
by year and currency, respectively. STG is a dummy variable equals to one if the issue currency is Sterling; USD is a dummy
currency is the U.S dollar while EURO is also a dummy variable equals to one if the euro is the issue currency.

Table 4
Sample Summary Statistics

Variable	No.	Mean	Median	Min	Max	St.dev	25th Percentile	75th Percentile	Skewness	Kurtosis
Panel A. Sub-debt Characteristics										
MATU	631	14.65	10.15	0.16	42.68	10.80	6.09	20.30	1.10	3.01
AMOUNT	631	5.17	5.52	-0.98	8.05	1.59	3.92	6.46	-0.74	2.98
SPREAD	631	124.45	90.00	0.00	933.00	133.05	30.00	175.00	2.06	9.15
Panel B. Accounting Variables										
LEV	523	22.44	20.86	0.20	404.42	26.79	13.79	26.99	11.16	158.85
NLTA	507	0.55	0.58	0.00	8.43	0.78	0.31	0.65	8.28	84.27
EITA	523	0.13	0.05	0.00	0.87	0.19	0.03	0.07	2.16	6.47
LIQ	504	2.33	0.02	0.00	305.17	19.52	0.01	0.05	11.69	153.33
LLRGL	401	0.01	0.01	0.00	0.06	0.01	0.01	0.01	2.08	11.95
ROA	469	2.31	1.15	-88.53	31.57	7.66	0.83	3.02	-5.95	88.75
SIZE	523	5.00	5.33	1.08	6.38	1.04	4.54	5.66	-1.46	4.68
Panel C. Market Condition Variables										
FTSE 100	631	5447.86	5430.31	3436.05	6724.54	826.90	4908.40	6170.42	-0.41	2.12
FTSEURO	584	3187.79	3217.27	1824.34	4150.76	543.18	2804.88	3617.96	-0.41	2.38
NASDAQ	542	6081.13	5485.36	3290.41	14759.31	2302.33	4868.94	6332.03	1.89	6.30
NIKKEI	631	13564.59	13175.49	7838.83	20833.21	3131.97	10882.18	16312.61	0.20	1.92
LIBOR	631	5.04	4.98	0.66	7.81	1.10	4.13	5.86	-0.03	3.89
EUROLIBOR	584	3.47	3.42	0.72	5.13	0.97	2.68	4.41	-0.06	2.07

Table 4 shows the summary statistics of sub-debt characteristics, accounting variables and market conditions of the whole sample. Panel A refers to the variables of sub-debt characteristics. MATU is the time to maturity of issue; AMOUNT is the natural log value of the US dollar-equivalent amount of issue; SPREAD is the difference between the yields to maturity of sub-debt at launch of issuance and the yield to maturity of corresponding currency Treasury security with a similar maturity. Panel B shows the relevant accounting variables. LEV is the ratio of total liabilities to the book value of equity; NLTA is the ratio of net loans to total assets; EITA is the ratio of equity investments to total assets; LIQ is the ratio of liquid assets to customers' deposits and short term funding; LLRGL is the ratio of loan loss reserves to total loans; ROA is the ratio of annual net income to the average of the preceding and current year-end assets; SIZE is the natural log value of issuing bank's total assets. FTSE100, FTSEURO, NASDAQ, NIKKEI, LIBOR and EUROLIBOR in Panel C are market condition variables to examine whether the booming of sub-debts is caused by the market discipline effect.

Table 5
Correlation Matrix

Panel A. Correlations between sub-debt characteristics

	SPREAD	MATU	AMOUNT
SPREAD	1.0000	0.0485	-0.0933
MATU	0.0485	1.0000	-0.2617
AMOUNT	-0.0933	-0.2617	1.0000

Panel B. Correlations between rating variables

	S&P	Moody	Finch	MLTR
S&P	1.0000	0.6781	0.3008	0.3020
Moody	0.6781	1.0000	0.3126	0.3862
Finch	0.3008	0.3126	1.0000	0.2934
MLTR	0.3020	0.3862	0.2934	1.0000

Panel C. Correlations between accounting variables

	LEV	NLTA	EITA	LIQ	LLRGL	SIZE	ROA
LEV	1.0000	0.1629	-0.0478	-0.1898	-0.2138	0.3882	-0.2523
NLTA	0.1629	1.0000	0.5646	-0.0077	0.0135	-0.0102	-0.0127
EITA	-0.0478	0.5646	1.0000	0.0534	0.0964	-0.2193	0.1859
LIQ	-0.1898	-0.0077	0.0534	1.0000	0.2300	-0.2569	0.5357
LLRGL	-0.2138	0.0135	0.0964	0.2300	1.0000	-0.0194	-0.0213
SIZE	0.3882	-0.0102	-0.2193	-0.2569	-0.0194	1.0000	-0.4862
ROA	-0.2523	-0.0127	0.1859	0.5357	-0.0213	-0.4862	1.0000

Panel D. Correlations between market condition variables

	FTSE100	FTSEURO	NASDAQ	NIKKEI	LIBOR	EUROLIBOR
FTSE100	1.0000	0.9485	0.6991	0.8860	0.8102	0.6896
FTSEURO	0.9485	1.0000	0.7135	0.8429	0.7751	0.6954
NASDAQ	0.6991	0.7135	1.0000	0.7245	0.6948	0.4986
NIKKEI	0.8860	0.8429	0.7245	1.0000	0.7714	0.4664
LIBOR	0.8102	0.7751	0.6948	0.7714	1.0000	0.7356
EUROLIBOR	0.6896	0.6954	0.4986	0.4664	0.7356	1.0000

Table 5 represents the correlation matrix for four groups of variables including sub-debt characteristics, rating variables, accounting variables and market condition variables. For sub-debt variables, SPREAD is the difference between the yields to maturity of sub-debt at launch of issuance and the yield to maturity of corresponding currency Treasury security with a similar maturity; MATU is the time to maturity of issue; AMOUNT is the natural log value of the US dollar-equivalent amount of issue. For rating variables, detail definition information could be found in Table 1. For accounting variables, LEV is the ratio of total liabilities to the book value of equity; NLTA is the ratio of net loans to total assets; EITA is the ratio of equity investments to total assets; LIQ is the ratio of liquid assets to customers' deposits and short term funding; LLRGL is the ratio of loan loss reserves to total loans; ROA is the ratio of annual net income to the average of the preceding and current year-end assets. For market condition variables, main stock market indexes are adopted, such as FTSE100, FTSEURO, NASDAQ, NIKKEI, LIBOR and EUROLIBOR.

Table 6 Regressions of Spreads on Rating Variables

Variable	S&P (1)	Moody's (2)	Fitch (3)	MLTR (4)
R1	-147.0927 [0.000]***	-144.7407 [0.000]***	-50.2418 [0.194]	-104.3877 [0.000]***
R2	-105.6628 [0.000]***	-93.1825 [0.000]***	-13.7695 [0.257]	-61.4976 [0.003]***
R3	-81.0896 [0.000]***	-84.7025 [0.000]***	-22.3855 [0.064]*	-57.7842 [0.007]***
R4	-26.0822 [0.213]	-42.1069 [0.052]*	46.6711 [0.004]***	31.1169 [0.467]
AMOUNT	0.0309 [0.011]**	0.0304 [0.019]**	0.0108 [0.450]	0.1918 [0.125]
MATU	0.3075 [0.515]	0.0374 [0.939]	-0.1274 [0.808]	0.2688 [0.601]
STG	75.1796 [0.000]***	70.9184 [0.000]***	96.1882 [0.000]***	89.6388 [0.000]***
USD	62.5329 [0.000]***	61.8449 [0.000]***	88.3394 [0.000]***	80.0893 [0.000]***
EURO	12.1011 [0.342]	7.9203 [0.503]	32.9412 [0.016]**	32.9253 [0.000]***
CONS	117.765 [0.000]***	127.7648 [0.000]***	50.6385 [0.000]***	93.0863 [0.000]***
N	631	631	631	631
R^2	0.1379	0.1247	0.0713	0.1034
Adj-R^2	0.1254	0.1120	0.0578	0.0904
F	17.84***	14.74***	13.87***	12.56***

Table 6 reports the results of standard OLS regression of spreads on rating variables over the sample period 1997-2009. SPREAD is the difference between the yields to maturity of sub-debts at launch of issuance and the yield to maturity of corresponding currency Treasury securities with a similar maturity; R1, R2, R3 and R4 are rating dummies which are defined as in Table 1. AMOUNT is the natural log value of the US dollar-equivalent amount of issue; MATU is the time to maturity of issue; STG is a dummy variable equal to one if the issue currency is sterling; USD is a dummy variable equal to one if the issue currency is the U.S dollar while EURO is also a dummy variable equal to one if the euro is the issue currency. All OLS regressions are robust with the White heteroskedasticity estimator of variance. P-values are shown in brackets while ***, **, * indicate significance at 1%, 5% and 10% levels, respectively.

Table 7
Fixed Effects and Random Effects Regressions of Spreads on Rating Variables

	Fixed Effects (FE)				Random Effects (RE)	
Variables	S&P (1)	Moody's (2)	Fitch (3)	MLTR (4)	S&P (1)	Moody's (2)
R1	-159.8781	-145.8924	-32.3983	-50.0930	-170.5750	-161.6458
	[0.000]***	[0.000]***	[0.393]	[0.581]	[0.000]***	[0.000]***
R2	-94.9661	-48.7231	-8.5760	-10.7091	-107.274	-68.3306
	[0.000]***	[0.009]***	[0.538]	[0.887]	[0.000]***	[0.000]***
R3	-54.986	-32.9696	-20.7129	23.1919	-69.9684	-59.2051
	[0.002]***	[0.085]*	[0.205]	[0.758]	[0.000]***	[0.000]***
R4	11.3526	20.5477	62.4210	19.1048	-7.0658	-5.9168
	[0.561]	[0.310]	[0.001]***	[0.875]	[0.689]	[0.745]
AMOUNT	0.1541	0.0103	0.0069	0.0004	0.0182	0.0134
	[0.262]	[0.464]	[0.630]	[0.979]	[0.176]	[0.332]
MATU	0.5539	0.7542	0.7915	1.0187	0.3327	0.4549
	[0.257]	[0.133]	[0.122]	[0.049]**	[0.481]	[0.349]
STG	64.8475	69.9836	80.3129	83.9624	71.1884	74.8416
	[0.005]***	[0.003]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***
USD	40.4879	48.8067	57.5431	60.0513	50.9589	59.8079
	[0.073]*	[0.036]**	[0.014]**	[0.012]**	[0.020]**	[0.008]***
EURO	7.5718	14.2564	22.3220	27.6688	12.5943	18.4684
	[0.742]	[0.549]	[0.354]	[0.259]	[0.572]	[0.424]
CONS	147.2305	130.5502	99.6434	93.0796	140.1743	140.6767
	[0.000]***	[0.003]***	[0.013]**	[0.243]	[0.000]***	[0.000]***
N	631	631	631	631	631	631
Fixed Year	YES	YES	YES	YES	YES	YES
R^2-within	0.2593	0.2125	0.1869	0.1569	0.2513	0.2014
R^2-between	0.0287	0.0186	0.0024	0.0064	0.0965	0.1116

R^2-overall	0.1590	0.1317	0.1097	0.0986	0.1866	0.1711
F	7.92***	6.10***	5.20***	4.21***	-	-
Wald-Chi	-	-		-	173.90***	136.35***
Hausman χ^2	52.46***	83.38***	56.64***	37.28**	-	-

Table 7 shows estimates of regression of spreads on rating variables with both fixed effects (FE) and random effects (RE) mo
the yields to maturity of sub-debt at launch of issuance and the yield to maturity of corresponding currency Treasury security
R4 are rating dummies which are defined as in Table 1. AMOUNT is the natural log value of the US dollar-equivalent amoun
of issue; STG is a dummy variable equal to one if the issue currency is sterling; USD is a dummy variable equal to one if the
EURO is also a dummy variable equal to one if the euro is the issue currency. Hausman χ^2 is adopted to test the appropriaten
hypothesis that the RE estimator is consistent. Year dummies are also included to control the year effect. P-values are shown
significance at 1%, 5% and 10% levels, respectively.

Table 8
Bivariate Linear Regressions on Accounting Measures and Market Condition Variables

Variables	Coef. (p-value)	Cons.Coef (p-value)	N	F-statistics (p-value)	R^2	Adj-R^2
Panel A. Accounting measures						
LEV	-0.1123 [0.615]	129.6750 [0.000]***	523	0.2500 [0.615]	0.0014	0.0005
NLTA	-7.0650 [0.364]	129.1860 [0.000]***	507	0.8300 [0.364]	0.0016	0.0003
EITA	-20.8270 [0.514]	129.8350 [0.000]***	523	0.4300 [0.514]	0.0011	0.0008
LIQ	0.1189 [0.700]	125.5330 [0.000]***	504	0.1500 [0.699]	0.0017	0.0003
LLRGL	8.1520 [0.307]	110.8690 [0.000]***	401	1.0500 [0.307]	0..0026	0.0001
ROA	0.1710 [0.838]	128.1000 [0.000]***	469	0.0400 [0.838]	0.0021	0.0001
SIZE	-4.6100 [0.421]	150.2270 [0.000]***	523	0.6500 [0.421]	0.0012	0.0007

Table 8 reports the bivariate linear regressions on accounting variables and market condition factors. Panel A is for accounting measures while Panel B is for market condition variables. The dependent variable is the spreads between yields (at issuance) on subordinated debt and a Treasury security of comparable maturity denominated in the same currency with similar maturity. LEV is the ratio of total liabilities to the book value of equity; NLTA is the ratio of net loans to total assets; EITA is the ratio of equity investments to total assets; LIQ is the ratio of liquid assets to customers' deposits and short term funding; LLRGL is the ratio of loan loss reserves to total loans; ROA is the ratio of annual net income to the average of the preceding and current year-end assets; SIZE is the natural log value of issuing bank's total assets. P-values are reported in brackets where ***, **, * indicate significance at 1%, 5% and 10% levels, respectively.

Table 9
Regression Results of Spreads on Bank Accounting Variables

Variable	OLS (1)	Fixed Effects (2)	Random Effects (3)
LEV	-0.4689	0.0606	-0.1643
	[0.515]	[0.933]	[0.804]
NLTA	5.5280	-5.8423	-2.2583
	[0.598]	[0.479]	[0.780]
EITA	-102.1987	-47.6484	-76.5229
	[0.059]*	[0.416]	[0.172]
LIQ	-54.2489	-58.6312	-64.3873
	[0.625]	[0.156]	[0.107]
LLRGL	867.3590	933.9855	976.4465
	[0.480]	[0.287]	[0.251]
ROA	4.1193	2.8387	3.6602
	[0.131]	[0.198]	[0.089]*
SIZE	4.8509	-8.5566	-2.6264
	[0.609]	[0.414]	[0.789]
AMOUNT	-0.0003	0.0117	0.0121
	[0.984]	[0.526]	[0.497]
MATU	0.7994	1.4639	1.3662
	[0.265]	[0.030]**	[0.033]**
STG	102.7231	87.8207	92.4284
	[0.000]***	[0.005]***	[0.001]***
USD	78.3938	55.4165	68.0243
	[0.002]***	[0.061]*	[0.016]**
Euro	45.9345	26.3260	35.5147
	[0.045]**	[0.386]	[0.219]
CONS	39.5636	139.3641	120.9813
	[0.508]	[0.051]*	[0.064]*
N	351	351	351
Fixed Year	YES	YES	YES
R^2	0.1804	-	-
Adj-R^2	0.1200	-	-
R^2-within	-	0.2110	0.1970
R^2-between	-	0.0376	0.1440
R^2-overall	-	0.1115	0.1523
F	4.16***	2.72***	-
Wald-Chi	-	-	71.51***
Hausman χ^2	-	-	7.2400

Table 9 shows the results of regression of spreads on bank accounting variables. The first column is for the traditional OLS regression which is robust with the White heteroskedasticity estimator of variance. The second column is for the fixed effects regressions while the third column is for the random effects regressions. The dependent variable is the spreads between yields (at issuance) on SND and a Treasury security of comparable maturity denominated in the same currency. LEV is the ratio of total liabilities to the book value of equity; NLTA is the ratio of net loans to total assets; EITA is the ratio of equity investments to total assets; LIQ is the ratio of liquid assets to customers' deposits and short term funding; LLRGL is the ratio of loan loss reserves to total loans; ROA is the ratio of annual net income to the average of the preceding and current year-end assets; SIZE is the natural log value of issuing bank's total assets. AMOUNT is the natural log value of the US dollar-equivalent amount of issue; MATU is the time to maturity of issue; STG is a dummy variable equal to one if the issue currency is sterling; USD is a dummy variable equal to one if the issue currency is the U.S dollar while EURO is also a dummy variable equal to one if the euro is the issue currency. Hausman χ^2 is adopted to distinguish the appropriateness between the fixed and random effects estimator with the null hypothesis that the random effects estimator is more appropriate. Year dummies are also included to control the year effect. P-values are shown in brackets as ***, **, * indicate significance at 1%, 5% and 10% levels, respectively.

Table 10
Bivariate Linear Regressions on Accounting Measures and Market Condition Variables

Variables	Coef. (p-value)	Cons.Coef (p-value)	N	F-statistics (p-value)	R^2	Adj-R^2
FTSE 100	0.0150 [0.020]**	43.3800 [0.218]	631	5.4300 [0.020]**	0.0086	0.007
FTSEURO	0.0260 [0.008]***	40.7150 [0.199]	584	7.0400 [0.008]***	0.0119	0.0103
NASDAQ	0.0020 [0.340]	109.9500 [0.000]***	542	0.9100 [0.340]	0.0017	0.0002
NIKKEI	0.0030 [0.063]*	81.8110 [0.001]***	631	3.4600 [0.063]*	0.0055	0.0039
LIBOR	7.1740 [0.138]	88.2570 [0.000]***	631	2.2100 [0.138]	0.0035	0.0019
EUROLIBOR	14.2020 [0.010]**	74.1200 [0.000]***	584	6.7100 [0.010]**	0.0114	0.0097

This table reports outcome of the bivariate linear regressions on market condition factors. FTSE100, FTSEURO, NASDAQ, NIKKEI, LIBOR and EUROLIBOR are market condition variables that mainly represent worldwide stock market indexes. P-values are reported in brackets where ***, **, * indicate significance at 1%, 5% and 10% levels, respectively.

Table 11
Regression Estimations of Spreads on Market Condition Variables

Variable	OLS (1)	Fixed Effects (2)	Random Effects (3)
FTSE100	-0.0023	-0.0208	-0.0187
	[0.919]	[0.370]	[0.408]
FTSEURO	0.0264	0.0541	0.0510
	[0.333]	[0.081]*	[0.087]*
NASDAQ	-0.0048	-0.0056	-0.0059
	[0.184]	[0.113]	[0.082]*
NIKKEI	0.0041	0.0031	0.0038
	[0.412]	[0.505]	[0.398]
LIBOR	-14.6641	-11.1466	-13.4726
	[0.166]	[0.325]	[0.218]
EUROLIBOR	9.5690	5.7525	8.0186
	[0.358]	[0.561]	[0.401]
AMOUNT	-0.0121	0.0006	-0.0002
	[0.500]	[0.973]	[0.988]
MATU	0.0177	0.9201	0.5300
	[0.975]	[0.117]	[0.338]
STG	103.1557	80.1728	89.5948
	[0.000]***	[0.003]***	[0.001]***
USD	81.4469	53.7348	66.9569
	[0.000]***	[0.039]**	[0.007]***
Euro	45.4963	26.7020	34.2356
	[0.017]**	[0.320]	[0.183]
CONS	-10.4301	60.1094	55.2934
	[0.844]	[0.327]	[0.328]
N	542	542	542
Fixed Year	YES	YES	YES
R^2	0.1607	-	-
Adj-R^2	0.1234	-	-
R^2-within	-	0.1770	0.1707
R^2-between	-	0.0141	0.0589
R^2-overall	-	0.1248	0.1456
F	4.92***	3.7500	-
Wald-Chi	-	-	91.31***
Hausman χ^2	-	29.09**	

Table 11 reports the linear regressions of spreads on market condition measurements. The first column lists the traditional OLS regression results which are robust with the White heteroskedasticity estimator of variance. The second column lists the fixed effects regression outcome while the third column shows the results of random effects regressions. The dependent variable is the spreads between yields (at issuance) on sub-debt and a Treasury security of comparable maturity denominated in the same currency. FTSE100, FTSEURO, NASDAQ, NIKKEI are market condition variables that represent worldwide stock market indexes. LIBOR and EUROLIBOR are the London inter-bank lending rate and the Eurocurrency market rate, respectively, capturing the conditions of credit markets. AMOUNT is the natural log value of the US dollar-equivalent amount of issue; MATU is the time to maturity of issue; STG is a dummy variable equal to one if the issue currency is Sterling; USD is a dummy variable equal to one if the issue currency is the U.S dollar while EURO is also a dummy variable equal to one if the euro is the issue currency. Hausman χ^2 is adopted to distinguish the appropriateness between FE and RE estimator with the null hypothesis that the RE estimator is appropriate. Year dummies are also included to control the year effect. P-values are shown in brackets as ***, **, * indicate significance at 1%, 5% and 10%, respectively.

Highlights

- UK bank’s sub-debt spreads are sensitive to bank’s risk-taking
- Credit ratings and market condition indexes co-vary with UK bank’s sub-debt spreads
- Sub-debt investors have incentives to differentiate UK banks
- UK sub-debts satisfy a precondition for market discipline in banking