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The Impact of Capital Structure on the Profitability Performance of ICT Firms

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Abstract: Information and communication technology (ICT) companies strive for ceaseless innovation to remain competitive while facing the challenge of maximizing firm value (FV) with limited resources, and increasing the interests of shareholders. However, capital structures have a considerable effect on FV, and the literature still disagrees with the optimum structure in specific industries and countries. Therefore, this study evaluates the FV of ICT companies in terms of profitability efficiency using data envelopment analysis. In addition, this study applies a Tobit regression and Kruskal-Wallis one-way ANOVA to identify the impact of leverage, liquidity, and firm size, which are major capital structure factors influencing FV. The analysis yields three main results. First, in the ICT industry, small and medium companies tend to have better profitability efficiency than companies of other sizes. Second, only small and medium ICT manufacturing companies' profitability efficiency is positively impacted by the current ratio. Third, only mid-sized service companies' profitability efficiency is positively impacted by the debt-equity ratio. The results have policy and practical implications for improving the FV of ICT companies.

Keywords: firm value; capital structure; profitability efficiency; data envelopment analysis

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1. Introduction

The information and communications technology (ICT) industry is technology-intensive and is growing rapidly. To remain competitive, companies in this industry aim for ceaseless innovation and technology enhancement to comply with consumer demands for better technology [1]. Simultaneously, companies aim to maximize their share price and shareholders' interests as the primary objective of management [2]. As firms have limited resources and capacities, they must create enterprise value effectively.

Firm value (FV) is the sale price that a corporation can realize for investors. Higher enterprise value leads to higher share returns, so shareholders prosper. Therefore, it is important for a company to maximize FV [2,3]. Several factors contribute to a firm value: financial health [4], business risk [5,6], growth opportunities [7,8], corporate governance [9], etc. Capital structure is one of the most critical variables among them. As an important subject in corporate finance, a significant number of studies investigated the effects of capital structure on firm value and its determinants [10,11]. However, many studies draw contradicting conclusions on the determinants of capital structure and the significance of the impact. Modigliani and Miller [12], and Walter [13] argue that capital structure does not affect FV, while it has a considerable impact according to Warner [14], Myers [15], and Deangelo and Masulis [16]. Furthermore, some studies verified the nonlinear relationship between capital structure and firm value. For example, Cuong and Canh [17] empirically validated the nonlinear relationship between capital structure and firm value among 92 Vietnamese companies from 2005 to 2010; Khanh et al. [9] observed a similar nonlinear relationship for the Vietnamese companies in the period from 2008 to 2018. Ayaz and Ahmad [18] further confirmed that a company's debt has a nonlinear impact on firm performance in Malaysia.

There are many factors that influence the capital structure, but firm size, leverage, and liquidity are most frequently employed in previous studies on finance structure [2,19]. Thus, this study focuses on these three factors to analyze the impact of capital structure on FV. In earlier studies, Jensen and Meckling [20], Jensen [21], Carter et al. [22], and Tahir and Razali [23] found a negative correlation between firm size and FV, while Majumdar [24], Jin and Jorion [25], Beasley et al. [26], Hoyt and Liebenberg [27], and Lin et al. [8] confirmed a positive relationship. Moreover, Jensen [21], McShane et al. [28], and Lin et al. [8] concluded that leverage had a negative effect on FV, although Singh and Bansal [11] verified that there was no significant effect. Lastly, Smith and Stulz [29] and Beasley et al. [26] found a positive correlation between liquidity and FV, while Eng and Spickett-Jones [30], and Husna and Satria [2] reported no correlation between these factors.

As such, studies on the effects of capital structure on FV are ambiguous and contradictory, leaving much space for further research [7]. In addition, there is no consensus in a specific industry in any country [11,19]. However, in general, empirical evidence suggests that leverage, liquidity, and firm size can influence FV [31–33].

Meanwhile, many earlier studies utilized Tobin's Q, which is the proportion of an asset's market value to its replacement value, to measure FV [34–36]. This is a ratio using financial and accounting data [37]. It has the benefit of minimizing distortion brought on by tax legislation and accounting standards [38]. However, Tobin's Q may be an improper measurement if traditional accounting methods fail to provide information about the real value of the company [39]. Moreover, methodologies used to calculate this ratio all aim to provide an approximate value and therefore cannot provide an accurate calculation [40]. Finally, Tobin's Q has a critical limitation in that it does not properly reflect multidimensional outcomes derived from a nonlinear capital structure [35,41].

Therefore, it is necessary to evaluate FV in consideration of multiple outcomes [42]. Data envelopment analysis (DEA) is a nonparametric method to evaluate the efficiency of decision-making units by considering multiple inputs and outputs. Thus, Sueyoshi and Goto [40], Kapelko and Oude Lansink [35], and Tu [43] recommended measuring FV with data envelopment analysis (DEA). Profit efficiency is an indicator that evaluates a company's efficiency as well as the potential profit that it could generate if it were completely efficient [44]. The strong association between a firm's efficiency and firm value was also confirmed by previous studies [45].

Accordingly, this study uses DEA to evaluate the value of 423 ICT companies in South Korea. Then, a Tobit regression was used to measure the effect of capital structure on the relevant efficiency. This study not only contributes to the literature on the capital structures of ICT companies in South Korea but also enriches the case studies of capital structure, the effect of which on FV is still controversial.

In summary, this study estimates firm value by evaluating profit efficiency. Then, it validates the following three hypotheses derived based on previous studies that investigated the relationship between firm value and firm size [8,20–27], leverage [8,21,28], and liquidity [26,29].

1. Leverage affects the FV of an ICT company.
2. Liquidity affects the FV of an ICT company.
3. The FV of an ICT company varies according to firm size.

The rest of this paper proceeds as follows. Section 2 presents the studies on the determinants of capital structure that influence FV as well as an enterprise's profitability efficiency. Section 3 describes the efficiency evaluation method, data, and research model. Section 4 provides the analytical outcomes of each research model. Sections 5 and 6 present the summary of the study and its implications. Lastly, the limitations of the study and future research directions are discussed in Section 7.

2. Literature Review

2.1. Determinants of Capital Structure

2.1.1. Firm Size

Larger firms have greater exposure to market risk and greater potential for disputes between institutions [20,21]. Institutional conflicts between business managers and shareholders encroach on shareholders' wealth and consequently decrease FV [7]. Allayannis and Weston [46], Carter et al. [22], and Tahir and Razali [23] empirically find a negative correlation between firm size and FV. Conglomerates, on the other hand, improve their FV through mass production [24] and have a variety of resources to strategically manage risks in addition to specialized knowledge [25,26]. By finding a positive correlation between company size and company value, Hoyt and Liebenbeg [27], and Lin et al. [8] argue that company size is important for value creation. Generally, studies measure the effect of company size using the natural log value of net sales or net assets; however, we categorize company size using average sales based on the Framework Act on Small and Medium Enterprises in Korea.

2.1.2. Leverage

Modigliani and Miller [47] argue that leverage increases the value of companies due to the tax shield effect derived from the interest deduction effect. However, some studies discover an inverse relationship between leverage and FV. This is because as a company's leverage grows, it becomes exposed to more risk, financial difficulty, and the problem of a lack of investment since there are limited opportunities to invest in projects with strong net present values [7]. This is because higher leverage tends to reduce the debt rating of a company in financial difficulty and increase borrowing costs [26]. In empirical studies, McShane et al. [28], Lin et al. [8], and Allayannis and Weston [46] argue for a negative correlation between leverage and FV. A variety of leverage measurements are used to measure the effect of leverage [19]. However, a common index for a company's leverage is debt to equity ratio (DER), which is the total liabilities of the capital market value [23,26,48].

2.1.3. Liquidity

The current ratio (CR) is a company's liquidity index, which is used to measure its capacity to meet its liabilities or to pay back short-term debts upon maturity using its liquid assets [49]. In other words, this ratio can be used to evaluate the extent to which a company can pay off its short-term debts when they come due using its cash and assets that can be immediately converted to cash [50]. It reflects how many usable liquid assets a company owns compared to its liquid liabilities and is a critical factor in evaluating a company's value by indicating its financial health to investors [50]. Based on empirical evidence, Eng and Spickett-Jones [30] and Husna and Stria [2] argue that liquidity and FV are unrelated because investors do not give much consideration to a company's liquidity; on the contrary, Aggarwal and Padhan [19] argue that higher liquidity allows a company to raise funds more easily and enables it to perform its short-term financial obligations better, thereby having a positive impact on FV.

2.2. Profitability Efficiency

A primary objective of a company's management is to create FV using given resources, thereby maximizing shareholder value. Therefore, many studies use a measurement of efficiency to evaluate a company's ability to create FV. As Table 1 shows, a variety of input and input factors are utilized to measure profitability efficiency. In addition, numerous studies utilized accounting-based financial ratios. For example, return on equity (ROE) and return on assets (ROA) are used as key indexes to evaluate efficiency [1,51–53] as it is better to use DEA in combination with major financial ratios than to use financial ratios only [54]. Moreover, DEA can strengthen the traditional analysis of ratios, thereby providing a reliable and consistent measurement. This is because the company's management and the information on technological efficiency provided by DEA can complement an analysis of

financial ratios [55]. Accordingly, Halkos and Salamouris [54] and Yu et al. [56] propose a DEA model that employs financial ratios to measure a company's profitability efficiency.

Table 1. Studies of profitability efficiency using DEA.

Citation	DMUs	Input Factor	Output Factor	Method
Seiford and Zhu [57]	55 U.S. commercial banks	Market capital, Total assets, Employees, Stockholder's equity	Price earnings ratio (P/E ratio), Earning per share (EPS), Market to book ratio (M/B ratio), Profit, Total return to investors (TRI), Turnover ratio	DEA
Zhu [58]	Fortune 500 companies	Market value, Total assets, No. of employees, Stockholder's equity	EPS, Revenue or Sales, Profit, TRI	Network DEA
Luo [51]	245 banks from the Compustat Disk in the year 2000	Market capital, Total assets, Employees	ROE, ROA, EPS, Revenue or Sales, Profit, Stock price	DEA
Wen et al. [52]	12 e-commerce firms	Employees, Investment, operating expenses	Profit margin (PM), Return of capital employed (ROCE), ROE, Days receivables, Revenue or Sales	DEA
Hoe et al. [1]	18 technology companies in Malaysia for the period of 2011–2015	Current ratio, Debt to assets ratio, Debt to equity ratio	EPS, ROA, ROE	DEA
Ravanshad and Amiri [53]	60 firms listed on the Tehran Stock Exchange	Total liabilities, Total equity ratio	1st stage: ROA, ROE 2nd stage: t: B/M ratio(book-to-market equity), E/P RATIO(ratios of earnings to price)	Network DEA

3. Methodology

3.1. Efficiency Evalutaion

The two major methods used to measure efficiency are DEA and stochastic frontier analysis (SFA). DEA is based on linear programming (LP) to evaluate the relative distance to the efficiency frontier derived from inputs and outputs, hence determining efficiency. On the contrary, SFA assumes the production function and the form of distribution to evaluate efficiency. DEA is simpler to apply than SFA and has the benefit of being able to take various inputs and outputs into account. The most widely used DEA models are the CCR model proposed by Charnes, Cooper & Rhodes [59] and the BCC model proposed by Banker, Charnes & Cooper [60]. The CCR model assumes Constant Returns to Scale (CRS), which assumes that when the inputs increase, the outputs increase by the same ratio. On the other hand, in the BCC model which assumes variable returns to scale (VRS), the degree of output increase is not constant when the input is increased by one unit. Although the CCR model and the BCC model differ in the returns to scale assumption, both models measure radial efficiency. In this study, the BCC model was applied because the investigated ICT companies are distributed throughout a number of sub-industries so there is sufficient heterogeneity among DMUs.

In addition, the DEA model can be either input-oriented or output-oriented depending on the characteristics of the firm's production process. The input-oriented model minimizes the inputs to produce a given level of outputs, and the output-oriented model maximizes the outputs given levels of the inputs. This study assumes that inputs are controllable elements to create outputs. Thus, an input-oriented BCC model was used to analyze whether an efficient operation was achieved by minimizing inputs.

However, the efficiency rating determined with traditional DEA may have bias and lacks statistical confidence intervals. Therefore, it could distort the assessment of a company's efficiency. It is necessary to use Bootstrap DEA to overcome this limitation. Bootstrap DEA not only provides an estimated value of efficiency adjusted for convenience but also estimates confidence intervals for the efficiency rating, thereby enabling a statistical evaluation.

For these reasons, this study evaluates a company's profitability efficiency by employing the Bootstrap DEA methodology. This study applies the five steps of Bootstrap DEA proposed by Simar and Wilson [61], repeated 2000 times [62], and estimates confidence intervals based on Kneip et al. [63].

Kruskal-Wallis one-way ANOVA is used to compare a company's profitability efficiency intervals in relation to its size. This method analyzes intervals among groups by examining the differences between the medians of each group. Since it is a non-parametric technique, Kruskal-Wallis one-way ANOVA is appropriate for analyzing efficiency intervals across different groups that do not match the normality assumption. In addition, this study uses a Tobit regression to validate the impact of a company's risk management on its profitability efficiency. Because the efficiency rating determined from DEA has a truncated scope that ranges from 0 to 1, it is more appropriate to use a maximum likelihood (ML) based Tobit regression than a standard ordinary least squares (OLS) regression model.

3.2. Data

This study verifies the effect of capital structure on the profitability efficiency of ICT companies according to industry and size. To do so, data from 2019 for 424 conglomerates, mid-sized companies, and small and medium companies that belong to ICT manufacturing and service industries were collected from the Data Analysis, Retrieval, and Transfer System (DART) which is managed by the Financial Supervisory Service in Korea. This study excludes data from one conglomerate that severely distorts the overall data when treating negative values, thereby using data from 423 companies for analysis.

Input and output variables are selected based on previous studies. First, two variables are selected as inputs: the number of employees critical for the firm's operations and the amount of total assets. Next, three factors are selected as outputs: ROA, ROE, and EPS, all of which are indexes typically used to evaluate company value. ROA reflects the degree of profitability relative to a company's total assets [51]. ROE captures how much interest invested capital has returned with a high return, implying positive prospects for the company [52] and increasing FV by generating investor demand for shares [2]. EPS shows how much net profit each share has generated [58]. A higher profit generated per share indicates the positive management performance of a company and triggers more investment by positively impacting the share price [2,64].

In addition, we selected DER and CR as environmental factors as alternative indexes for those in Section 2 and the determinants of capital structure. The descriptive statistics of the inputs, outputs, and environmental factors are summarized in Tables 2 and 3.

Table 2. Descriptive statistics: ICT manufacturing firms.

		Employees	Total Assets	ROA	ROE	EPS	DER	CR
Major	Max	105,257	216,180.92	0.94	5.79	13,223.00	1,557.38	355.83
	Median	8891	5070.13	0.87	5.20	8007.00	51.44	187.34
	Min	226	175.83	0.75	4.33	1.00	−1353.40	73.05
	Mean	20,302	31,010.59	0.87	5.03	8051.73	159.94	174.57
	St.dev	29,962	61,086.62	0.06	0.42	3215.41	670.39	85.13
Midsize	Max	2560	1185.88	1.10	12.36	13,446.00	6482.76	2287.01
	Median	432	261.35	0.87	5.24	7542.00	56.41	151.22
	Min	17	76.73	0.60	0.36	2112.00	−3510.63	17.26
	Mean	501	308.68	0.87	5.33	7790.56	−2.17	254.20
	St.dev	467	221.95	0.08	1.37	1404.12	1060.30	354.22
SME	Max	1397	387.71	1.11	33.22	12,234.00	4789.66	3406.95
	Median	108	83.36	0.86	5.19	7423.00	49.72	213.56
	Min	8	11.82	0.00	0.00	3754.00	−3151.08	27.50
	Mean	148	94.36	0.82	5.61	7473.93	48.84	380.17
	St.dev	159	60.00	0.15	3.28	941.33	684.20	442.55

Table 3. Descriptive statistics: ICT service firms.

		Employees	Total Assets	ROA	ROE	EPS	DER	CR
Major	Max	23,372	30,839.37	0.93	7.70	25,221.00	2,098.74	664.38
	Median	1,124	850.16	0.88	5.28	8398.50	75.35	165.03
	Min	118	100.35	0.80	4.85	4121.00	−7759.84	56.87
	Mean	3991	5491.00	0.88	5.58	10,032.89	−156.98	218.17
	St.dev	5930	9309.24	0.04	0.81	5269.77	1922.10	161.07
Midsize	Max	3942	6671.59	1.18	8.39	22,306.00	17,880.15	1512.25
	Median	276	205.30	0.87	5.21	7587.00	43.68	217.24
	Min	7	39.36	0.33	3.41	4077.00	−1010.52	24.74
	Mean	478	537.96	0.87	5.25	8318.18	364.76	338.01
	St.dev	701	1101.99	0.11	0.58	2718.80	2,377.59	319.31
SME	Max	837	734.89	1.05	29.14	18,987.00	7006.57	19,080.41
	Median	104	61.92	0.86	5.21	7410.00	51.57	246.86
	Min	5	8.57	0.08	1.51	3614.00	−7151.80	17.54
	Mean	138	79.99	0.80	5.65	7506.35	11.46	581.42
	St.dev	134	79.89	0.18	2.87	1442.65	1011.97	1783.32

3.3. Research Model

This study is conducted in three stages as shown in Figure 1. It first conducted Bootstrap DEA using the number of employees and total assets as inputs and ROA, ROE, and EPS as outputs to evaluate the companies' profitability efficiency. Second, the profitability efficiency of these companies is categorized into six groups by industry (manufacturing and service) and size (conglomerate, mid-sized, and small and medium), and are evaluated for their interval differentials of efficiency per size and industry through Kruskal-Wallis one-way ANOVA. Lastly, for each of the six groups, we do a Tobit regression using DER and CR, two important factors that influence the capital structure, as independent variables, and profitability effectiveness as a dependent variable. This is to evaluate how capital structure affects company profitability efficiency by industry and by size.

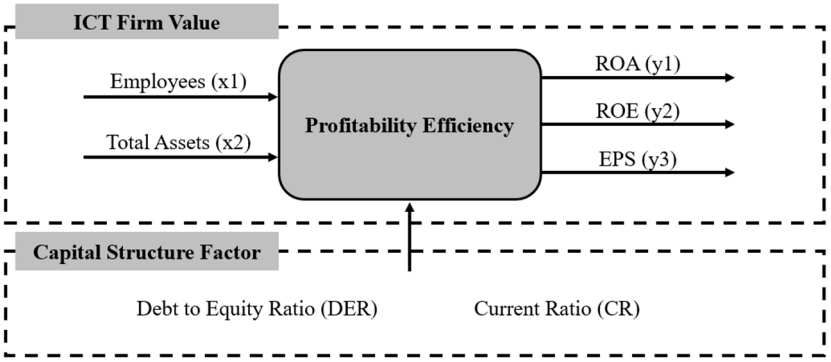

Figure 1. Profitability evaluation model.

The Pearson correlations between inputs, outputs, and environmental variables are validated as presented in Table 4. The relationship between assets and employees(significance level: 1%), EPS and assets(significance level: 5%), and EPS and ROA(significance level: 1%) are significant. On the other hand, the correlations between inputs/outputs and environmental factors such as DER and CR are insignificant, indicating that input/output factors and environmental factors are distinct.

Table 4. Pearson correlations analysis.

		Employee	Assets	ROA	ROE	EPS	CR	DER
Employee	Correlation	1						
	Sig.							
Assets	Correlation	0.956 **	1					
	Sig.	0.000						
ROA	Correlation	0.048	0.042	1				
	Sig.	0.322	0.392					
ROE	Correlation	−0.015	−0.012	−0.040	1			
	Sig	0.759	0.803	0.416				
EPS	Correlation	0.071	0.095 *	0.437 **	0.014	1		
	Sig.	0.145	0.050	0.000	0.776			
CR	Correlation	−0.031	−0.021	0.035	0.008	0.015	1	
	Sig.	0.524	0.669	0.474	0.864	0.751		
DER	Correlation	0.004	0.005	0.081	−0.071	0.058	−0.004	1
	Sig.	0.938	0.926	0.096	0.142	0.235	0.928	

** $p < 0.01$; * $p < 0.05$ (2-tailed).

The level of correlation simply among inputs or outputs does not have a significant impact on efficiency rankings [65]. Thus, the significant correlation between assets and employees, and EPS and ROA would not significantly affect profitability efficiency. On the contrary, the correlation between inputs and outputs may affect the average efficiency scores. However, the correlation between EPS and assets is relatively low(0.095) and significant at the 5% significance level. Thus, this study assumes that the significant correlation in Table 4 will not affect profitability efficiency.

4. Results

4.1. Kruskal-Wallis One-Way ANOVA Results

First, Bootstrap DEA was conducted to evaluate the efficiencies of ICT companies. The calculated efficiency scores are presented in the appendix. These efficiency scores were used to conduct the Kruskal-Wallis one-way ANOVA. Table 5 reports the pairwise comparison of profitability efficiency according to ICT industry and size.

Table 5. Pairwise comparison of ICT manufacturing and service firms.

Comparison	Manufacturing				Services			
	Test Statistic	Std. Error	Std. Test Statistic	Sig. Test Statistic	Test Statistic	Std. Error	Std. Test Statistic	Sig. Test Statistic
Major-Mid	−44.206	21.390	−2.067	0.116	−30.523	15.213	−2.006	0.134
Major-SME	−127.783	20.729	−6.164	0.000 ***	−86.618	14.192	−6.103	0.000 ***
Mid-SME	−83.577	9.445	−8.849	0.000 ***	−56.095	9.086	−6.174	0.000 ***

*** $p < 0.01$.

The results in Table 5 show that in both the ICT manufacturing and service industries, small and medium companies are significantly different from mid-sized companies and conglomerates at a level of significance of 0.01, but conglomerates and mid-sized businesses do not significantly differ from one another. Figure 2 depicts the distribution of company profitability efficiency by firm size ICT manufacturing and service industries. It shows that in ICT manufacturing, the median of small and medium companies (0.305) is higher than those of mid-sized companies (0.122) and conglomerates (0.029). In the ICT service industries, the median of mid-sized companies (0.364) is higher than those of mid-sized companies (0.156) and conglomerates (0.059). Particularly, the efficiency distribution by

size in both manufacturing and service industries in ICT are very similar. The smaller the size of a company, the more favorable it is for creating company value.

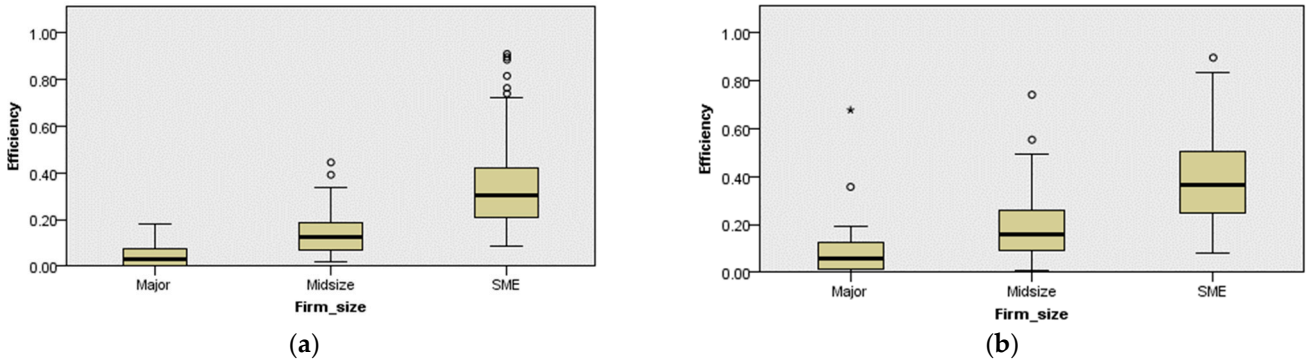

Figure 2. Box plots of profitability efficiency by firm size in the ICT manufacturing (**a**) and service industries (**b**).

4.2. Tobit Regression Results

Tobit regression analysis was conducted to verify the effects of capital structure on a company's profitability efficiency. The results are presented in Table 6. In the ICT manufacturing industry, only CR in small and medium companies has a positive effect on a company's profitability efficiency at the 1% level of significance. Thus, only the liquidity factor positively affects a firm's profitability efficiency for small and medium-sized ICT manufacturing companies. These findings are in line with those of Smith and Stulz [29] and Beasley et al. [26], although their work did not consider the corporate size.

Table 6. Effect of capital structure on profitability efficiency.

Size	Factor	Manufacturing				Services			
		Coefficient	Std. Error	z-Value	Sig.	Coefficient	Std. Error	z-Value	Sig.
Major	Liquidity	0.000	0.000	1.330	0.183	0.001	0.003	0.520	0.603
	Leverage	0.000	0.000	0.421	0.674	0.000	0.000	1.774	0.076
Mid	Liquidity	0.000	0.000	0.827	0.408	0.000	0.000	1.287	0.198
	Leverage	0.000	0.000	0.142	0.887	0.000	0.000	3.152	0.002 ***
SME	Liquidity	0.000	0.000	4.446	0.000 ***	0.000	0.000	1.078	0.281
	Leverage	0.000	0.000	−1.185	0.236	0.000	0.000	0.139	0.890

*** $p < 0.01$.

However, in the ICT service industry, only DER in mid-sized companies has a positive effect on profitability efficiency at the 5% significance level. In other words, only the leverage factor positively affects a firm's profitability efficiency for mid-sized ICT service companies. These findings are consistent with those of Cheng and Tzeng [66], and Hadinugroho et al. [67].

5. Discussion

The results can be attributed to the characteristics of the ICT industries in South Korea. According to the "ICT Statistical Analysis 2020" of the Korea Information Society Development Institute (KISDI), in South Korea's ICT industries, a company that is less than 10 years old tends to be more intensive in research and development (R&D) and foreign direct investment than older companies. Furthermore, companies with fewer than 300 employees are more engaged in technology investments. Significant intensity has been

found in companies that are 10 to 19 years old. This demonstrates that small, medium-sized, and emerging companies are playing a critical role in the technological development and growth of ICT industries. Active investment in technology plays an important role for such companies in ICT to gain competitiveness. However, conglomerates with more than 300 employees actively participate in foreign direct investment since more than half of the conglomerates engage in export and import trade. Thus, larger and older companies rely more on external environments, including trade.

However, it is a positive phenomenon that ICT companies in South Korea have a lower ratio of debts relative to assets and sales compared to other industries; however, it has been shown that the interest costs are high. This suggests that the management of uncertainty in financial markets is necessary for ICT industries. In particular, the smaller the company, the greater the cost of debt and interest tends to be, meaning that small and medium companies are more exposed to risks in financial markets. In addition, a younger company tends to have greater exposure to risks in financial markets. Particularly young companies, those that are less than ten years old, have a high degree of debt in comparison to their size. It is more likely that small and medium ICT companies are part of a global supply chain; therefore, a decrease in imports and exports of conglomerates will likely cause a downturn in the performance of small and medium companies. In the case of a real crisis in the financial market, small and medium ICT companies, and emerging ICT companies likely face greater uncertainty because of the worsening real economy; it is, therefore, necessary to manage uncertainty in financial markets.

According to "A study on growth factors and characteristics of ICT firms" published by the KISDI in 2015, young companies with fewer than 100 employees under 20 years of age, a strong focus on exports, and high growth and profit-generating groups are frequently found in South Korean ICT industries. High-growth companies tend to be manufacturing companies that have more than three main products. Most are also companies that target businesses rather than consumers or research-oriented companies that operate independent research centers and engage in independent R&D. On the contrary, high profit-generating companies tend to be service companies. They are commonly market-oriented companies that target foreign markets and have a market share greater than 10%. In addition, companies with fewer than six main products and companies that focus on R&D with more than 5% R&D concentration comprise the majority.

6. Conclusions

This study contributes to the literature because it extends the discussion of previous studies on the relationship between firm value and capital structure. It is still unclear how capital structure affects a firm's value because it can differ by country, industry, and so on. However, this study empirically supports the positive relationship between these factors for large, medium-sized, and small Korean ICT companies. Furthermore, this study analyzed the value of companies from the perspective of profitability efficiency in contrast to other studies that mostly used Tobin's Q or other financial measures.

This study also provides several managerial implications as follows. First, in the ICT industries in South Korea, small and medium companies tend to have better profitability efficiency than mid-sized companies and conglomerates in both the ICT manufacturing and service sectors. The effect of a high level of R&D, foreign direct investment, and patent concentrations of small, medium, and emerging ICT companies on their growth and development as well as active investment in technology are their sources of competitiveness. Taking this into account, governments should prioritize their support for small, medium, and emerging companies so they can make stable investments amid the uncertainty of the financial market to maintain their competitiveness.

Second, it was found that CR only improved the profitability efficiency of small and medium-sized manufacturers. South Korean ICT companies do not have a high level of debt relative to sales but bear a high level of interest costs, a phenomenon that is more severe for smaller companies. Small and medium companies that are less than 10 years

old bear a significantly greater level of debt relative to their size and are thus vulnerable to financial market risks. The only method for small and medium manufacturing businesses to pay off their debt commitments and short-term loans without incurring additional interest expenses is to increase profitability, postpone maturity dates, raise funds, and issue new shares, but all these methods are difficult to realize in practice. It is therefore necessary for governments to subsidize these companies by paying cashable assets or reducing their liquid liabilities through the deduction of corporate tax, thereby reducing the burden of high-interest costs. According to Table 2, the average CR of mid-sized manufacturing ICT companies have relatively high liquidity, at 380.17%, a high figure that is above 200%. In other words, some companies are holding more cashable assets than necessary. These companies should reinvest their assets to generate profits, thereby reducing liabilities and interest costs.

Third, only mid-sized service companies' profitability and efficiency are positively impacted by DER. DER is an index of reliance on external capital. Generally, a normal level is below 100%, and a dangerous level is above 200% [68]. However, a higher DER is not always negative. A company that manages its capital efficiency can gain leverage effects where the ROE is raised with external capital such as debt [69]. In particular, large companies can employ external capital more efficiently since they have the resources, financial stability, and professional know-how to manage risks. [25,26]. In reality, highly profitable companies in the South Korean ICT industry are those in the service sector with a market share higher than 10%. These companies strengthen their competitiveness by actively engaging in foreign direct investment such as the establishment and operation of production factories and R&D centers abroad. Therefore, governments should subsidize external fundraising by these companies through supportive policies for mid-sized ICT service companies. Furthermore, mid-sized service companies should raise funds more actively through licensing, joint development, technology purchases, and cooperation in the prototype development and mass production stages with foreign companies.

7. Limitations and Future Research

Despite several contributions, this study has limitations. First, the scope is limited to the South Korean ICT industry; therefore, it is difficult to apply its analytical outcomes and the resulting implications to ICT industries in other countries. It is necessary for future studies to collect data from ICT companies not just in South Korea but also a variety of other countries to produce more generalizable conclusions. Second, capital structure has a long-term effect on a company's performance and its value [70,71]. However, since this study utilizes data from a single year, it is unable to provide insight into the long-term effect of capital structure on the firm value. Moreover, it is possible that a specific occurrence in a given year could influence the companies' efficiency or profitability, which could lead to biased results. In order to examine the long-term influence of capital structure and eliminate the impact of specific events in a given year, multi-year data will need to be evaluated in the future. Third, the 423 companies analyzed in this study are diverse in terms of the firm's size and sub-industries, and this diversity may reduce the homogeneity of the data. This study was unable to secure enough data to independently apply DEA to each industry and company size. Therefore, this study assumed that all the companies are comparable in that they all engage in ICT business, and measured profitability efficiency using one efficiency frontier. If sufficient data is collected and the frontiers are formed for each category, future studies will be able to draw more detailed findings. Alternatively, more advanced methodologies such as meta-frontier DEA can be used to account for the heterogeneity issue [72]. Fourth, this study used the input-oriented BCC DEA model with the assumption of radial efficiency. A proportional reduction in input resources is therefore assumed in order to measure the efficiency of the DMUs [73]. Although the assumption of radial efficiency is commonly used, future research may consider non-radial models such as the slack-based model (SBM) which does not rely on the assumption of proportional contraction in input factors. Lastly, there are previous studies that argued

for the existence of the optimal capital structure which is the best mix of debt and equity financing to maximize firm value. This raised the possibility that the relationship between leverage/liquidity and firm value is nonlinear. However, this study assumed the linear relationship for the Tobit regression analysis. This is because most of the ICT companies in Korea are innovative firms with a short history. High-tech companies that attempt innovation are difficult to estimate the risk level associated with investment, and often do not disclose financial information in detail, making it difficult to obtain bank loans or necessitating high-interest rates [74]. As a result, they have no choice but to raise funds by issuing shares. This happens more often to young companies [75] because they have lower credentials and less deep relationships with banks [76]. Thus, it was assumed that ICT companies in Korea have not yet attained the optimal capital structure and that the change in capital structure would increase or decrease the firm value in a single direction. Future research may conduct a regression assuming the curvilinear relationship between leverage/liquidity and firm value and compare the results.

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