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Article

Debt Origin and Investment Efficiency from Korea

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Abstract: This study empirically analyzes the effect of debt origin on investment efficiency. According to previous studies that report that the quality of financial reporting may vary depending on the origin of the debt, the empirical analysis predicted that the effects of the origin of the debt on investment efficiency would be differential. Debt origin was divided into private and public debt. The analysis results of this study are as follows. First, there is a significant negative relationship between the private debt and investment efficiency, while there is a significant positive relationship between public debt and investment efficiency. This means that capital gains under public debt may be more profitable to managers by improving the quality of their accounting information than those under private debt. This is in line with the previous research which found that, when financing with public debt, the earnings management is reduced and accounting transparency is high. This study focuses on the origin of debt as a determinant of investment efficiency and analyzes the level of investment efficiency according to the origin of debt. We examine the sustainability of firms from the perspective of investment efficiency, such as raising capital and selecting optimal investment options. The results of this study suggest that the level of incentives and investment efficiency of managers may be differentiated depending on the origin of the debt.

Keywords: debt origin; public debt; private debt; investment efficiency; sustainability

1. Introduction

This study examines the relationship between debt origin and investment efficiency. Specifically, the purpose of this paper is to classify debt origin into public debt and private debt according to the debt procurement method, and to verify how the debt origin are related to investment efficiency. Efficient investment increases firm value, while inefficient investment lowers it. The lower the investment efficiency, the lower the earnings persistence and the less relevant of accounting earnings (Lee and Paek 2015). Firm value is defined as the present value of future cash flows. The better the future cash flow, the higher the sustainability of the firm. Corporate activities are divided into business activities, investment activities and financial activities. By selecting the optimal investment using the raised capital, the firm's value can be increased, and the firm's sustainability can be increased.

Corporate bonds are a typical form of public debt in which firms raise capital from an unspecified number of investors through capital markets. In a public debt contract, it is not easy for many investors to access the internal information of the debt issuer, which makes it difficult to grasp the future profitability or the investment risk of the debt issuer. In addition, public debt may not be controlled smoothly due to the weak monitoring system for corporate decision making and difficult negotiation required to rebalance contract conditions. Therefore, transparent financial information is expected to play a greater role for investors with a high risk of information asymmetry and benefit them more (Chun et al. 2011).

Private debt is a contract that provides financing through a bilateral contract between a creditor and a debtor, and is a representative example of a financial institution's loan contract. Creditors of private debt can easily obtain information on the future profitability and risk prospects of the investment firm through flexible and efficient negotiation and information exchange with the firm. In addition, it is easy to cope with the uncertainty of the firm after investment because it is possible to continuously monitor the decision-making process of the firm and to exercise control through the flexible change of contract conditions. Therefore, information costs of private debt are not as large as those of public debt due to information asymmetry (Chun et al. 2011).

Private debt creditors claim to be more advantageous in terms of borrowers' information acquisition than public debt creditors (Ramakrishnan and Thakor 1984; Carey et al. 1993; Houston and James 1996; An et al. 2004). This is because private debt creditors are increasingly refinancing funds to the debtor and increasing the opportunity to acquire the private information of the borrower through accumulated monitoring over time. Since private debt creditors have a relative advantage in obtaining this information compared to public debt creditors, companies with significant information asymmetry problems tend to prefer private placement to minimize reverse selection costs. Thus, monitoring and rigorous contractual provisions of private creditors dilute this information asymmetry problem and control the potential reverse selection problem (An et al. 2004). In sum, there is a principal-agent problem between the debt-financing firm and the creditor. The cost of information asymmetry between a firm and a creditor differs depending on whether it is financed by public debt or private debt. In other words, both the firm and the creditor will try to find the optimal method of debt financing. On the other hand, investment efficiency refers to the adoption of an investment plan with positive net present value (NPV) under circumstances where there is no market friction such as reverse selection or agency cost. Thus, investment opportunities with negative NPV are classified as overinvestment and underinvestment is defined as giving up investment opportunities with positive NPV (Biddle et al. 2009; Lee and Paek 2015). In previous research, accounting information and investment efficiency are mainly examined in terms of earnings quality. Firms can reduce information asymmetry by improving earnings quality. Managers can have better investment opportunities by reducing adverse selection and moral hazard, and high earnings quality can increase investment efficiency (Biddle and Hilary 2006; McNichols and Stubben 2008; Biddle et al. 2009; Chen et al. 2011). Chen et al. (2011) reported that high earnings quality and high relevance to investment efficiency may occur in emerging countries. In addition, many previous studies have analyzed the relationship between earnings quality and investment efficiency in various perspectives. However, few studies have examined the relationship between earnings quality and investment efficiency in terms of capital procurement. Some studies have looked at the reduction of funding and debt costs (Francis et al. 2004, 2005). Bharath et al. (2008) examine the debt market's accessibility and its impact on debt contracts. This study examines the relationship between debt origin and investment efficiency in terms of debt financing.

The results of this study are as follows. First, the relationship between public debt and investment efficiency is significantly positive. These results support the hypothesis of this study. Thus, a firm that issued a public debt is more efficient than a firm that did not. As a result of analyzing the sample by the overinvestment sample and the underinvestment sample, a statistically more significant result was observed in the underinvestment sample. This is in line with previous research findings that public creditors require a high level of financial reporting quality for the debtors to reduce information asymmetry between the debtors and creditors (Chun et al. 2011; Givoly et al. 2010).

Second, the relationship between private debt and investment efficiency is significantly negative. In other words, firms that issued private debt are inefficient compared to firms that did not. As a result of analyzing the sample by the overinvestment sample and the underinvestment sample, a statistically more significant result was observed in the underinvestment sample. This allows private debt creditors to dilute this information asymmetry problem and control potential reverse selection problems with monitoring and rigorous contractual provisions (An et al. 2004). Thus, the incentive to increase the quality of financial reporting is relatively lower than that of public debt.

This study focuses on the origin of debt as a determinant of investment efficiency and analyzes the level of investment efficiency according to debt origin. The impact on the sustainability of firms was examined according to the origin of debt during capital procurement, suggesting that the investment efficiency of firms could differ depending on the origin of debt. In other words, it is meaningful to suggest that the level of incentive and investment efficiency of managers can be differentiated, and the impact on corporate sustainability can differ depending on the origin of debt.

The rest of this study is as follows. In Section 2, the previous studies and hypotheses about the origin of debt and investment efficiency are presented. In Section 3, the research design is explained. In Section 4, we present the results of empirical analysis and in Section 5, we present the conclusion and limitations of the study.

2. Prior Literature and Hypothesis Development

2.1. Debt Origin

Previous research has argued that the role of debt is to reduce the manager's discretion and function as a check when making investment decisions (Myers 1977; Jensen 1986). D'Mello and Miranda (2010) reported that debt reduces overinvestment.

Public debt creditors have less access to the private information of a firm than private debt creditors, there are few effective ways to monitor and discipline management, and information asymmetry between managers and creditors is high (Chun et al. 2011; Givoly et al. 2010). In addition, public creditors require a high quality of financial reporting to reduce information asymmetry because financial statements are the main source of information for evaluating firms (Chun et al. 2011; Givoly et al. 2010). Public debt creditors have less access to the private information of the firm than private creditors and are less able to effectively control managers, leading to greater incentives for managers to engage in opportunistic behavior (Givoly et al. 2010). Thus, the presence of public debt may affect the quality of financial reporting.

Chun et al. (2011) examined the relationship between accrual-based earnings management and debt origin, and the relationship between earnings management through actual activities and debt origin. The results show that firms that issue public debt have lower levels of earnings management through discretionary accruals than firms that issue private debt. In addition, the degree of actual earnings management through production and expenditure activities was also low in firms which issue public debt, implying that the investors of public debt are dissolving the risks associated with information asymmetry and the lack of control over the firm through information intermediaries and that a higher level of transparent accounting information is required for public debt issuers.

Jung and Lee (2014) examined the relationship between private debt and foreign ownership. As a result, private debt and foreign ownership showed significant negative effect. In other words, foreign ownership decreased as private debt ratio increased. This implies that the higher the portion of private debt, the lower the benefit from improving the quality of accounting information.

Park (2013) analyzed the effect of debt origin on audit fees by classifying debt origin into public debt and private debt according to procurement sources and verifying the effect on audit fees. As a result, regression coefficients of private debt and public debt showed a positive direction, but only public debt was statistically significant. This result implies that the requirement of more reliable accounting information leads to the increase of audit fees in the case of public debt, where there are relatively more stakeholders rather than in private debt.

Yeo et al. (2015) analyzed the effect of public debt on the relationship between listed firms and the quality of financial reporting and found that public debt has a negative effect on the relationship between listed firms and the quality of financial reporting. This implies that the quality of financial reporting may be low in the case of firms with public debt, due to the manager's opportunistic earnings management.

Jung (2016) examined the relationship between private debt ratio and trading volume and found that the private debt ratio and trading volume showed a positive direction. In other words, trading volume increases as the private debt ratio increases, which is interpreted to be the result of an increase in the level of disagreement among investors.

In sum, public debt is a strong incentive to raise the quality of accounting earnings as a part of solving the information asymmetry problem between firms and external investors.

2.2. Investment Efficiency

Investment efficiency is judged to be efficient if the company makes a normal investment as expected, if the company invests normally. However, if the actual investment level is greater (overinvestment) or smaller (underinvestment) compared to the expected investment level, it is judged that the company's investment is inefficient. Biddle et al. (2009) defined a company's investment to be efficient if the company makes an investment with a positive net present value (NPV) based on the results of previous studies.

Park and Bae (2011) verified that the quality of financial reporting and corporate governance reduce overinvestment and underinvestment in firms from a previous study which found that the higher the quality of financial reporting, the better the investment efficiency. The analysis showed that the quality of financial reporting increases the investment of firms with potential for underinvestment, but has little effect on the decrease in investment of firms with potential for overinvestment. These results indicate that the quality of financial reporting does not completely eliminate investment inefficiency, but the quality of financial reporting moderates the information asymmetry. In addition, verifying the effects of corporate governance (an audit committee, the major shareholder ratio, the foreign ownership ratio) on overinvestment and underinvestment yielded inconsistent results. Therefore, it can be seen that corporate governance does not completely reduce the inefficient investment of the firm.

Lee and Paek (2015) analyzed the effect of corporate investment efficiency on earnings persistence and value relevance. Efficient investment will increase firm value, while inefficient investment will decrease firm value. When the firm's actual investment level is outside the expected investment level, the lower the investment efficiency, the lower earnings persistence and the lower the relevance of the accounting earnings. As a result, the more inefficient a firm's investment behavior, the lower the earnings persistence and value relevance.

With a higher quality of accounting information, the lesser information asymmetry will reduce market anomalies which reduces managerial opportunistic behavior (Lee 2009). Firms that borrow debt as public debt have a higher probability of high earnings quality than those that do not. Many previous studies have argued that the better the earnings quality, the better the investment efficiency. In terms of the relationship between debt origin and investment efficiency, public debt may act as a mechanism to solve information asymmetry problems for firms and external investors. If the information asymmetry problem is solved by improving the earnings quality, it will lead to efficient investment. Private debt has less incentive to improve the earnings quality than public debt. The shares of private/public debt in the total debt holding of firms or the actual levels in H1/H2 are relative shares. Accordingly, if the debt is raised by private debt rather than public debt, the investment efficiency is expected to be lower than that of public debt. Therefore, the hypotheses that verify the relationship between debt origin and investment efficiency is as follows.

Hypothesis 1 (H1). *Private debt and investment efficiency have a negative relationship.*

Hypothesis 2 (H2). *Public debt and investment efficiency have a positive relationship.*

3. Research Design

3.1. Data and Sample

The sample consists of listed companies from 2002 to 2017. Information on financial data was collected from FN Data-Guide provided by the Financial Information and Solution Co., Ltd. (Seoul, Korea) and TS-2000 database provided by Korea Listed Companies Association. We set the sample period after the foreign exchange crisis. Investment efficiency, which is a dependent variable, is $t + 1$, and independent variable is t , so the analysis period is until 2017, which is available.

Table 1 shows the sample selection process. The reason the financial industry is excluded from the sample in the sample selection criterion is that the accounting treatment of these companies is different from other companies and homogeneity of the sample cannot be secured. There are differences in the components of the financial statements, and even the same account subjects have different meanings from other industries. Those firms whose year-ends are not on 31 December are excluded because of data homogeneity. In this analysis, observations with anomalies of 1% and 99% of the distribution of each variable were winsorized. The final sample used in this study is 8754 firm-year observations.

Table 1. Sample selection.

Sample Selection Criteria	Firm-Year Observations
Firms listed in the Korea Exchange 2002 to 2017	9977
(less) Firms with fiscal year end except December and financial firms	(793)
(less) Financial and stock data cannot collect from FN Data-Guide	(430)
Final sample	8754

Table 2 shows the distribution of the sample by year and industry. Panel A of Table 2 shows the distribution of the sample by year. Although the number of listed companies has been on an increasing trend by year, there has not been a large variation in the period. Panel B of Table 2 shows the industry distribution of the sample. In the model estimated by [Chen et al. \(2011\)](#), the residual means investment inefficiency. In [Chen et al. \(2011\)](#)'s model, the residual means investment inefficiency. The sample is an overinvestment if the residual is greater than 0 and an underinvestment if the residual is less than zero.

Table 2. Distributions over the sample period.

Panel A: Distribution of Sample by Year						
Year	Total Sample		Overinvestment Sample		Underinvestment Sample	
	Frequency	Percent (%)	Frequency	Percent (%)	Frequency	Percent (%)
2002	413	4.72	178	4.96	235	4.74
2003	433	4.95	182	4.79	251	5.06
2004	448	5.12	172	4.53	276	5.57
2005	465	5.31	214	5.64	251	5.06
2006	485	5.54	208	5.48	277	5.59
2007	500	5.71	208	5.48	292	5.89
2008	521	5.95	179	4.71	342	6.90
2009	540	6.17	249	6.56	291	5.87
2010	567	6.48	249	6.56	318	6.42
2011	592	6.76	263	6.93	328	6.62
2012	600	6.85	253	6.66	347	7.00
2013	610	6.97	287	7.56	323	6.52

Table 2. Cont.

2014	618	7.06	251	6.61	367	7.41
2015	636	7.27	297	7.82	339	6.84
2016	652	7.45	315	8.30	337	6.80
2017	674	7.70	293	7.69	382	7.71
Total	8754	100	3798	100	4956	100
Panel B: Distribution of Sample by Industry						
Industry	Total Sample		Overinvestment Sample		Underinvestment Sample	
	Frequency	Percent (%)	Frequency	Percent (%)	Frequency	Percent (%)
Food, Beverage	447	5.11	188	4.95	258	5.21
Fiber, Clothes, Leathers	341	3.90	171	4.50	170	3.43
Timber, Pulp, Furniture	364	4.16	151	3.98	213	4.30
Cokes, Chemical	963	11.00	421	11.09	542	10.94
Medical Manufacturing	432	4.93	171	4.50	261	5.27
Rubber and Plastic	295	3.37	130	3.42	165	3.33
Non Metallic	272	3.11	109	2.87	163	3.29
Metallic	739	8.44	309	8.14	430	8.68
PC, Medical	602	6.88	260	6.85	342	6.90
Machine and Electronic	617	7.05	240	6.32	377	7.61
Other Transportation	657	7.51	286	7.53	371	7.49
Construction	431	4.92	205	5.40	226	4.56
Retail and Whole Sales	715	8.17	312	8.22	403	8.13
Transportation Service	298	3.40	130	3.42	168	3.39
Professional Services	793	9.06	424	11.17	369	7.45
Other	788	9.00	291	7.64	498	10.05
Total	8754	100	3798	100	4956	100

3.2. Methodology

In this study, the regression model for testing the effect of the debt origin on the investment efficiency is shown in Equations (1) and (3). Equations (1) and (3) apply the methodology of [Chun et al. \(2011\)](#). Debt origin was verified by dividing debt ratio (total loans/total assets), bond ratio (bonds/total assets), and the bond dummy variable. Equation (2) applies the methodology of [Jung and Lee \(2014\)](#). Debt origin is divided into public debt ratio and public debt is divided by the sum of public debt and private debt.

$$\begin{aligned}
 INV_EF_{it+1} = & \beta_0 + \beta_1 LOANR_{it} + \beta_2 BONDR_{it} + \beta_3 SIZE_{it} + \beta_4 LEV_{it} + \beta_5 LOSSDUM_{it} \\
 & + \beta_6 TA_{it} + \beta_7 STD_OCF_{it} + \beta_8 AGE_{it} + \beta_9 SLACK_{it} + \beta_{10} OWN_{it} \\
 & + \beta_{11} FOR_{it} + \beta_{12} BIG4_{it} + \sum YD + \sum ID + \varepsilon_{it}
 \end{aligned} \quad (1)$$

$$\begin{aligned}
 INV_EF_{it+1} = & \beta_0 + \beta_1 BOND_LOAN_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 LOSSDUM_{it} + \beta_5 TA_{it} \\
 & + \beta_6 STD_OCF_{it} + \beta_7 AGE_{it} + \beta_8 SLACK_{it} + \beta_9 OWN_{it} + \beta_{10} FOR_{it} \\
 & + \beta_{11} BIG4_{it} + \sum YD + \sum ID + \varepsilon_{it}
 \end{aligned} \quad (2)$$

$$\begin{aligned}
 INV_EF_{it+1} = & \beta_0 + \beta_1 LOANR_{it} + \beta_2 BONDDUM_{it} + \beta_3 SIZE_{it} + \beta_4 LEV_{it} \\
 & + \beta_5 LOSSDUM_{it} + \beta_6 TA_{it} + \beta_7 STD_OCF_{it} + \beta_8 AGE_{it} + \beta_9 SLACK_{it} \\
 & + \beta_{10} OWN_{it} + \beta_{11} FOR_{it} + \beta_{12} BIG4_{it} + \sum YD + \sum ID + \varepsilon_{it}
 \end{aligned} \quad (3)$$

where the dependent variable, investment efficiency, is measured as was done by [Chen et al. \(2011\)](#) and is defined as the absolute value of the estimated residual multiplied by -1 . The closer the residual is to zero,

the better the investment, and the farther the residual is from zero, the more inefficient the investment. Investment efficiency is generally based on the methodologies of McNichols and Stubben (2008); Biddle et al. (2009); and Chen et al. (2011). In this study, the methodologies of Biddle et al. (2009) and Chen et al. (2011) were applied. In Equation (1), *LOANR* is measured by dividing borrowings by total assets. *BOND* is measured by *BONDR*.

In Equation (1), *LOANR* and *BONDR* are the variables of interest in this study. The predictive sign of *LOANR* is in the negative direction, and the predictive sign of *BONDR* is in the positive direction. In Equation (2), *BOND_LOAN* is the public debt ratio, which is measured by dividing public debt by the sum of public debt and private debt. The predictive sign of *BOND_LOAN* is in the positive direction. In Equation (3), *LOANR* and *BONDDUM* are the variables of interest in this study. The predictive sign of *LOANR* is in the negative direction and the predictive sign of *BONDDUM* is in the positive direction. The control variables are *SIZE*, *LEV*, *LOSSDUM*, *TA*, *STD_OCF*, *AGE*, *SLACK*, *OWN*, *FOR* and *BIG4*. *SIZE* is the size of the firm and is determined by taking the natural logarithm of the firm's total assets.

LEV represents leverage or capital structure as the debt ratio of a firm. *LOSSDUM* is a loss dummy variable, which is 1 for a loss firm and 0 otherwise. *TA* is the tangible asset ratio, which is the firm's tangible asset divided by its total assets. *STD_OCF* is the standard deviation of dividing operating cash flow from the cash flow statement for five years from $t - 4$ to t by the lagged total assets. *AGE* is the value obtained by taking the natural logarithm of the age of firm. *SLACK* is the ratio of cash divided by total assets, *OWN* is the ownership ratio of major shareholder, and *FOR* is the ratio of foreign ownership. *BIG4* is a dummy variable that is 1 if the auditor is a *BIG4* accounting firm and 0 otherwise. *YD* is year dummy and *ID* is industry dummy.

The control variables were set with reference to the previous studies (Biddle et al. 2009; Chen et al. 2011; Cho and Kang 2016). We added variables to control the size of firm (*SIZE*) and the debt ratio (*LEV*). In addition, we included in the control variables the effects of *LOSSDUM*, volatility of operating cash flow (*STD_OCF*), and *AGE* on investment efficiency (Biddle et al. 2009; Richardson 2006).

The degree of cash holdings (*SLACK*) included the ability to raise funds for capital investment, while the tangible asset ratio (*TA*) included the tangible asset ratio (*TA*) to control the impact of past levels of capital investment (Biddle et al. 2009; Cho and Kang 2016). In addition, to control the effect of corporate governance on investment efficiency, the control variable was selected as the major shareholder (*OWN*) and foreign ownership (*FOR*). In addition, industry-specific dummies (*ID*) are included to control industry-specific characteristics. Please refer to Appendix A for a summary of variables.

In this study, we used the method of Chen et al. (2011) as a proxy for investment efficiency. In the model estimated by the following equation, the residual means investment inefficiency. The sample is an overinvestment if the residual is greater than 0 and an underinvestment if the residual is less than zero. In this study, the absolute value of residuals is used to analyze the magnitude of investment efficiency. We also used the value multiplied by -1 to match the direction of the interest variable and the dependent variable. Thus, the greater value means that investment is more efficient.

$$INVEST_{it} = \beta_0 + \beta_1 NEG_{it-1} + \beta_2 GRW_{it-1} + \beta_3 NEG_{it-1} \times GRW_{it-1} + \varepsilon_{it} \quad (4)$$

where $INVEST_{it}$ is the sum of new investment in machinery, equipment, vehicles, land, buildings, and research and development expenditures, less the sale of fixed assets, and scaled by lagged total assets for firm i in year t (property, plant and equipment at the end of year $t -$ property, plant and equipment at the beginning of year $t +$ depreciation expense + losses on disposal of fixed assets – gains on disposal of fixed assets + research and development expenditures)/beginning total asset. NEG_{it} takes the value of 1 for negative revenue growth, and 0 otherwise. GRW_{it} is the annual revenue growth rate for firm i in year $t - 1$ (sales for firm i in year $t - 1$ sales for firm i in year $t - 2$)/sales for firm i in year $t - 2$. ε_{it} is the residual.

4. Empirical Results

Panel A in Table 3 shows the descriptive statistics of the main variables for total samples. Since the debt ratio (*LEV*), corporate size (*SIZE*), tangible asset ratio (*TA*), and major shareholder equity (*OWN*) exhibit no significant difference between the mean and the median, it can be assumed that they are close to a normal distribution.

Table 3. Descriptive statistics.

Panel A Total Sample (n = 8754)								
Variable	n	Mean	Std. Dev.	Min	25th Percentile	Median	75th Percentile	Max
INV_EF	8754	−0.051	0.062	−0.330	−0.061	−0.030	−0.013	0.000
LOANR	8754	0.242	0.175	0.000	0.094	0.233	0.365	1.118
BONDR	8754	0.032	0.057	0.000	0.000	0.000	0.045	0.520
BOND_LOANR	8754	0.081	0.124	0.000	0.000	0.000	0.151	0.500
BONDDUM	8754	0.380	0.485	0.000	0.000	0.000	1.000	1.000
SIZE	8754	26.617	1.489	23.649	25.575	26.368	27.432	30.783
LEV	8754	0.464	0.255	0.010	0.281	0.454	0.612	2.140
LOSSDUM	8754	0.200	0.400	0.000	0.000	0.000	0.000	1.000
TA	8754	0.339	0.358	0.000	0.175	0.319	0.461	2.033
STD_OCF	8754	0.143	0.083	0.030	0.086	0.125	0.177	0.525
AGE	8754	2.727	0.879	0.000	2.303	2.944	3.367	4.111
SLACK	8754	0.056	0.064	0.000	0.012	0.036	0.077	0.850
OWN	8754	0.428	0.164	0.073	0.310	0.428	0.539	0.840
FOR	8754	0.101	0.139	0.000	0.006	0.037	0.145	0.620
BIG4	8754	0.645	0.479	0.000	0.000	1.000	1.000	1.000

Notes: (1) This table presents the descriptive statistics for the variables used in the regression analyses. INV_EF = investment efficiency, the absolute value of the residual measured as Chen et al. (2011) multiplied by (−1) for firm *i* in year *t* + 1; LOANR = loan ratio, loanr is measured by dividing borrowings by total assets for firm *i* in year *t*; BONDR = bond ratio, bondr is measured by dividing bonds by total assets for firm *i* in year *t*; BONDDUM = bond dummy variable, 1 if the firm issued bond, and 0 otherwise for firm *i* in year *t*; BOND_LOANR = the public debt ratio, which is measured by dividing public debt by the sum of public debt and private debt for firm *i* in year *t*; SIZE = firm size, the natural logarithm of total assets for firm *i* in year *t*; LEV = debt ratio for firm *i* in year *t*, (total debt/total assets); LOSSDUM = loss dummy variable, 1 if the firm reported negative net income, and 0 otherwise for firm *i* in year *t*; TA = tangible asset ratio for firm *i* in year *t*, (property + plant + equipment/total assets); STD_OCF = the standard deviation of operating cash flows, the standard deviation of operating cash flows for five years from period *t* − 4 to period *t*; AGE = the natural logarithm of firm age for firm *i* in year *t*; SLACK = cash ratio, cash/total assets; OWN = the ownership ratio, the largest shareholders ownership for firm *i* in year *t*; FOR = the foreign ownership ratio, foreign ownership for firm *i* in year *t*; BIG4 = big4 auditor, 1 if an annual financial statement is audited by a big4 auditor, and 0 otherwise. (2) Please refer to Section 3.2 for variable definitions.

Table 4 shows the Pearson correlation analysis results of the main variables. Investment efficiency has a significant negative relationship with LOANR, LEV, LOSSDUM, TA and STD_OCF. This means that the more a firm is financed by private debt, the higher its debt ratio, the more negative its negative income, the greater its tangible assets and the greater the volatility of its operating cash flows, the lower the investment efficiency of firm. Investment efficiency has a significant positive relationship with BONDR, BOND_LOANR, BONDDUM, SIZE, AGE, SLACK, OWN, FOR, BIG4. This means that the greater degree of financing through public debt, the larger the firm size, the older the firm, the higher the level of cash reserves, the higher the shareholding ratio and foreign ownership ratio, and if a company is audited by a big4 accounting firm, the greater the investment efficiency. These results were obtained without controlling the effects of other variables on investment efficiency. Therefore, multivariate regression analysis was performed, including several control variables.

Table 4. Pearson correlations (n = 8754).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) INV_EF														
(2) LOANR	−0.051 ***													
(3) BONDR	0.008 ***	0.392 ***												
(4) BOND_LOANR	0.016 ***	0.187 ***	0.873 ***											
(5) BONDDUM	0.020 **	0.395 ***	0.707 ***	0.790 ***										
(6) SIZE	0.070 ***	0.130 ***	0.395 ***	0.448 ***	0.482 ***									
(7) LEV	−0.043 ***	0.570 ***	0.267 ***	0.169 ***	0.291 ***	0.171 ***								
(8) LOSSDUM	−0.049 ***	0.300 ***	0.052 ***	−0.027 **	0.047 ***	−0.132 ***	0.162 ***							
(9) TA	−0.083 ***	0.120 ***	0.070 ***	0.038 ***	0.046 ***	0.086 ***	0.321 ***	−0.010						
(10) STD_OCF	−0.062 ***	−0.052 ***	−0.005 ***	0.003	−0.020 *	−0.071 ***	0.034 ***	0.048 ***	−0.026 **					
(11) AGE	0.014 *	0.082 ***	0.004	−0.012	0.054 ***	0.059 ***	0.004	0.083 ***	0.032 ***	−0.103 ***				
(12) SLACK	0.018 **	−0.277 ***	−0.058 ***	0.006	−0.102 ***	−0.085 ***	−0.101 ***	−0.062 ***	−0.134 ***	0.071 ***	−0.080 ***			
(13) OWN	0.027 **	−0.089 ***	−0.109 ***	−0.112 ***	−0.135 ***	−0.065 ***	−0.118 ***	−0.131 ***	−0.001	−0.076 ***	−0.128 ***	−0.077 ***		
(14) FOR	0.016 **	−0.197 ***	0.150 ***	0.266 ***	0.168 ***	0.492 ***	−0.073 ***	−0.167 ***	0.035 ***	0.016 *	−0.025 **	0.093 ***	−0.163 ***	
(15) BIG4	0.025 **	0.004	0.153 ***	0.182 ***	0.176 ***	0.400 ***	0.034 ***	−0.080 ***	−0.007 *	−0.019 **	−0.053 ***	0.018 **	0.038 ***	0.252 ***

Notes: (1) This table presents the Pearson correlations for the variables used in the regression analyses. (2) Please refer to Section 3.2 for variable definitions. (3) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

4.1. Multivariate Results

Table 5 shows the results of the regression analysis of Equations (1)–(3) on the relationship between debt origin and investment efficiency for the total sample. We considered Model 1 to be the most appropriate for examining the debt origin–investment efficiency link. It is a model that has often been used in previous studies, and is generally scaled with total assets. We provided results of other models as robustness checks. The F value of the analysis result is statistically significant, indicating that the research model is appropriate. The VIF of the independent variable used in the regression analysis of this study was less than 3 and did not exceed 10, indicating that the problem of multicollinearity is not serious.

In Model 1, the LOANR and investment efficiency were significant in the negative direction at the 5% level. In addition, BONDR and investment efficiency were significant in the positive direction at the 1% level. This means that firms that have made a large amount of financing through loans, which is private debt, have low investment efficiency. Firms that have sourced a lot of financing by issuing public debt have a high investment efficiency. In Model 2, BOND_LOANR and investment efficiency, defined as the share of public debt in the total of public and private debt, were statistically significant. In Model 3, the LOANR and investment efficiency were significant in the negative direction at the 5% level, and the public debt and investment efficiency were defined as dummy variables. The relationship between BONDDUM and investment efficiency showed a significant in the positive direction at the 1% level.

Table 5. Debt origin and investment efficiency: total sample (n = 8754).

Variables	Model 1		Model 2		Model 3	
	Coeff. (t-Value)	p-Value VIF	Coeff. (t-Value)	p-Value VIF	Coeff. (t-Value)	p-Value VIF
INTERCEPT	0.069 (3.400) ***	0.001 0.000	0.057 (2.710) ***	0.007 0.000	0.096 (4.630) ***	<0.0001 0.000
LOANR	−0.012 (−2.180) **	0.029 2.203			−0.015 (−2.100) **	0.036 2.161
BONDR	0.102 (5.850) ***	<0.0001 1.436				
BOND_LOANR			0.039 (4.940) ***	<0.0001 1.337		
BONDDUM					0.017 (8.020) ***	<0.0001 1.612
SIZE	−0.007 (−8.470) **	<0.0001 1.975	−0.006 (−7.590) ***	<0.0001 2.053	−0.008 (−9.610) ***	<0.0001 2.118
LEV	0.017 (3.630) ***	<0.0001 2.011	0.015 (3.600) ***	0.000 1.386	0.016 (3.330) ***	<0.0001 2.013
LOSSDUM	−0.019 (−8.480) ***	<0.0001 1.202	−0.020 (−8.950) ***	<0.0001 1.134	−0.019 (−8.530) ***	<0.0001 1.202
TA	−0.009 (−1.850) *	0.065 1.450	−0.009 (−1.930) *	0.054 1.456	−0.006 (−1.390)	0.165 1.454
STD_OCF	0.082 (7.600) ***	<0.0001 1.166	0.087 (7.750) ***	<0.0001 1.164	0.083 (7.630) ***	<0.0001 1.166
AGE	−0.005 (−4.880) ***	<0.0001 1.113	−0.005 (−4.420) ***	<0.0001 1.104	−0.005 (−5.100) ***	<0.0001 1.110
SLACK	−0.039 (−2.770) ***	0.006 1.188	−0.052 (−3.390) ***	0.001 1.107	−0.036 (−2.520) **	0.012 1.183
OWN	−0.025 (−4.510) ***	<0.0001 1.203	−0.023 (−4.030) ***	<0.0001 1.209	−0.023 (−4.140) ***	<0.0001 1.208
FOR	0.026 (3.390) ***	0.001 1.601	0.023 (2.900) ***	0.004 1.603	0.027 (3.630) ***	0.000 1.601
BIG4	0.001 (0.580)	0.580 1.253	0.001 (0.390)	0.696 1.253	0.001 (0.610)	0.541 1.253
YD	Included		Included		Included	
ID	Included		Included		Included	
F-VALUE	43.18 ***		41.42 ***		44.18 ***	
ADJ R-SQ	13.84%		13.76%		14.12%	

Notes: (1) This table presents the results from regressing debt origin on investment efficiency for total sample. Models 1, 2, and 3 are classified as follows. Model 1 scaled public and private debts to total assets, and model 2 scaled public and private debts to the sum of public and private debts. Model 3 looks at public debt as dummy variable rather than continuous variable. (2) Please refer to Section 3.2 for variable definitions. (3) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 6 shows the results of the regression analysis of Equations (1)–(3) on the relationship between debt origin and investment efficiency for the overinvestment sample. In Model 1, the LOANR and investment efficiency were not statistically significant. The relationship between BONDR and investment efficiency showed a positive direction, but was not statistically significant. In Model 2, BOND_LOANR and investment efficiency, defined as the share of public debt in the total of public and private debt, were not statistically significant. In Model 3, the LOANR and investment efficiency were not statistically significant, and the public debt and investment efficiency were defined as dummy variables. The relationship between BONDDUM and investment efficiency showed a positive direction, but was not statistically significant.

Table 6. Debt origin and investment efficiency: overinvestment sample (n = 3798).

Variables	Model 1		Model 2		Model 3	
	Coeff. (t-Value)	p-Value VIF	Coeff. (t-Value)	p-Value VIF	Coeff. (t-Value)	p-Value VIF
INTERCEPT	-0.158 (-5.770) ***	<0.0001 0.000	-0.162 (-5.800) ***	<0.0001 0.000	-0.146 (-5.200) ***	<0.0001 0.000
LOANR	-0.010 (-1.080)	0.281 2.177			-0.013 (-1.380)	0.168 2.120
BONDR	0.004 (0.180)	0.859 1.585				
BOND_LOANR			-0.010 (-1.000)	0.318 1.439		
BONDDUM					0.004 (1.250)	0.210 1.728
SIZE	0.004 (3.990) ***	<0.0001 2.323	0.005 (4.210) ***	<0.0001 2.363	0.004 (3.420) ***	0.001 2.471
LEV	-0.009 (-1.410)	0.157 1.969	-0.015 (-2.580) **	0.010 1.412	-0.010 (-1.460)	0.143 1.972
LOSSDUM	-0.002 (0.550)	0.585 1.205	-0.003 (0.890)	0.371 1.140	-0.002 (-0.570)	0.566 1.206
TA	-0.051 (7.970) ***	<0.0001 1.510	-0.050 (7.680) ***	<0.0001 1.528	-0.050 (-7.850) ***	<0.0001 1.520
STD_OCF	-0.019 (-1.300)	0.195 1.194	-0.009 (-0.620)	0.536 1.194	-0.019 (-1.290)	0.199 1.194
AGE	0.001 (0.890)	0.375 1.140	0.001 (0.160)	0.870 1.131	0.001 (0.890)	0.375 1.138
SLACK	-0.014 (-0.770)	0.442 1.198	-0.029 (-1.380)	0.167 1.104	-0.014 (-0.750)	0.453 1.195
OWN	-0.017 (-2.360) **	0.019 1.219	-0.016 (-2.120) **	0.035 1.223	-0.017 (-2.270)	0.023 1.221
FOR	-0.015 (-1.470)	0.142 1.796	-0.013 (-1.240)	0.214 1.812	-0.015 (-1.460)	0.143 1.795
BIG4	-0.002 (-0.830)	0.407 1.279	-0.003 (-1.000)	0.318 1.281	-0.002 (-0.820)	0.411 1.279
YD	Included		Included		Included	
ID	Included		Included		Included	
F-VALUE	10.56 ***		10.51 ***		10.61 ***	
ADJ R-SQ	8.36%		8.60%		8.40%	

Notes: (1) This table presents the results from regressing debt origin on investment efficiency for overinvestment sample. Models 1, 2, and 3 are classified as follows. Model 1 scaled public and private debts to total assets, and model 2 scaled public and private debts to the sum of public and private debts. Model 3 looks at public debt as a dummy variable rather than a continuous variable. (2) Please refer to Section 3.2 for variable definitions. (3) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 7 shows the results of the regression analysis of Equations (1)–(3) on the relationship between debt origin and investment efficiency for the underinvestment sample. In Model 1, the LOANR and the investment efficiency were significant in the negative direction at the 10% level. BONDR and investment efficiency were significant in the positive direction at the 1% level. Firms that have sourced a lot of financing by issuing public debt are highly efficient.

In Model 2, BOND_LOANR and investment efficiency were significant in the positive direction at the 1% level. This means that the higher the funding ratio through public debt, the higher the investment efficiency. In Model 3, LOANR and investment efficiency were significant in the negative direction at the 10% level, and BONDDUM and investment efficiency were positively significant at the 1% level. This means that firms that have sourced a large amount of financing through loans, which are private debt, have low investment efficiency. Firms that have sourced a lot of financing by issuing public debt are highly efficient.

Table 7. Debt origin and investment efficiency: underinvestment sample (n = 4956).

Variables	Model 1		Model 2		Model 3	
	Coeff. (t-Value)	p-Value VIF	Coeff. (t-Value)	p-Value VIF	Coeff. (t-Value)	p-Value VIF
INTERCEPT	0.182 (6.700) ***	<0.0001 0.000	0.169 (5.910) ***	<0.0001 0.000	0.217 (7.750) *	<0.0001 0.000
LOANR	-0.014 (-1.760) *	0.080 2.236			-0.016 (-1.750) *	0.080 2.200
BONDR	0.144 (6.060) ***	<0.0001 1.365				
BOND_LOANR			0.064 (5.740) ***	<0.0001 1.283		
BONDDUM					0.023 (7.850) ***	<0.0001 1.557
SIZE	-0.012 (-11.200) ***	<0.0001 1.807	-0.011 (-10.250) ***	<0.0001 1.896	-0.013 (-12.170) ***	<0.0001 1.947
LEV	0.029 (4.500) ***	<0.0001 2.059	0.027 (4.870) ***	<0.0001 1.385	0.027 (4.200) ***	<0.0001 2.061
LOSSDUM	-0.027 (-9.280) ***	<0.0001 1.206	-0.028 (-9.600) ***	<0.0001 1.137	-0.027 (-9.250) ***	<0.0001 1.206
TA	0.011 (1.770) *	0.076 1.456	0.010 (1.500)	0.133 1.454	0.013 (2.120) **	0.034 1.458
STD_OCF	0.126 (8.590) ***	<0.0001 1.162	0.128 (8.390) ***	<0.0001 1.159	0.127 (8.660) ***	<0.0001 1.162
AGE	-0.008 (-5.960) ***	<0.0001 1.108	-0.007 (-5.100) ***	<0.0001 1.099	-0.009 (-6.210) ***	<0.0001 1.106
SLACK	-0.065 (-3.320) ***	0.001 1.191	-0.073 (-3.510) ***	0.000 1.117	-0.060 (-3.100) ***	0.002 1.185
OWN	-0.028 (-3.690) ***	0.000 1.204	-0.026 (-3.390) ***	0.001 1.210	-0.024 (-3.240) ***	0.001 1.210
FOR	0.043 (4.130) ***	<0.0001 1.497	0.037 (3.330) ***	0.001 1.483	0.046 (4.430) ***	<0.0001 1.498
BIG4	0.002 (0.840)	0.401 1.244	0.002 (0.680)	0.680 1.243	0.002 (0.820)	0.412 1.244
YD	Included		Included		Included	
ID	Included		Included		Included	
F-VALUE	42.32 ***		40.28 ***		43.22 ***	
ADJ R-SQ	20.76%		20.51%		21.11%	

Notes: (1) This table presents the results from regressing debt origin on investment efficiency for the underinvestment sample. Models 1, 2, and 3 are classified as follows. Model 1 scaled public and private debts to total assets, and model 2 scaled public and private debts to the sum of public and private debts. Model 3 looks at public debt as a dummy variable rather than a continuous variable. (2) Please refer to Section 3.2 for variable definitions. (3) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

As mentioned above, the relationship between debt origin and investment efficiency was lower in the firms with higher financing through loan, and the more efficient with the financing through bonds. In addition, it can be seen that only the regression analysis results of the total sample and the underinvestment sample are statistically strong. This result shows that the relationship between debt origin and investment efficiency may be differentiated by overinvestment and underinvestment sample. The cause of overinvestment is moral hazard, which is an act of selecting an investment plan that can bring high profit even if the probability of profit creation is low. On the other hand, the cause of underinvestment is reverse selection, so that the capital supplier is ex-post because it is possible to limit the capital supply in advance. Inferring the cause of the occurrence, it is considered that the benefit obtained by increasing the earnings quality in relation to debt characteristics and investment efficiency can reduce the reverse selection.

4.2. Robustness Analysis

In the sample, there are companies that raise funds by using both private and public liabilities, so it is necessary to examine the investment efficiency based on the relative weight between the means of debt origin. Table 8 shows the result of further analysis of the hypothesis by scaling the debt origin to total liabilities (asset-equity) rather than total assets. Panel A, B and C in Table 8 show the regression analysis results for the total sample, the overinvestment sample and the underinvestment sample, respectively. The analysis results are similar to Table 5, which supports the hypothesis even when scaled by total liabilities rather than total assets. As a result of the analysis, when scaled to total liabilities, it can be seen that the relative weight has an effect on the significance of the difference.

Table 8. Debt origin and investment efficiency: analysis results scaled to total liabilities instead of total assets.

Panel A: Total Sample			
Variables	Model 1	Model 2	Model 3
	Coeff. (t-Value)	Coeff. (t-Value)	Coeff. (t-Value)
INTERCEPT	0.062 (3.080) ***	0.035 (1.810) *	0.060 (3.000) ***
LOANR	-0.010 (-2.340) **	-0.004 (-0.910)	
BONDR	0.046 (4.820) ***		0.039 (4.320) ***
SIZE	-0.006 (-8.080) ***	-0.005 (-6.990) ***	-0.006 (-8.130) ***
LEV	0.019 (4.400) ***	0.019 (4.440) **	0.015 (3.860) ***
LOSSDUM	-0.019 (-8.460) ***	-0.019 (-8.470) ***	-0.019 (-8.880) ***
TA	-0.008 (-1.750) *	-0.008 (-1.760) *	-0.008 (-1.840) *
STD_OCF	0.082 (7.590) ***	0.083 (7.620) ***	0.083 (7.680) ***
AGE	-0.005 (-4.890) ***	-0.005 (-5.310) ***	-0.005 (-5.010) ***
SLACK	-0.042 (-2.930) ***	-0.037 (-2.590) **	-0.035 (-2.500) **
OWN	-0.025 (-4.590) ***	-0.027 (-4.830) ***	-0.025 (-4.530) ***
FOR	0.024 (3.140) ***	0.025 (-3.330) ***	0.027 (3.660) ***
BIG4	0.001 (0.560)	0.001 (0.590)	0.001 (0.610)
YD	Included	Included	Included
ID	Included	Included	Included
F-VALUE	42.84 ***	43.32 ***	43.92 ***
ADJ R-SQ	13.75%	13.54%	13.70%
Panel B: Overinvestment Sample			
Variables	Model 1	Model 2	Model 3
	Coeff. (t-Value)	Coeff. (t-Value)	Coeff. (t-Value)

Table 8. Cont.

INTERCEPT	−0.160 (−5.930) ***	−0.159 (−6.150) ***	−0.161 (−5.940) ***
LOANR	−0.008 (−1.470)	−0.009 (−1.610)	
BONDR	−0.003 (−0.210)		−0.008 (−0.700)
SIZE	0.004 (4.190) ***	0.004 (4.340) ***	0.004 (4.130) ***
LEV	−0.010 (−1.700) *	−0.010 (−1.710) **	−0.013 (−2.260)
LOSSDUM	−0.002 (−0.590)	−0.002 (0.590)	−0.002 (−0.790)
TA	−0.050 (−7.910) ***	−0.050 (−7.910) ***	−0.050 (−7.920) ***
STD_OCF	−0.019 (−1.310)	−0.019 (−1.300)	−0.019 (−1.280)
AGE	0.001 (0.910)	0.001 (0.920)	0.001 (0.830)
SLACK	−0.016 (−0.850)	−0.016 (−0.860)	−0.010 (−0.540)
OWN	−0.018 (−2.410) **	−0.018 (−2.400) **	−0.017 (−2.350)
FOR	−0.015 (−1.540)	−0.015 (−1.550)	−0.013 (−1.300)
BIG4	−0.002 (−0.880)	−0.002 (−0.880)	−0.002 (−0.790)
YD	Included	Included	Included
ID	Included	Included	Included
F-VALUE	10.61 ***	10.92 ***	10.85 ***
ADJ R-SQ	8.40%	8.42%	8.37%

Panel C: Underinvestment Sample

Variables	Model 1	Model 2	Model 3
	Coeff. (t-Value)	Coeff. (t-Value)	Coeff. (t-Value)
INTERCEPT	0.175 (6.440) ***	0.140 (5.310) **	0.172 (6.340) ***
LOANR	−0.010 (−1.750) *	−0.002 (−0.270)	
BONDR	0.067 (5.030) **		0.060 (4.720) ***
SIZE	−0.011 (−10.900) ***	−0.010 (−9.910) ***	−0.011 (−10.890) ***
LEV	0.030 (5.390)	0.030 (5.400) **	0.027 (5.100) ***
LOSSDUM	−0.027 (−9.270)	−0.027 (−9.260)	−0.027 (−9.630) ***
TA	0.011 (1.840) ***	0.011 (1.810) *	0.011 (1.750) *
STD_OCF	0.127 (8.600)	0.128 (8.670) ***	0.128 (8.710) ***
AGE	−0.008 (−5.990)	−0.009 (−6.230) ***	−0.008 (−6.060) ***

Table 8. Cont.

SLACK	−0.066 (−3.400)	−0.058 (−2.980) ***	−0.059 (−3.120) ***
OWN	−0.028 (−3.730) **	−0.029 (−3.890) ***	−0.028 (−3.700) ***
FOR	0.041 (3.960)	0.043 (4.070) ***	0.045 (4.390) ***
BIG4	0.002 (0.820)	0.002 (0.840)	0.002 (0.820)
YD	Included	Included	Included
ID	Included	Included	Included
F-VALUE	41.91 ***	42.21 ***	43.03 ***
ADJ R-SQ	20.59%	20.24%	20.56%

Notes: (1) This table presents the analysis results scaled to total liabilities instead of total assets from regressing debt origin on investment efficiency. Models 1, 2, and 3 are classified as follows. Model 1 scaled public and private debts to total assets, and model 2 scaled public and private debts to the sum of public and private debts. Model 3 looks at public debt as a dummy variable rather than a continuous variable. (2) Please refer to Section 3.2 for variable definitions. (3) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 9 shows the results of further analysis of the hypotheses by applying the model using the $t - 1$ year rather than the t year. Panels A, B and C in Table 9 show the regression analysis results for the total sample, the overinvestment sample and the underinvestment sample, respectively. The results of the analysis showed that only public debt was significant in Model 1, Model 2 and Model 3.

Table 9. Debt origin and investment efficiency: analysis result for time difference model.

Panel A: Total Sample			
Variables	Model 1	Model 2	Model 3
	Coeff. (t-Value)	Coeff. (t-Value)	Coeff. (t-Value)
INTERCEPT	0.067 (3.330) ***	0.055 (2.650) ***	0.086 (−4.190) ***
LOANR $it - 1$	−0.002 (−0.280)		−0.004 (−0.630)
BONDR $it - 1$	0.093 (5.390) ***		
BOND_LOANR $it - 1$		0.040 (5.040) ***	
BONDDUM $it - 1$			0.014 (6.780) ***
SIZE	−0.007 (−8.490) ***	−0.006 (−7.620) ***	−0.007 (−9.260) ***
LEV	0.014 (3.210) ***	0.014 (3.400) ***	0.014 (3.070) ***
LOSSDUM	−0.020 (−8.960) ***	−0.020 (−8.830) ***	−0.020 (−9.010) ***
TA	−0.008 (−1.750) *	−0.009 (−1.930) *	−0.006 (−1.310)
STD_OCF	0.084 (7.710) ***	0.087 (7.790) ***	0.083 (7.710) ***

Table 9. Cont.

AGE	−0.005 (−5.020) ***	−0.005 (−4.370) ***	−0.005 (−5.270) ***
SLACK	−0.033 (−2.360) **	−0.044 (−2.890) **	−0.031 (−2.190) **
OWN	−0.024 (−4.410) **	−0.022 (−3.920) ***	−0.023 (−4.120) **
FOR	0.027 (3.630) ***	0.023 (2.830) ***	0.029 (3.820) ***
BIG4	0.001 (0.530)	0.001 (0.450)	0.001 (0.530)
YD	Included	Included	Included
ID	Included	Included	Included
F-VALUE	43.09 ***	41.18 ***	43.65 ***
ADJ R-SQ	13.82%	13.72%	13.98%
Panel B: Overinvestment Sample			
	Model 1	Model 2	Model 3
Variables	Coeff. (t-Value)	Coeff. (t-Value)	Coeff. (t-Value)
INTERCEPT	−0.152 (−5.630) ***	−0.162 (−5.820) ***	−0.145 (−5.250) ***
LOANR it − 1	0.003 (0.380)		0.001 (0.150)
BONDR it − 1	0.003 (0.110)		
BOND_LOANR it − 1		−0.011 (−1.070)	
BONDDUM it − 1			0.002 (0.860)
SIZE	0.004 (3.770) ***	0.005 (4.220) ***	0.004 (3.410) ***
LEV	−0.014 (−2.320) **	−0.016 (−2.760) ***	−0.015 (−2.330) **
LOSSDUM	−0.003 (−0.870)	−0.002 (−0.780)	−0.003 (−0.890)
TA	−0.050 (−7.840) ***	−0.050 (−7.670) ***	−0.050 (−7.740) ***
STD_OCF	−0.018 (−1.260)	−0.011 (−0.750)	−0.018 (−1.260)
AGE	0.001 (0.840)	0.001 (0.600)	0.001 (0.830)
SLACK	−0.008 (−0.440)	−0.031 (−1.490)	−0.008 (−0.420)
OWN	−0.016 (−2.230) **	−0.016 (−2.220) **	−0.016 (−2.170) **
FOR	−0.012 (−1.190)	−0.014 (−1.310)	−0.012 (−1.190)
BIG4	−0.002 (−0.770)	−0.002 (−0.600)	−0.002 (−0.780)

Table 9. Cont.

YD	Included	Included	Included
ID	Included	Included	Included
F-VALUE	10.53 ***	10.57 ***	10.55 ***
ADJ R-SQ	8.34%	8.65%	8.36%
Panel C: Underinvestment Sample			
	Model 1	Model 2	Model 3
Variables	Coeff. (t-Value)	Coeff. (t-Value)	Coeff. (t-Value)
INTERCEPT	0.179 (6.600) ***	0.171 (6.010) ***	0.206 (7.390) ***
LOANR it – 1	–0.005 (–0.540)		–0.008 (–0.920)
BONDR it – 1	0.132 (5.660) ***		
BOND_LOANR it – 1		0.065 (6.000) ***	
BONDDUM it – 1			0.020 (6.900) ***
SIZE	–0.012 (–11.150) ***	–0.011 (10.420) ***	–0.013 (11.860) ***
LEV	0.026 (4.410) ***	0.026 (4.750) ***	0.026 (4.290) ***
LOSSDUM	–0.028 (–9.660) ***	–0.028 (–9.600) ***	–0.028 (–9.720) ***
TA	0.011 (1.770) *	0.009 (1.360)	0.014 (2.190) **
STD_OCF	0.128 (8.710) ***	0.129 (8.440) ***	0.129 (8.780) ***
AGE	–0.008 (–6.120) ***	–0.008 (–5.280)	–0.009 (–6.390) ***
SLACK	–0.058 (–3.000) ***	–0.059 (–2.860) ***	–0.056 (–2.890) ***
OWN	–0.027 (–3.640) **	–0.025 (–3.190) ***	–0.025 (–3.280) ***
FOR	0.044 (4.240) ***	0.036 (3.280) ***	0.047 (4.530) ***
BIG4	0.002 (0.740)	0.002 (0.600)	0.002 (0.750)
YD	Included	Included	Included
ID	Included	Included	Included
F-VALUE	42.21 ***	40.04 ***	42.77 ***
ADJ R-SQ	20.71%	20.48%	20.94%

Notes: (1) This table presents the time difference model analysis results from regressing debt origin on investment efficiency. Models 1, 2, and 3 are classified as follows. Model 1 scaled public and private debts to total assets, and model 2 scaled public and private debts to the sum of public and private debts. Model 3 looks at public debt as a dummy variable rather than a continuous variable. (2) Please refer to Section 3.2 for variable definitions. (3) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 10 shows results of further analysis using the investment efficiency measured as [Biddle et al. \(2009\)](#). Panels A, B and C in Table 10 show the regression analysis results for the total sample, the overinvestment sample and the underinvestment sample, respectively. The results of the analysis are similar to those in Table 5.

Table 10. Debt origin and investment efficiency: analysis result using the investment efficiency measured as [Biddle et al. \(2009\)](#).

Panel A: Total Sample			
Variables	Model 1	Model 2	Model 3
	Coeff. (t-Value)	Coeff. (t-Value)	Coeff. (t-Value)
INTERCEPT	−0.109 (−6.680) ***	−0.112 (−6.620) ***	−0.100 (−5.930) ***
LOANR	−0.017 (−3.010) ***		−0.018 (−3.290) ***
BONDR	0.021 (1.500)		
BOND_LOANR		0.004 (0.600) ***	
BONDDUM			0.004 (2.600) ***
SIZE	0.003 (4.190) ***	0.003 (4.270) ***	0.002 (3.460) ***
LEV	0.002 (0.400)	−0.006 (−1.830) *	0.001 (0.310)
LOSSDUM	−0.008 (−4.370) ***	−0.009 (−5.100) ***	−0.008 (−4.390) ***
TA	−0.052 (−14.160) ***	−0.051 (−13.550) ***	−0.052 (−13.970) ***
STD_OCF	−0.019 (−2.040) **	−0.012 (−1.290)	−0.019 (−2.040) ***
AGE	−0.001 (−0.750)	−0.001 (−1.140)	−0.001 (−0.810)
SLACK	−0.014 (−1.250)	−0.019 (−1.490)	−0.014 (−1.200)
OWN	−0.001 (−0.330)	0.001 (0.050)	−0.001 (−0.210)
FOR	−0.006 (−1.020)	−0.006 (−0.960)	−0.006 (−0.940)
BIG4	−0.003 (−2.060) **	−0.003 (−2.090) **	−0.003 (−2.050) **
YD	Included	Included	Included
ID	Included	Included	Included
F-VALUE	27.38 ***	26.58 ***	27.53 ***
ADJ R-SQ	9.78%	9.83%	9.83%
Panel B: Overinvestment Sample			
Variables	Model 1	Model 2	Model 3
	Coeff. (t-Value)	Coeff. (t-Value)	Coeff. (t-Value)
INTERCEPT	−0.175 (−5.950) ***	−0.183 (−6.090) ***	−0.156 (5.150) ***

Table 10. Cont.

LOANR	−0.013 (−1.230)		−0.017 (1.700) *
BONDR	0.002 (0.090)		
BOND_LOANR		−0.008 (−0.770)	
BONDDUM			0.005 (1.730)
SIZE	0.005 (4.260) ***	0.005 (4.650) ***	0.004 (3.460) ***
LEV	−0.009 (−1.230)	−0.017 (−2.600) ***	−0.009 (−1.260)
LOSSDUM	−0.002 (−0.620)	−0.004 (1.100)	−0.002 (−0.660)
TA	−0.059 (−8.500) ***	−0.058 (−8.270) ***	−0.058 (−8.360) ***
STD_OCF	−0.043 (−2.530) **	−0.030 (−1.690) *	−0.044 (−2.540) **
AGE	0.001 (0.380)	−0.001 (−0.250)	0.001 (0.370)
SLACK	−0.020 (−0.950)	−0.041 (−1.820) *	−0.020 (−0.940)
OWN	−0.012 (−1.470)	−0.012 (−1.480)	−0.011 (−1.370)
FOR	−0.019 (−1.860) *	−0.023 (−2.110) **	−0.019 (−1.820) *
BIG4	−0.002 (−1.030)	−0.003 (−1.170)	−0.003 (−1.060)
YD	Included	Included	Included
ID	Included	Included	Included
F-VALUE	10.69 ***	10.941 ***	10.78 ***
ADJ R-SQ	8.80%	9.27%	8.88%
Panel C: Underinvestment Sample			
	Model 1	Model 2	Model 3
Variables	Coeff. (t-Value)	Coeff. (t-Value)	Coeff. (t-Value)
INTERCEPT	−0.074 (−3.930) ***	−0.074 (−3.740) ***	−0.071 (−3.650) ***
LOANR	−0.023 (−3.650) ***		−0.021 (−3.470) **
BONDR	0.046 (2.880) ***		
BOND_LOANR		0.020 (2.550) **	
BONDDUM			0.005 (2.380) **
SIZE	0.001 (2.020) **	0.001 (1.750) *	0.001 (1.770) *
LEV	0.008 (1.820) *	−0.001 (−0.330)	0.007 (1.710) *
LOSSDUM	−0.013 (−6.860) ***	−0.015 (−7.480) ***	−0.013 (−6.850) ***

Table 10. Cont.

TA	−0.044 (−10.590) ***	−0.043 (−10.010) ***	−0.043 (−10.430) ***
STD_OCF	−0.001 (−0.130)	0.002 (0.170)	−0.001 (−0.090)
AGE	−0.003 (−2.870) ***	−0.003 (−2.600) ***	−0.003 (−2.980) ***
SLACK	−0.012 (−0.970)	−0.005 (−0.360)	−0.010 (−0.810)
OWN	0.005 (0.910)	0.008 (1.550)	0.005 (1.000)
FOR	0.008 (1.140)	0.011 (1.480)	0.008 (1.220)
BIG4	−0.003 (−1.490)	−0.003 (−1.620)	−0.003 (−1.490)
YD	Included	Included	Included
ID	Included	Included	Included
F-VALUE	22.24 ***	20.68 ***	22.15 ***
ADJ R-SQ	12.93%	12.52%	12.89%

Notes: (1) This table presents analysis results from regressing debt origin on investment efficiency measured as in [Biddle et al. \(2009\)](#). The model in [Biddle et al. \(2009\)](#) is as follows. $INVEST_{it} = \alpha_0 + \alpha_1 GRW_{it-1} + \varepsilon$. Please refer to Section 3.2 for variable definitions. Models 1, 2, and 3 are classified as follows. Model 1 scaled public and private debts to total assets, and model 2 scaled public and private debts to the sum of public and private debts. Model 3 looks at public debt as dummy variable rather than continuous variable. (2) Please refer to Section 3.2 for variable definitions. (3) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 11 shows the results of further analysis using the methodology of [Gow et al. \(2010\)](#). [Gow et al. \(2010\)](#) proposed a method to use the standard error clustered by firm and year to solve the dependency problem of integrating cross-sectional time series data. In this study, t-values were further analyzed using clustered standard errors by firm-year by applying the methodology of [Gow et al. \(2010\)](#). Panels A, B and C in Table 11 show the regression analysis results for the total sample, the overinvestment sample and the underinvestment sample, respectively. The results of the analysis are similar to Table 5, which shows that the study supports the hypotheses even after considering time series dependence and cross-sectional dependence.

Table 11. Debt origin and investment efficiency: analysis results using the methodology of [Gow et al. \(2010\)](#).

Panel A: Total Sample			
Variables	Model 1	Model 2	Model 3
	Coeff. (t-Value)	Coeff. (t-Value)	Coeff. (t-Value)
INTERCEPT	0.069 (0.507)	0.057 (0.440)	0.096 (0.640)
LOANR	−0.012 (−2.148) **		−0.015 (−2.529) **
BONDR	0.102 (2.020) *		
BOND_LOANR		0.039 (1.792) *	
BONDDUM			0.017 (1.972) *

Table 11. Cont.

SIZE	−0.007 (−0.945)	−0.006 (−0.911)	−0.008 (−1.016)
LEV	0.018 (1.435)	0.015 (0.977)	0.016 (1.415)
LOSSDUM	−0.019 (−2.045) *	−0.020 (−2.173) *	−0.019 (−2.059) *
TA	−0.009 (−0.288)	−0.009 (−0.323)	−0.006 (−0.209)
STD_OCF	0.082 (1.064)	0.087 (1.133)	0.083 (1.070)
AGE	−0.005 (−1.176)	−0.005 (−1.209)	−0.005 (−1.202)
SLACK	−0.040 (−1.609)	−0.052 (−1.735)	−0.036 (−1.592)
OWN	−0.025 (−1.374)	−0.023 (−1.257)	−0.023 (−1.361)
FOR	0.026 (0.988)	0.023 (0.973)	0.027 (1.023)
BIG4	0.001 (0.244)	0.001 (0.169)	0.001 (0.258)
YD	Included	Included	Included
ID	Included	Included	Included
F-VALUE	42.27 ***	40.71 ***	42.51 ***
ADJ R-SQ	14.17%	14.10%	14.45%
Panel B: Overinvestment Sample			
	Model 1	Model 2	Model 3
Variables	Coeff. (t-Value)	Coeff. (t-Value)	Coeff. (t-Value)
INTERCEPT	−0.158 (−4.677) ***	−0.162 (−4.389) ***	−0.146 (−4.261) ***
LOANR	−0.010 (−0.857)		−0.013 (−1.049)
BONDR	0.004 (0.208)		
BOND_LOANR		−0.010 (−1.136)	
BONDDUM			0.004 (1.160)
SIZE	0.004 (3.559) ***	0.005 (3.491) ***	0.004 (3.178) ***
LEV	−0.009 (−1.559)	−0.015 (−2.059) *	−0.010 (−1.627)
LOSSDUM	−0.002 (−0.498)	−0.003 (−0.746)	−0.002 (−0.521)
TA	−0.051 (7.970) ***	−0.050 (−7.578) ***	−0.050 (−7.563) ***

Table 11. Cont.

STD_OCF	−0.019 (−1.300)	−0.009 (−0.597)	−0.019 (−1.105)
AGE	0.001 (0.890)	0.001 (0.142)	0.001 (0.684)
SLACK	−0.014 (−0.770)	−0.029 (−0.998)	−0.014 (−0.598)
OWN	−0.017 (−2.360) **	−0.016 (−1.926) *	−0.017 (−2.030) **
FOR	−0.015 (−1.470)	−0.013 (−1.290)	−0.015 (−1.420)
BIG4	−0.002 (−0.830)	−0.003 (−1.064)	−0.002 (−0.995)
YD	Included	Included	Included
ID	Included	Included	Included
F-VALUE	9.16 ***	9.07 ***	9.18 ***
ADJ R-SQ	9.24%	9.51%	9.28%
Panel C: Underinvestment Sample			
	Model 1	Model 2	Model 3
Variables	Coeff. (t-Value)	Coeff. (t-Value)	Coeff. (t-Value)
INTERCEPT	0.182 (1.149)	0.169 (1.118)	0.217 (1.232)
LOANR	−0.014 (−1.812) *		−0.016 (−2.140) **
BONDR	0.144 (2.419) **		
BOND_LOANR		0.064 (2.425) **	
BONDDUM			0.023 (2.362) **
SIZE	−0.012 (1.421)	−0.011 (−1.424)	−0.013 (−1.466)
LEV	0.029 (2.262) **	0.027 (1.588)	0.027 (2.245) **
LOSSDUM	−0.027 (−2.797) **	−0.028 (−3.028) ***	−0.027 (−2.814) **
TA	0.011 (0.328)	0.010 (0.301)	0.013 (0.384)
STD_OCF	0.126 (1.363)	0.128 (1.402)	0.127 (1.375)
AGE	−0.008 (−1.873) *	−0.007 (−1.753) *	−0.009 (−1.927) *
SLACK	−0.065 (−1.721)	−0.073 (−1.687)	−0.060 (−1.722)
OWN	−0.028 (−1.214)	−0.026 (−1.110)	−0.024 (−1.170)

Table 11. Cont.

FOR	0.043 (1.564)	0.037 (1.562)	0.046 (1.607)
BIG4	0.002 (0.362)	0.002 (0.305)	0.002 (0.352)
YD	Included	Included	Included
ID	Included	Included	Included
F-VALUE	43.06 ***	41.45 ***	43.55 ***
ADJ R-SQ	21.26%	21.03%	21.61%

Notes: (1) This table presents the analysis results using the methodology of [Gow et al. \(2010\)](#) from regressing debt origin on investment efficiency. Models 1, 2, and 3 are classified as follows. Model 1 scaled public and private debts to total assets, and model 2 scaled public and private debts to the sum of public and private debts. Model 3 looks at public debt as dummy variable rather than continuous variable. (2) Please refer to Section 3.2 for variable definitions. (3) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

4.3. Other Robustness Analysis

There is a large debate about the changing corporate debt/investment link before and since the global financial crisis of 2007/2008. In Europe for instance, investment dynamics changed significantly after the crisis, and the link between corporate debt holdings and investment activity changed. It would be interesting to see whether a similar difference could be observed in a sample for the debt origin/efficiency link, as financial constraints potentially had a very different effect on investment efficiency after 2008. As a result of dividing and verifying samples before and after the financial crisis, statistical significance was maintained before the financial crisis, but there was no statistical significance after the financial crisis. It can be inferred that the statistical significance of debt characteristics and investment efficiency does not appear due to changes in corporate financial constraints, investment behavior, and accounting information after the financial crisis. Second, our model features year and industry dummies. This model itself has the disadvantage of not being able to measure the characteristics of an individual company, but it can grasp the overall situation of the company through cross-sectional analysis. However, in order to compensate for the shortcomings of cross-sectional analysis, the fixed effect model of individual companies was further analyzed. As a result of the analysis, statistical significance was maintained. Third, listed firms are included in our data set, which have easier access to capital/bond markets and usually depend less on (private) bank funding. For smaller firms/SMEs, results for H1/H2 could look very different; bank funding could be a less costly source of funding in relative terms. Therefore, we examined differences between large listed firms and SMEs and how the results of this paper would be affected if SMEs were used. As a result of analyzing SMEs and large companies, SMEs did not show statistical significance in relation to debt origin and investment efficiency. Large corporations show statistical significance in the relationship between debt characteristics and investment efficiency. It is inferred that this is due to the difference in financing means and procurement cost depending on the size of company. Finally, In [Chen et al. \(2011\)](#)'s model, the residual was estimated by considering the additional control variables, and investment efficiency was re-verified. As additional control variables, firm size, debt ratio, and profitability were selected to reflect the characteristics of the firm. As a result of re-verification, statistical significance was maintained.

5. Conclusions

This study examines the relationship between debt origin and investment efficiency using a sample of 8754 firm-years from 2002 to 2017. Debt origin was classified into public and private debt and investment efficiency was measured by the method of [Chen et al. \(2011\)](#).

Public debt is a firm's financing from a large number of unspecified investors through the capital market. Corporate bonds are the most common form of public debt. Private debt is a contract in which

financing is achieved through a bilateral contract between creditor and debtor. A typical form of debt is a bank loan. Principal–agent problems exist between firms and investors, and the primary cause of agent problems is information asymmetry. There is a difference between public and private debt in terms of setting up contracts and in post monitoring.

On the other hand, firms seek to maximize firm value by raising funds for efficient management activities. However, there is a possibility of overinvestment or underinvestment because the information asymmetry may occur due to the market imperfection. The cause of overinvestment is moral hazard, which is the act of selecting an investment plan that can produce high returns even if the probability of revenue generation is low. The cause of underinvestment is reverse selection, which allows the capital supplier to limit capital supply in advance. In the following, a firm's underinvestment problem arises. As mentioned above, the degree of information asymmetry and the incentives for improving the quality of accounting information differ between firms and creditors according to whether the debt financing method is procured as a public or private debt. Thus, the impact on the value and sustainability of a firm may be said to differ depending on the debt origin. Therefore, this study empirically analyzes the relationship between debt origin and investment efficiency.

The analysis results of this study are as follows. First, public debt and investment efficiency were significantly correlated in a positive direction, supporting the hypothesis of this study. As a result of dividing the sample into an overinvestment sample and an underinvestment sample, the analysis result was statistically significant in the underinvestment sample. This is in line with previous studies that public debt creditors use their financial statements as the primary source of information for evaluating a firm and require firms to have a high level of financial reporting quality to reduce information asymmetry between firm and creditor (Chun et al. 2011; Givoly et al. 2010). Second, private debt and investment efficiency were significantly correlated in the negative direction, supporting the hypothesis of this study. As a result of dividing the sample into an overinvestment sample and an underinvestment sample, the analysis result was statistically more significant in the underinvestment sample. This means that private debt creditors can dilute information asymmetry problems through monitoring and stringent contract clauses and control potential adverse selection problems (An et al. 2004). Thus, the incentive to improve the quality of financial reporting is relatively inferior to that of public debt.

As mentioned above, the empirical result was lower in investment efficiency for firms with more financing through loans, and more efficient for firms with predominant financing through bonds. In addition, it can be seen that only the regression analysis results of the total sample and the underinvestment sample are statistically strong. This result shows that the relationship between debt origin and investment efficiency can be differentiated by overinvestment and underinvestment samples.

As a further analysis result, according to the research method of Chun et al. (2011), the debt ratio was analyzed by scaling to total liabilities rather than total assets, and the time difference model was further considered. As a result, the robustness of the study was maintained even when scaled to total debt. However, the analysis results using the time difference model showed the same direction, but the statistical significance was somewhat lower. The results were maintained even when the method of measuring investment efficiency was different, and the results were maintained even in the analysis applying the methodology of Gow et al. (2010), considering the cross-sectional time series dependence.

This study is meaningful for examining how investment efficiency varies depending on the debt origin in the information asymmetry between firms and investors. Debt contracts between firms and creditors create information asymmetry due to hidden characteristics and hidden behavior. As a result of information asymmetry incurred at the time of initiating a debt contract, as well as in the post-monitoring process, it is impossible to make an optimal decision not only for corporate positions but also for creditors. The results of this study indirectly suggested that the incentive to improve the quality of accounting information is relatively greater in public debt financing methods by verifying the relationship between debt origin and investment efficiency. The difference in investment efficiency

depends on the method of debt financing, which ultimately leads to the gap between the optimal investment and the firm's investment, which will also affect the firm's value and the firm's sustainability.

The limitations of this study and further discussing are as follows. In this study, the level variables of public and private debt were set as independent variables as characteristics related to debt contracts, but there are limitations in not considering the hidden contract or hidden behavior. We hope that data on hidden contracts or hidden behavior will be studied in future studies. Second, we assume the link between external financing and investment efficiency to vary across sectors where the degree of market access of firms might vary. However, we have not verified this. Third, we have not estimated the model with interacted sector-year fixed effects to account for sector-specific business cycles. Finally, a single firm in the sample can be in the over- or underinvestment sample for different years, i.e., transition from over- to underinvestment from one year to the other. That opens up discussions on potential strategic dynamic investment decisions firms could take. In other words, over-investment and under-investment strategies may change by time series. In this study, cross-sectional analysis was selected as the main model, not firm-fixed analysis. It would be meaningful to discuss the dynamic investment strategies of each firm in the future. It is thought that the sustainability of the company could be improved by supplementing the above-mentioned limitations and examining future research topics. We look forward to further research into the specific company situation. The result of the study that the difference in investment efficiency according to the debt origin can affect a firm's sustainability is expected to provide important implications not only for managers but also for investors and supervisory institutions.

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Appendix A. Variable Definitions for H1, H2

Dependent Variables

INV_EF investment efficiency, is measured as was done by [Chen et al. \(2011\)](#) and is defined as the absolute value of the estimated residual multiplied by -1

Explanatory Variables

BONDR bond ratio, is measured by dividing bonds by total assets
 LOANR loan ratio, is measured by dividing borrowings by total assets
 BOND_LOAN public debt ratio, is measured by dividing public debt by the sum of public debt and private debt
 BONDDUM bond dummy variable, which is 1 for firms with bonds and 0 otherwise

Control variables

SIZE firm's size, natural log of total assets
 LEV debt ratio of a firm, measured as liabilities divided by total assets
 LOSSDUM loss dummy variable, which is 1 for a loss firm and 0 otherwise
 TA tangible asset ratio, measured as tangible assets divided by total assets
 STD_OCF the standard deviation of operating cash flow, measured as the standard deviation of dividing operating cash flow from the cash flow statement for five years from $t - 4$ to t by the lagged total assets listing period, measured as the value obtained by taking the natural logarithm of the age of firm
 AGE
 SLACK cash ratio, the ratio of cash divided by total assets
 OWN the ownership ratio of major shareholder
 FOR the ratio of foreign ownership

BIG4	BIG4 is a dummy variable, 1 if the auditor is a BIG4 accounting firm and 0 otherwise
YD	year dummy
ID	industry dummy

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