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A quantile regression analysis on corporate governance and the cost of bank loans: a research note

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Abstract

Purpose – This paper aims to investigate whether there is heterogeneity in the relationship between the bank loan interest rate and its determinants using the quantile regression method and to reconcile some conflicting findings in prior literature.

Design/methodology/approach – First, the effects of 18 determinants were examined on the bank loan interest rate using the ordinary least squares method (OLS). Second, it was investigated whether the relationship between the loan rate and its determinants is heterogeneous across quantiles of loan rates using the quantile regression method.

Findings – Considerable heterogeneity was found in the relationship between the loan rate and its determinants. Specifically, a determinant that is beneficial for the bank loan rate, on average, as revealed by the OLS method may become unimportant or even detrimental for firms located at extremely high or low loan rate quantiles. By revealing extreme heterogeneity in the relationship between the loan rate and some of its determinants, the authors potentially explain two conflicting findings in prior literature.

Originality/value – The conventional OLS method masks the heterogeneity in the relationship between the bank loan interest rate and its determinants. Quantile regression can be used to supplement the OLS estimates to gain a more detailed and complete picture of the relationship between the dependent variable and explanatory variables.

Keywords Corporate governance, Board characteristics, Cost of debt, Least absolute deviations, Median regression, Quantile regression

Paper type Research paper

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1. Introduction

Bank loans are an important source of capital for most firms around the world. For example, the average total liabilities to total stockholders' equity ratio is 0.926 in 2005 in Taiwan. On average, in that year, bank loans in Taiwan accounted for 40.46 per cent of total liabilities, whereas long-term debt accounted for 16.86 per cent of total liabilities[1]. Francis *et al.* (2012, p. 521) report that, in the USA, in 2005, the total amount of equity issued was about $115 billion, the total amount of corporate bonds issued was about $700 billion and the total amount of bank loans issued was about $1,500 billion, which is more than twice of the value of bonds issued. These statistics clearly indicate the importance of bank loans for most firms' operations. Prior research has identified corporate governance and many other factors as important determinants of bank loan pricing or the cost of debt financing. The two purposes of this study are:

(1) to investigate whether there is heterogeneity in the relationship between the bank loan interest rate and its determinants using the quantile regression (QReg) method as introduced by Koenker and Bassett (1978, 1982); and

(2) to reconcile some conflicting findings in prior literature.

Prior studies find that board characteristics of borrowers, a component of corporate governance, are important determinants of the cost of debt financing. The board of directors is responsible for monitoring the risk and performance of a firm and for ensuring the integrity of its financial reporting. As such, the board can affect the cost of a firm's debt financing. For example, Bhojraj and Sengupta (2003) and Anderson *et al.* (2004) find that the cost of debt is negatively related to board independence. Ashbaugh-Skaife *et al.* (2006) find that credit ratings, an inverse proxy for the cost of debt, are positively related to board independence, consistent with Bhojraj and Sengupta (2003) and Anderson *et al.* (2004). Moreover, they find that credit ratings are also positively related to directors' equity ownership of the firm (the percentage of a firm's outstanding shares held by directors) but are negatively related to chief executive officer (CEO)-Chairman duality (a CEO is also the Chairman of the Board). Lorca *et al.* (2011) confirm that the cost of debt is negatively related to directors' equity ownership. In addition, they find that the cost of debt is negatively associated with board activity (the number of board meetings in a year) and find a non-linear relationship between the cost of debt and board size, with the cost of debt decreasing in board size on average but increasing in board size when board size becomes too large. Indeed, the extant literature contains conflicting findings regarding the relationship between the cost of debt and board size. On the one hand, Zou and Adams (2008, p. 456) report a positive relationship between the cost of debt and board size. On the other hand, Chen (2012, p. 3,352) finds no significant relationship between the cost of debt and board size, and Anderson *et al.* (2004, p. 332) report a significantly negative relationship. One of the objectives of this paper is to reconcile this and other conflicting findings using the QReg method.

Most of prior studies examine the relationship between the cost of debt and its determinants using the ordinary least squares (OLS) method. As such, they identify the conditional *mean* relationship or a central tendency between the cost of debt and its determinants. However, this conditional mean or central tendency may not be descriptive of the relationship between the cost of debt and its determinants when the cost of debt is in extreme upper or lower tails because the relationship between the dependent variable and explanatory variables may be heterogeneous (i.e. not uniform) across the quantiles of the dependent variable (Koenker and Bassett, 1978). That is, a determinant that is beneficial for the bank loan rate, on average, as revealed by the OLS method may become unimportant or even detrimental for firms located at extremely high or low quantiles of the bank loan rate. By estimating only the conditional mean relationship between the dependent and explanatory variables, the OLS method masks the heterogeneity in the estimated relationship.

In contrast, the QReg method estimates the relationship between the dependent variable and explanatory variables at any chosen point in the conditional distribution of the dependent variable[2]. We thus obtain *multiple* sets of coefficient estimates with each set describing the relationship between the dependent variable and explanatory variables at a certain quantile of the dependent variable, e.g. the 10, 25, 50, 75 and 90 per cent quantiles[3]. A well-known special case of quantile regression is the median regression or the least absolute deviations (LAD) estimator, which is sometimes applied in accounting research to show a supplementary view besides OLS results (Basu and Markov, 2004) or to provide a robustness check for potential undue influence of outliers (Mansi *et al.*, 2004; Ely and Waymire, 1999; Choi *et al.*, 2011). With quantile regression, we get an entire distribution of coefficient estimate sets, instead of only the mean coefficient estimate set by the OLS method or the median coefficient estimate set by the LAD method.

Based on prior literature, we identify five corporate governance variables and many control variables as determinants of the bank loan interest rate. We first examine the effects of these governance variables and control variables on the loan interest rate using the OLS method to establish a baseline for comparison with the QReg method. Our main findings can be briefly summarized as follows. First, we find that the loan interest rate is significantly negatively related to directors' equity ownership and negatively related to board independence. Second, we find that the loan interest rate is positively related to board member equity pledge, a practice common in Taiwan where board members of a firm use their shareholdings in that firm as collateral for personal loans from outside financial institutions, and is positively related to CEO-Chairman duality[4]. Third, the loan interest rate is insignificantly related to board size. These findings are mostly consistent with prior literature. Finally, the coefficients on control variables are also generally consistent with prior literature.

Next, we investigate whether there is heterogeneity in the relationship between the loan interest rate and our corporate governance variables/control variables across five representative quantiles of the loan rate distribution (the 10, 25, 50, 75 and 90 per cent quantiles) using the QReg method. First, we find that the loan rate is significantly negatively related to directors' equity ownership at each of the five quantiles. In addition, we find some heterogeneity in that relationship, i.e. the coefficient on directors' equity ownership at one quantile differs somewhat from that at another quantile. Second, we find considerable heterogeneity in the relationship between the loan rate and board independence. Specifically, although the coefficient on board independence is significantly negative for four out of five quantiles, it becomes substantially and increasingly more negative for higher loan rate quantiles. This suggests that board independence is much more important for firms located in higher loan rate quantiles than firms in lower quantiles. Third, we again find considerable heterogeneity in the relationship between the loan rate and board member equity pledge and in the relationship between the loan rate and CEO-Chairman duality. Fourth, we find that the coefficient on board size is significantly positive for firms located in lower loan rate quantiles, but it becomes insignificant for firms in the highest quantile (90 per cent). This suggests that the OLS finding of an insignificant coefficient is driven by firms in the highest quantile. More importantly, this offers a potential explanation for the inconclusive findings in the literature. Our findings suggest that the cost of debt is positively associated with board size for firms in lower cost of debt quantiles, consistent with Zou and Adams (2008). However, the relationship becomes insignificant for firms in the very high cost of debt quantile, consistent with Chen (2012).

Finally, we continue to find considerable heterogeneity in the relationship between the loan rate and most of our control variables. For example, we find that the market-to-book ratio is positively related to the bank loan rate for firms located in low loan rate quantiles, but it is negatively related to the loan rate in high quantiles. This potentially explains a conflicting finding in the literature. Bhojraj and Sengupta (2003, p. 466) report a positive relationship between bond yields and the market-to-book ratio, but Francis *et al.* (2012, p. 531) show a negative relationship. Our findings reveal that the positive relationship between the loan rate and the market-to-book ratio, consistent with Bhojraj and Sengupta (2003), turns into negative, consistent with Francis *et al.* (2012), as firms move from lower loan rate quantiles to higher quantiles.

We contribute to the accounting literature in several ways. First, prior studies on the relationship between the cost of debt and corporate governance typically examine a small set of governance variables (Bhojraj and Sengupta, 2003; Anderson *et al.*, 2004). We directly examine the relationship between the bank loan interest rate and a broad set of governance variables. Second, we demonstrate considerable heterogeneity in the relationship between the bank loan interest rate and our corporate governance variables/control variables using the QReg method. This is an important finding because it reveals that a corporate governance variable or control variable could be important for firms at certain loan rate quantiles or *on average* as revealed by the OLS estimates, but not important for firms at some other loan rate quantiles. Thus, firms at different quantiles of the loan rate distribution should pay attention to *different* corporate governance variables/control variables for them to reduce their bank loan rates. The OLS estimates mask the complexity of the relationship between the loan rate and its determinants and tend to imply that a corporate governance variable is uniformly important for firms in all quantiles, which, as we show, is often incorrect. Finally, we reconcile two inconclusive or conflicting findings in the extant literature regarding the relationships of the cost of debt with board size and with the market-to-book ratio by revealing extreme heterogeneity in these relationships across the cost of debt quantiles.

The remainder of the paper is organized as follows. Section 2 reviews the literature and describes our research methodology. Section 3 describes the sample, and Section 4 presents our findings. We conclude in Section 5.

2. Literature review and research methodology

We use quantile regression to examine the relationship between the bank loan interest rate and corporate governance variables and whether such a relationship varies across different points on the loan rate distribution. The following is the regression model for our tests:

$$\begin{aligned} LRATE_{t+1,q} = \; & b_{0q} + b_{1q}BMOWN_t + b_{2q}INDB_t + b_{3q}BMPLEDGE_t + b_{4q}DUAL_t \\ & + b_{5q}BDSIZE_t + b_{6q}AMT_{t+1} + b_{7q}Collateral_{t+1} + b_{8q}CSCORE_t \\ & + b_{9q}BigN_t + b_{10q}TENURE_t + b_{11q}MB_t + b_{12q}LEV_t + b_{13q}SIZE_t \\ & + b_{14q}ROA_t + b_{15q}CAPINT_t + b_{16q}IntCov_t + b_{17q}PRate_t + b_{18q}Age_t + e_t \end{aligned} \quad (1)$$

where, q indicates a percentile in the conditional distribution of the loan rate. We first estimate equation (1) using the OLS method to obtain an average relationship between the bank loan interest rate ($LRATE_{t+1}$) and its determinants. Then, we examine equation (1) at five representative quantiles of the loan rate distribution, 10, 25, 50, 75 and 90 per cent, using the QReg method. That is, we estimate the relationship between the loan rate and its determinants at each of these quantiles and examine whether the relationship is heterogeneous across different quantiles.

Our dependent variable is the bank loan interest rate ($LRATE_{t+1}$). The *Taiwan Economic Journal* (TEJ) maintains a database for bank loans in Taiwan. For each firm in its database in a year, TEJ compiles loan amounts of all outstanding loans and loan interest rates. For each firm-year, we identify *new* loans originating for that firm in the subsequent year (year t+1). Our bank loan interest rate ($LRATE_{t+1}$) is the interest rate of a new loan (firm and loan subscripts are omitted for ease of exposition for all variables). Note that the bank loan interest rate is measured in the subsequent year (year t+1) after the determinants in equation (1), except the loan-specific determinants of AMT_{t+1} and $Collateral_{t+1}$, are measured in the current year (year t). This is to ensure that a firm's financial statement information is available to bank loan officers when they assess the risk of the firm (Sengupta, 1998; Jiang, 2008).

We examine 18 determinants of loan rate in equation (1) based on prior literature. These determinants can be classified into two categories: corporate governance variables and control variables. We explain each of these 18 variables below.

We begin with the discussion of five corporate governance variables. First, directors' equity ownership or board member equity ownership ($BMOWN_t$) is measured as the percentage of a firm's outstanding shares held by its board members. Jensen (1993) argues that the board with greater ownership in the firm is more likely to monitor management diligently. Empirically, Ashbaugh-Skaife *et al.* (2006) and Lorca *et al.* (2011) find that the cost of debt is negatively related to director ownership. We thus expect a negative coefficient on board member equity ownership ($BMOWN_t$).

Second, board independence ($INDB_t$) is measured as the ratio between the number of independent board members and board size. Myers *et al.* (1997) find that independent board members curtail managerial perquisite consumption. Prevost *et al.* (2002) find a positive relationship between firm performance and the percentage of independent directors. Moreover, Bhojraj and Sengupta (2003) and Anderson *et al.* (2004) find a negative relationship between the cost of debt and board independence. We thus expect a negative coefficient on board independence ($INDB_t$).

Third, board member equity pledge ($BMPLEDGE_t$) is measured as the percentage of board members' shareholdings of their firm used as collateral for their personal loans from outside financial institutions. In Taiwan, board members sometimes use their shareholdings in the firm where they are board members as collateral to obtain personal loans from outside financial institutions, a practice we termed board member equity pledge ($BMPLEDGE_t$). Board members often use the proceeds to purchase additional shares of the firm to increase their voting rights (control over the firm). Board member equity pledge thus causes those board members' voting rights to exceed their net ownership in the firm (net cash flow rights), and can create a strong incentive on the part of these board members to maintain high share prices. Fan and Wong (2002) show that the separation of voting rights from cash flow rights provides both means and incentives for controlling shareholders to benefit at the expense of outside or minority shareholders. Chiou *et al.* (2002) find that the probability of financial distress is positively related to board member equity pledge in Taiwan. The above studies all suggest that the excess of voting rights over cash flow rights creates agency conflicts between controlling shareholders and outside/minority stakeholders, which tends to increase the loan interest rate. We therefore expect a positive coefficient on board member equity pledge ($BMPLEDGE_t$).

Fourth, CEO-Chairman dual position ($DUAL_t$) is a dummy variable, which is set to one if the CEO also serves as the chairman of the board and zero otherwise. Patton and Baker (1987) and Booth *et al.* (2002) find that the effectiveness of board monitoring is reduced when a firm's CEO also serves as the chairman of the board. In addition, Dechow *et al.* (1996) and Carcello and Nagy (2004) both find that the probability of financial fraud increases in firms where CEOs are also the chairman of the board. In Taiwan, Chen and Yeh (2002) find a positive relationship between earnings management and CEO-Chairman dual positions. Based on these studies, we expect a positive coefficient on CEO-Chairman duality ($DUAL_t$).

Fifth, board size ($BDSIZE_t$) is measured by the number of board members on the board. There are two opposite views about the effect of board size on monitoring effectiveness. Lipton and Lorsch (1992) and Jensen (1993) argue that large boards tend to suffer from social loafing and require higher coordination costs. Yermack (1996) find that Tobin's Q is negatively related to board size, consistent with the view that larger boards of directors are less effective. On the other hand, many researchers argue that larger boards are more likely to include expert board members and are less likely to be dominated by management, both of which tend to enhance the effectiveness of board monitoring (Herman, 1981; Zahra and Stanton, 1989). Finally, Zou and Adams (2008) report a positive relationship, but Chen (2012) finds no significant relationship, and Anderson *et al.* (2004, p. 332) report a significantly negative relationship. Because of these conflicting findings, we make no prediction for the relationship between the loan rate and board size.

We now turn to the discussion of 13 control variables. First, we include two loan-specific variables, loan amount (AMT_{t+1}) and loan collateral ($Collateral_{t+1}$). AMT_{t+1} is measured as the natural logarithm of the amount of a new loan (in thousands of New Taiwan dollars) in year t+1. $Collateral_{t+1}$ is a dummy variable set to one if a new loan in year t+1 is a collateral loan, and zero otherwise. We expect a negative coefficient on AMT_{t+1} (Kim *et al.*, 2011, p. 1,173) and a negative coefficient on $Collateral_{t+1}$.

Second, we include a measure of accounting conservatism as a control variable because Zhang (2008) argues that conservative financial reporting benefits borrowers *ex ante* through lower interest rates. We measure accounting conservatism ($CSCORE_t$) following Khan and Watts (2009). As a first step, we estimate the following equation with annual cross-sectional regressions:

$$\begin{aligned} EARN_t = {} & \beta_{1t} + \beta_{2t}NEG_t + RET_t(\mu_{1t} + \mu_{2t}MCAP_t + \mu_{3t}MB_t + \mu_{4t}MLEV_t) \\ & + NEG_t \times RET_t(\lambda_{1t} + \lambda_{2t}MCAP_t + \lambda_{3t}MB_t + \lambda_{4t}MLEV_t) + \varepsilon_t \end{aligned} \quad (2)$$

where, $EARN_t$ is net income before extraordinary items, scaled by beginning-of-year market value of equity; RET_t is annual returns over the 12 months from 8 months before the fiscal year-end to four months after the fiscal year-end; NEG_t is one if $RET \leq 0$, and zero otherwise; $MCAP_t$ is the natural log of the market value of equity; MB_t is the market-to-book ratio; and $MLEV_t$ is the long-term and short-term debt, scaled by beginning-of-year market value of equity.

Then, we collect the yearly λ-coefficients (i.e. λ_{1t}-λ_{4t}) and calculate the firm-year measure of conservatism, $CSCORE_t$, using equation (3):

$$CSCORE_t = \lambda_{1t} + \lambda_{2t}MCAP_t + \lambda_{3t}MB_{i,t} + \lambda_{4t}MLEV_t \tag{3}$$

The higher the $CSCORE_t$, the more conservative the firm is in its financial reporting in year t. We thus expect a negative coefficient on conservatism ($CSCORE_t$).

Third, we include auditor quality ($BigN_t$) and auditor tenure ($TENURE_t$). Teoh and Wong (1993) find that perceived audit quality of Big N auditors is higher than that of non-Big N auditors. Mansi *et al.* (2004) find that the cost of debt is generally lower for firms audited by auditors with a longer tenure. Based on the above discussion, we expect a negative coefficient on auditor quality ($BigN_t$) and on auditor tenure ($TENURE_t$). See Table I for definitions of $BigN_t$, $TENURE_t$ and other variables.

Fourth, the market-to-book ratio (MB_t) is commonly used as a proxy for growth. As explained earlier, prior literature provide conflicting results regarding the relationship between the cost of debt and MB_t. We thus offer no predicted sign for the coefficient on MB_t. Fifth, following prior literature (Kim and Shi, 2011), we include financial leverage (LEV_t) and prime interest rate ($PRate_t$). We expect positive coefficients on these two variables.

Sixth, following Callahan *et al.* (2012), we include firm size ($SIZE_t$), return on assets (ROA_t) and a dummy for interest coverage ratio ($IntCov_t$), which is set to one if a firm's interest coverage ratio is above the median interest coverage ratio in a year and zero otherwise[5]. We expect negative coefficients on these three variables.

Seventh, we also include capital intensity ($CAPINT_t$) to examine whether capital structure affects the loan rate. On the one hand, capital intensive firms are likely to have greater volatility in earnings due to higher operating leverage (Baginski *et al.*, 1999; Lev, 1983). This suggests a positive relationship between loan rate and capital intensity. On the other hand, capital-intensive firms have more tangible assets in the event of liquidation, suggesting a negative relationship. Given the conflicting views, we do not predict the sign for capital intensity. Finally, we expect a negative coefficient on firm age (Age_t).

3. Sample selection and descriptive statistics

All data needed for this study are collected from TEJ database during 1996-2012. We first delete observations in the financial industry or with missing values for variables in this study. We then align the loan interest rate in the next year ($LRATE_{t+1}$) with determinants in the current year (except for AMT_{t+1} and $Collateral_{t+1}$, which are concurrent with $LRATE_{t+1}$). This reduces our sample period to 1996-2011. To reduce the undue influence of extreme values, we winsorize all continuous variables at 1 and 99 per cent of their respective distributions. Through the above selection process, we obtain a final sample of 239,322 year-firm loan observations spanning 1996-2011.

Table I. Summary statistics

Variable	Mean	SD	Lower quartile	Median	Upper quartile
$LRATE_{t+1}$ (%)	3.671	2.151	2.000	3.000	5.170
$BMOWN_t$ (%)	23.059	14.073	12.550	19.680	30.270
$INDB_t$	0.079	0.138	0.000	0.000	0.167
$BMPLEDGE_t$ (%)	18.888	25.749	0.000	5.160	30.750
$DUAL_t$	0.274	0.446	0.000	0.000	1.000
$BDSIZE_t$	7.191	2.779	5.000	7.000	9.000
AMT_{t+1}	10.824	1.642	9.903	10.820	11.879
$Collateral_{t+1}$	0.536	0.499	0.000	1.000	1.000
$CSCORE_t$	−0.004	0.272	−0.014	0.000	0.000
$BigN_t$	0.794	0.405	1.000	1.000	1.000
$TENURE_t$	11.007	6.122	6.000	10.000	15.000
MB_t	1.378	1.062	0.700	1.090	1.710
LEV_t	0.491	0.158	0.384	0.480	0.587
$SIZE_t$	15.706	1.398	14.676	15.551	16.598
ROA_t	0.023	0.084	−0.007	0.032	0.069
$CAPINT_t$	0.303	0.200	0.138	0.273	0.448
$IntCov_t$	0.491	0.500	0.000	0.000	1.000
$PRate_t$ (%)	1.969	1.404	0.910	1.500	2.130
Age_t	26.675	12.342	17.000	26.000	35.000

Notes: The sample consists of 239,322 firm-year-loan observations from 1996 to 2011, taken from the *Taiwan Economic Journal* database: Variable Definition: $LRATE_{t+1}$ interest rate of a new loan for a firm in the next year (year t + 1); $BMOWN_t$ is the percentage of a firm's outstanding shares owned by board members; $INDB_t$ is the number of independent board members divided by board size; $BMPLEDGE_t$ is the percentage of board members' stockholdings used as pledge for personal loans; $DUAL_t$ is one if the Chairman of the board is also the CEO, and zero otherwise; $BDSIZE_t$ is the number of board members on the board; AMT_{t+1} is the natural logarithm of the amount of a new loan (in thousands of New Taiwan dollars) in year t+1; $Collateral_{t+1}$ is one if a new loan in year t+1 is a collateral loan, and zero otherwise; $CSCORE_t$ is a measure of firm-year-specific conservatism estimated using equations (2) and (3); $BigN_t$ is one if the observation is audited by a Big 4 (or previously 5, 6, or 8) audit firm, and zero otherwise; $TENURE_t$ audit firm tenure is measured by the number of years in the auditor–client relationship; MB_t is market-to-book ratio; LEV_t is the financial leverage measured as the ratio between total liabilities and total assets; $SIZE_t$ is the natural logarithm of total assets; ROA_t is the return on assets; $CAPINT_t$ is the gross PPE divided by total assets; $IntCov_t$ is one if a firm's interest coverage ratio (income before interest expense and taxes divided by interest expense) is larger than the median interest coverage ratio in a year, and zero otherwise; $PRate_t$ is the prime interest rate measured as the average interest rate on a one-month certificate of deposit from five major Taiwan banks; and Age_t is the number of years since a firm is listed

Table I reports descriptive statistics for variables in equation (1). The mean loan interest rate ($LRATE_{t+1}$) is 3.671 per cent, whereas the median is 3.000 per cent. The mean (median) $BMOWN_t$ is 23.059 per cent (19.680 per cent). This suggests that directors in Taiwan are often large shareholders of the firm, comparable to Spain where directors also hold a significant portion of the firm (Lorca *et al.*, 2011). On average, 7.90 per cent of board members are independent ($INDB_t$)[6]. Although the mean $BMPLEDGE_t$ is 18.888 per cent, the median is 5.160 per cent. Moreover, 27.4 per cent of CEOs also serve as the chairman of the board ($DUAL_t$), and the average board size is 7.191 members.

Regarding control variables, the median AMT_{t+1} is 10.820[7]. On average, 53.6 per cent of loans are collateralized. The mean conservatism ($CSCORE_t$) is −0.004; Big N auditors audit 79.4 per cent of the sample; the mean auditor tenure ($TENURE_t$) is 11.007 years. The mean MB_t (1.378) is higher than the median (1.090); the mean LEV_t (0.491) is very close to its median (0.480). The mean ROA_t is 0.023; the mean $CAPINT_t$ is 0.303; and the mean $IntCov_t$ is 0.491. Finally, the prime rate ($PRate_t$) ranges from the first quartile of 0.910 per cent to the third quartile of 2.130 per cent. The average firm age (Age_t) is 26.675 years.

Table II presents the Pearson correlations among key variables. We find that the loan interest rate is significantly positively correlated with $BMPLEDGE_t$ (0.319), $DUAL_t$ (0.024), $BDSIZE_t$ (0.008), $Collateral_{t+1}$ (0.141), LEV_t (0.211), $CAPINT_t$ (0.117) and $PRate_t$ (0.751). On the other hand, the loan interest rate is significantly negatively correlated with $BMOWN_t$ (−0.057), $INDB_t$ (−0.295), AMT_{t+1} (−0.090), $CSCORE_t$ (−0.232), $BigN_t$ (−0.053), $TENURE_t$ (−0.212), MB_t (−0.020), $SIZE_t$ (−0.020), ROA_t (−0.149), $IntCov_t$ (−0.182) and Age_t (−0.084). These univariate correlations are mostly consistent with our expectations based on prior literature.

4. Empirical findings

We first estimate equation (1) using the OLS method. Table III reports our findings, which provides a baseline for comparison with the QReg results. Among our five governance variables, we find a significantly negative coefficient on $BMOWN_t$ (−0.007, p-value < 0.001) and on $INDB_t$ (−0.891, p-value < 0.01), consistent with prior literature. On the other hand, we find a significantly positive coefficient on $BMPLEDGE_t$ (0.007, p-value < 0.001) and on $DUAL_t$ (0.062, p-value < 0.10), consistent with our expectation based on prior literature. Finally, the coefficient on $BDSIZE_t$ is insignificant. Recall that we did not offer expected sign for $BDSIZE_t$ because Chen (2012), Zou and Adams (2008) and Anderson *et al.* (2004) find conflicting results.

Turning to control variables, we find that the coefficient on AMT_{t+1} is significantly negative (−0.053, p-value < 0.05), consistent with Kim *et al.* (2011) that the interest rate for a larger loan is lower. We, however, find a positive coefficient on $Collateral_{t+1}$, contrary to our expectation. This seems to suggest that banks demand collateral for firms with high default risk but no collateral for firms with low default risk. Consequently, loans with collateral have higher interest rates than loans without collateral. This finding is consistent with Costello and Wittenberg-Moerman (2011, p. 112) who find that the interest rates for loans with covenant restrictions are higher than the interest rates for loans without covenant restrictions.

Table III shows that the coefficient on $CSCORE_t$ (conservatism) and that on $BigN_t$ are both insignificant, failing to support our expectation based on prior literature. On the other hand, the coefficient on $TENURE_t$ is significantly negative, consistent with our expectation. Moreover, the coefficient on the market-to-book ratio (MB_t) is insignificant. Recall that we did not offer expected sign for MB_t because Bhojraj and Sengupta (2003, p. 466) and Francis *et al.* (2012, p. 531) report conflicting results. Finally, the coefficients on the remaining control variables are all significant and in expected directions except for ROA_t and $CAPINT_t$. The coefficients on these two variables are insignificant.

Next, we estimate equation (1) using the QReg method. We choose five representative quantiles (10, 25, 50, 75 and 90 per cent) and examine whether the relationship between the loan interest rate and our 18 explanatory variables is heterogeneous across the loan

Table II.
Pearson correlations

Variables		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)	(Q)	(R)
$LRATE_{t+1}$	(A)																		
$BMOWN_t$	(B)	−0.057																	
$INDB_t$	(C)	−0.295	0.034																
$BMPLEDGE_t$	(D)	0.319	−0.225	−0.258															
$DUAL_t$	(E)	0.024	−0.023	0.010	−0.050														
$BDSIZE_t$	(F)	0.008	0.016	−0.069	0.019	−0.148													
AMT_{t+1}	(G)	−0.090	−0.067	−0.081	0.132	−0.079	0.172												
$Collateral_{t+1}$	(H)	0.141	−0.036	−0.017	0.048	0.041	−0.025	0.054											
$CSCORE_t$	(I)	−0.232	0.012	0.098	−0.098	−0.027	0.044	0.019	−0.008										
$BigN_t$	(J)	−0.053	0.066	0.091	−0.028	−0.004	0.074	0.104	−0.045	−0.020									
$TENURE_t$	(K)	−0.212	−0.123	−0.197	0.068	−0.072	0.061	0.188	−0.096	0.053	−0.035								
MB_t	(L)	−0.020	0.106	0.119	−0.147	0.009	−0.013	0.018	−0.035	0.006	0.052	−0.115							
LEV_t	(M)	0.211	−0.004	−0.057	0.198	−0.003	−0.019	0.088	0.093	0.018	−0.044	−0.132	−0.116						
$SIZE_t$	(N)	−0.020	−0.162	−0.222	0.278	−0.140	0.395	0.552	−0.071	0.005	0.128	0.329	−0.000	0.062					
ROA_t	(O)	−0.149	0.106	0.077	−0.144	−0.044	0.026	0.047	−0.077	−0.005	0.042	0.062	0.414	−0.373	0.121				
$CAPINT_t$	(P)	0.117	0.084	−0.131	0.069	−0.036	0.145	0.069	0.065	−0.043	−0.012	−0.005	−0.107	0.095	0.158	−0.129			
$IntCov_t$	(Q)	−0.182	0.086	0.076	−0.187	−0.023	0.001	0.010	−0.089	0.017	0.047	0.020	0.350	−0.376	0.045	0.645	−0.194		
$PRate_t$	(R)	0.751	0.004	−0.333	0.278	−0.013	0.073	−0.038	0.035	−0.282	−0.012	−0.179	0.092	0.029	0.090	0.013	0.139	−0.018	
Age_t	(S)	−0.084	−0.121	−0.285	0.181	−0.066	0.243	0.126	−0.058	0.012	−0.098	0.397	−0.185	−0.019	0.292	0.032	−0.026	−0.007	−0.067

Notes: The sample consists of 239,322 firm-year-loan observations from 1996 to 2011, taken from the *Taiwan Economic Journal* database; see Table I for variable definition; numbers in bold indicate significance at the 10% or better levels

Variables	Predicted significance	Coefficient	p-value
Constant (b_0)	?	3.587***	(0.000)
Governance Variables			
$BMOWN_t$ (b_1)	–	−0.007***	(0.000)
$INDB_t$ (b_2)	–	−0.891***	(0.002)
$BMPLEDGE_t$ (b_3)	+	0.007***	(0.000)
$DUAL_t$ (b_4)	+	0.062*	(0.056)
$BDSIZE_t$ (b_5)	?	0.008	(0.486)
Control Variables			
AMT_{t+1} (b_6)	–	−0.053**	(0.042)
$Collateral_{t+1}$ (b_7)	–	0.347***	(0.000)
$CSCORE_t$ (b_8)	–	−0.153	(0.348)
$BigN_t$ (b_9)	–	−0.057	(0.280)
$TENURE_t$ (b_{10})	–	−0.014***	(0.003)
MB_t (b_{11})	?	−0.044	(0.355)
LEV_t (b_{12})	+	1.829***	(0.000)
$SIZE_t$ (b_{13})	–	−0.121***	(0.001)
ROA_t (b_{14})	–	−0.330	(0.458)
$CAPINT_t$ (b_{15})	?	−0.134	(0.301)
$IntCov_t$ (b_{16})	–	−0.294***	(0.000)
$PRate_t$ (b_{17})	+	1.063***	(0.000)
Age_t (b_{18})	–	−0.005**	(0.013)
Adj. R^2			0.643
N			239,322

Notes: See Table I for variable definitions; numbers in brackets are two-tailed p-values of the t-statistics; *; **; *** indicate significance at 10%, 5% and 1%, respectively

Table III.
OLS regression results

rate quantiles. Table IV reports our findings. First, the coefficients on director equity ownership ($BMOWN_t$) are −0.006 (p-value < 0.001), −0.005 (p-value < 0.001), −0.005 (p-value < 0.001), −0.006 (p-value < 0.001) and −0.008 (p-value < 0.001), respectively, for the 10, 25, 50, 75 and 90 per cent loan rate quantiles. These coefficients are all significantly negative at conventional levels. This suggests that a lower loan rate is associated with higher board member equity ownership at all levels of loan rate distribution. In Panel A of Table V, we report test statistics on whether the coefficients on $BMOWN_t$ across different quantiles are significantly different. For five levels of quantiles, we can test ten pairs of differences. For example, the difference in the coefficients on $BMOWN_t$ between the 10 and 25 per cent quantiles is −0.001 (i.e. −0.006 + 0.005; Table IV). We then test whether such a difference is significant using an F-statistic. As shown in Panel A of Table V, the difference in the coefficients on $BMOWN_t$ between the 10 and 25 per cent quantiles (−0.001) is insignificant at the conventional levels (p-value = 0.170). In fact, six of the ten pairs of differences are statistically insignificant. However, four of the ten pairs of differences are statistically significant (last column of Panel A of Table V). We thus conclude that there is some heterogeneity in the relationship between the loan rate and board member equity ownership across different quantiles.

Table IV. QReg regression results

Variables	q = 10%	q = 25%	q = 50%	q = 75%	q = 90%
Constant (b_{0q})	2.039*** (0.000)	2.269*** (0.000)	2.818*** (0.000)	3.985*** (0.000)	5.652*** (0.000)
Governance Variables					
$BMOWN_t$ (b_{1q})	−0.006*** (0.000)	−0.005*** (0.000)	−0.005*** (0.000)	−0.006*** (0.000)	−0.008*** (0.000)
$INDB_t$ (b_{2q})	−0.005 (0.806)	−0.174*** (0.000)	−0.551*** (0.000)	−1.350*** (0.000)	−2.440*** (0.000)
$BMPLEDGE_t$ (b_{3q})	0.005*** (0.000)	0.006*** (0.000)	0.007*** (0.000)	0.008*** (0.000)	0.007*** (0.000)
$DUAL_t$ (b_{4q})	0.030*** (0.000)	0.022*** (0.000)	0.078*** (0.000)	0.100*** (0.000)	0.118*** (0.000)
$BDSIZE_t$ (b_{5q})	0.003* (0.076)	0.008*** (0.000)	0.007*** (0.000)	0.008*** (0.001)	0.003 (0.126)
Control Variables					
AMT_{t+1} (b_{6q})	0.038*** (0.000)	−0.005** (0.017)	−0.048*** (0.000)	−0.113*** (0.000)	−0.190*** (0.000)
$Collateral_{t+1}$ (b_{7q})	0.217*** (0.000)	0.319*** (0.000)	0.379*** (0.000)	0.366*** (0.000)	0.335*** (0.000)
$CSCORE_t$ (b_{8q})	−0.290*** (0.000)	−0.205*** (0.000)	−0.244*** (0.000)	−0.080*** (0.000)	0.042*** (0.001)
$BigN_t$ (b_{9q})	−0.079*** (0.000)	−0.104*** (0.000)	−0.089*** (0.000)	−0.086*** (0.000)	−0.012 (0.391)
$TENURE_t$ (b_{10q})	−0.004*** (0.000)	−0.006*** (0.000)	−0.012*** (0.000)	−0.022*** (0.000)	−0.031*** (0.000)
MB_t (b_{11q})	0.007** (0.037)	0.008*** (0.000)	−0.013*** (0.000)	−0.058*** (0.000)	−0.080*** (0.000)
LEV_t (b_{12q})	1.040*** (0.000)	1.200*** (0.000)	1.482*** (0.000)	2.010*** (0.000)	2.579*** (0.000)
$SIZE_t$ (b_{13q})	−0.139*** (0.000)	−0.116*** (0.000)	−0.093*** (0.000)	−0.079*** (0.000)	−0.052*** (0.000)
ROA_t (b_{14q})	−0.482*** (0.000)	−0.477*** (0.000)	−0.588*** (0.000)	−0.276*** (0.000)	−0.166* (0.096)
$CAPINT_t$ (b_{15q})	0.103*** (0.000)	0.004 (0.758)	−0.093*** (0.000)	−0.077*** (0.000)	−0.258*** (0.000)
$IntCov_t$ (b_{16q})	−0.203*** (0.000)	−0.237*** (0.000)	−0.295*** (0.000)	−0.358*** (0.000)	−0.331*** (0.000)
$PRate_t$ (b_{17q})	0.819*** (0.000)	1.037*** (0.000)	1.168*** (0.000)	1.216*** (0.000)	1.100*** (0.000)
Age_t (b_{18q})	−0.002*** (0.000)	−0.004*** (0.000)	−0.006*** (0.000)	−0.007*** (0.000)	−0.008*** (0.000)
Adj. R^2	0.263	0.371	0.452	0.493	0.432
N	239,322	239,322	239,322	239,322	239,322

Notes: See Table I for variable definitions; numbers in brackets are two-tailed *p*-values of the *t*-statistics; *; **; *** indicate significance at 10%, 5% and 1%, respectively

Quantiles	q = 25%	q = 50%	q = 75%	q = 90%
Panel A: Differences in the coefficients on BMOWN across LRATE quantiles				
q = 10%	−0.001 (0.170)	−0.001 (0.430)	0.000 (0.956)	0.002*** (0.000)
q = 25%		0.000 (0.663)	0.001 (0.221)	0.003*** (0.000)
q = 50%			0.001 (0.320)	0.003*** (0.000)
q = 75%				0.002*** (0.000)
Panel B: Differences in the coefficients on INDB across LRATE quantiles				
q = 10%	0.169*** (0.000)	0.546*** (0.000)	1.345*** (0.000)	2.435*** (0.000)
q = 25%		0.377*** (0.000)	1.176*** (0.000)	2.266*** (0.000)
q = 50%			0.799*** (0.000)	1.889*** (0.000)
q = 75%				1.090*** (0.000)
Panel C: Differences in the coefficients on BMPLEDGE across LRATE quantiles				
q = 10%	−0.001*** (0.000)	−0.002*** (0.000)	−0.003*** (0.000)	−0.002*** (0.000)
q = 25%		−0.001*** (0.000)	−0.002*** (0.000)	−0.001*** (0.000)
q = 50%			−0.001*** (0.000)	−0.000 (0.529)
q = 75%				0.001*** (0.000)
Panel D: Differences in the coefficients on DUAL across LRATE quantiles				
q = 10%	0.008 (0.345)	−0.048*** (0.000)	−0.070*** (0.000)	−0.088*** (0.000)
q = 25%		−0.056*** (0.000)	−0.078*** (0.000)	−0.096*** (0.000)
q = 50%			−0.022*** (0.000)	−0.040** (0.048)
q = 75%				−0.018 (0.636)
Panel E: Differences in the coefficients on BDSIZE across LRATE quantiles				
q = 10%	−0.005*** (0.000)	−0.004*** (0.000)	−0.005*** (0.001)	−0.0001 (0.778)
q = 25%		0.001 (0.501)	−0.000 (0.779)	0.005* (0.065)
q = 50%			−0.001 (0.416)	0.004* (0.072)
q = 75%				0.005*** (0.010)
Panel F: Differences in the coefficients on CSCORE across LRATE quantiles				
q = 10%	−0.085*** (0.000)	−0.046* (0.090)	−0.210*** (0.000)	−0.332*** (0.000)
q = 25%		0.039*** (0.000)	−0.125*** (0.000)	−0.247*** (0.000)
q = 50%			−0.164*** (0.000)	−0.286*** (0.000)
q = 75%				−0.122*** (0.000)
Panel G: Differences in the coefficients on TENURE across LRATE quantiles				
q = 10%	0.002*** (0.000)	0.008*** (0.000)	0.018*** (0.000)	0.027*** (0.000)
q = 25%		0.006*** (0.000)	0.016*** (0.000)	0.025*** (0.000)
q = 50%			0.010*** (0.000)	0.019*** (0.000)
q = 75%				0.009*** (0.000)
Panel H: Differences in the coefficients on MB across LRATE quantiles				
q = 10%	−0.001 (0.364)	0.020*** (0.000)	0.065*** (0.000)	0.087*** (0.000)
q = 25%		0.021*** (0.000)	0.066*** (0.000)	0.088*** (0.000)
q = 50%			0.045*** (0.000)	0.067*** (0.000)
q = 75%				0.022*** (0.000)

Notes: See Table I for variable definitions: numbers in brackets are two-tailed *p*-values of the *F*-statistics; *; **; *** indicate significance at 10%, 5% and 1%, respectively

Table V.
Tests of differences in slopes across quantiles

Second, the coefficients on board independence ($INDB_t$) are −0.005 (p-value = 0.806), −0.174 (p-value < 0.001), −0.551 (p-value < 0.001), −1.350 (p-value < 0.001) and −2.440 (p-value < 0.001) across five quantiles (Table IV). The coefficient becomes increasingly more negative as the loan rate quantiles increase. Panel B of Table V shows that all ten pairs of differences in the coefficients on $INDB_t$ between two quantiles are significant different. Moreover, the difference in coefficients between any two quantiles is large. For example, the difference in coefficients between 10 and 90 per cent quantiles is 2.435 (p-value < 0.001). These results reveal considerable heterogeneity in the relationship between the bank loan rate and board independence. Moreover, board independence matters much more for firms located in higher loan rate quantiles than firms in lower quantiles.

Third, the coefficients on $BMPLEDGE_t$ are significantly positive for all five quantiles (Table IV). These coefficients tend to increase slightly as the loan rate increases. Panel C of Table V shows that the coefficient on $BMPLEDGE_t$ when the loan rate is high (q = 75 or 90 per cent) is significantly larger than the coefficient on $BMPLEDGE_t$ when the loan rate is low (q = 10 or 25 per cent). This suggests that although board member equity pledge is universally detrimental to the loan rate, the negative effect is slightly more pronounced for firms at the higher loan rate quantiles than firms at the lower quantiles.

Fourth, Table IV shows that the coefficient on $DUAL_t$ is significantly positive for each of the five quantiles and increases almost monotonically from 0.030 (10 per cent quantile) to 0.118 (90 per cent quantile). Panel D of Table V suggests that most of the increases in the coefficient on $DUAL_t$ across two quantiles are significant. Thus, there is again considerable heterogeneity in the relationship between the loan rate and CEO-Chairman duality. Moreover, the detrimental effect of CEO-Chairman duality on the bank loan rate is more pronounced at higher loan rate quantiles.

Fifth, we discuss our findings for board size ($BDSIZE_t$). The extant literature contains conflicting theories and evidence regarding whether larger or smaller boards of directors are more effective. Our OLS coefficient on $BDSIZE_t$ is insignificant. However, our QReg results (Table IV) suggest that the relationship between the loan rate and $BDSIZE_t$ is rather heterogeneous with the relationship being significant positive at lower loan rate quantiles (q = 10, 25, 50 and 75 per cent) but becoming insignificant at the highest quantile (q = 90 per cent). Clearly, the OLS estimate does not reveal a full picture of the relationship between the loan rate and board size.

Sixth, Tables IV and V show considerable heterogeneity in the relationship between the loan rate and most of our 13 control variables. We discuss only three variables for brevity, $CSCORE_t$, $TENURE_t$ and MB_t. Recall that the OLS coefficient on $CSCORE_t$ is insignificant (Table III). Thus, our OLS result does not confirm Zhang's (2008) finding that the cost of debt is lower for firms with more conservative financial reporting. However, our QReg results reveal that the coefficients on $CSCORE_t$ are significantly negative for the 75 per cent loan rate quantile and below, consistent with Zhang (2008). But the coefficient on $CSCORE_t$ turns to significantly positive for the 90 per cent loan rate quantile. This finding is counterintuitive. We conjecture that a possible explanation is that firms in the 90 per cent loan rate quantile predominantly have bad news. These firms' willingness to report the bad news timely (i.e. conservatism) does not change the fact these firms have a lot of bad news. Banks charge higher loan rates to these firms for bad news despite these firms' conservative financial reporting.

Seventh, the OLS coefficient on $TENURE_t$ is significantly negative (Table III), consistent with Mansi *et al.* (2004) that the cost of debt is lower for firms with longer auditor tenure. The QReg estimate is significantly negative in each quantile and it becomes more negative as the loan rate quantile increases (Table IV). So, there is considerable heterogeneity in the relationship between the loan rate and $TENURE_t$ because all ten differences in the coefficients on $TENURE_t$ across two quantiles are significant (Table V).

Finally, the coefficient on MB_t is significantly positive in the 10 and 25 per cent quantiles of loan rate distribution (Table IV). These findings are consistent with Bhojraj and Sengupta (2003, p. 466) who also report a positive relationship between the cost of debt and the market-to-book ratio. In sharp contrast, the coefficient on MB_t becomes significantly negative in the 50, 75, and 90 per cent loan rate quantiles. These findings are consistent with Francis *et al.* (2012, p. 531) who show a negative relationship between the cost of debt and the market-to-book ratio. Table V shows that nine out of ten pairs of differences in coefficients are significant, suggesting considerable heterogeneity in the relationship between the loan rate and the market-to-book ratio[8].

5. Conclusion

Prior studies conventionally use the OLS method to examine the relationship between the dependent variable and explanatory variables. The OLS method produces only one set of coefficient estimates that describe the mean effect of the explanatory variables on the dependent variable. In contrast, the quantile regression (QReg) method generates a multitude of coefficient estimates with each set of estimates describing the relationship between the dependent and explanatory variables at a particular quantile of the dependent variable. Consequently, the QReg estimates provide a more detailed and complete picture of the relationship between the dependent variable and explanatory variables. Although quantile regression is becoming widely used in economics, finance and other disciplines, its use in accounting research has only started. The purpose of this study is:

(1) to investigate whether there is heterogeneity in the relationship between the bank loan interest rate and its determinants using the QReg method; and

(2) to reconcile some conflicting findings in prior literature. In so doing, we also demonstrate the inadequacy of the OLS estimates and the richness of QReg estimates.

We find considerable heterogeneity in the relationship between the loan rate and most of our corporate governance variables across the loan rate quantiles. For example, the coefficient on board size is significantly positive for the 10, 25, 50 and 75 per cent loan rate quantiles, but it becomes insignificant at the 90 per cent quantile. This finding potentially reconciles the conflicting findings between Zou and Adams (2008) and Chen (2012). We also find considerable heterogeneity in the relationship between the loan rate and our control variables. For example, the coefficient on the market-to-book ratio is significantly positive in the low loan rate quantiles, but it becomes significantly positive in the high loan rate quantiles. This finding potentially reconciles the conflicting results between Bhojraj and Sengupta (2003) and Francis *et al.* (2012). The heterogeneity shown in this study highlights the inadequacy of the OLS estimates, which capture only the mean relationship between the dependent variable and explanatory variables, and the usefulness of the QReg estimates, which provide a more detailed and complete picture of the relationship between the dependent variable and explanatory variables.

Notes

1. These statistics are calculated using all firms in the *Taiwan Economic Journal* database in 2005.
2. Koenker and Hallock (2001) contain an excellent introduction to quantile regression. Quantile regression analyses can be easily implemented using commercial statistics software such as Stata and SAS.
3. Recall that the dependent variable, given a fixed value of each explanatory variable, is a random variable with a distribution. The OLS method estimates the mean value of the dependent variable given a fixed value of each explanatory variable – the conditional mean relationship. In contrast, the QReg method estimates various percentiles of the distribution of the dependent variables, e.g., 10, 25, 50, 75, and 90 per cent percentiles, given a fixed value of each explanatory variable.
4. We discuss board member equity pledge in more detail in the next section.
5. As interest coverage ratio above a certain threshold offers little incremental benefit to creditors (banks), we define IntCov_t as a dummy variable.
6. The mean INDB_t is low (0.079) because there is no requirement for independent board members in Taiwan before 2001.
7. This suggests that the median loan amount without logarithm transformation is 50,011 (thousand) New Taiwan dollars, which is roughly $1,667,033 using an exchange rate of one US dollar for 30 New Taiwan dollars.
8. Detailed results similar to those in Table V for variables not discussed in the paper are available from the authors upon request.

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