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Relationship between Horizontal and Vertical Part Supplier Management to Stabilize Production and the Capital Structure of Tourism in Global Information Technology Companies

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Abstract

This analyzes the relationship between the debt ratio of parts suppliers and the strategic characteristics of the company in the overall SCM system to stabilize production from a financial perspective by dividing the company's production strategy into horizontal and vertical cases. The strategic alliance types and the vendor-specific types were used as substitute variables that represented horizontal and vertical structure, respectively. The difference between the actual and target debt ratio of global parts suppliers and their relationship with the strategic SCM characteristics of the company was analyzed using the generalized method of moments, which utilizes instrumental variable estimation method. This study found that the greater a company's horizontal integration of parts suppliers was, the lower a company's debt ratio was. Specifically, non-equity alliances, such as technology alliances and research and development alliances, have reduced debt ratios more than companies with equity alliances. Conversely, in the case of vertical structure, primary vendors had a lower debt ratio than secondary vendors. This is the first study to analyze the relationship between production strategy and the capital structure of parts suppliers of global IT companies. The comparison was conducted through an objective accounting data of which importance is increasing in horizontal and vertical SCM strategies to stabilize production.

Keywords: SCM strategy; Production management; Part supplier management; Sustainable partnership; Financial approach; The debt ratio; IT industry

Introduction

In the global supply chain management (SCM) of information and communications technology companies, the ratio of sales to purchases is increasing, which means that companies are increasingly reliant on supply chains while concentrating on a small number of core capabilities [1-3]. This phenomenon has recently shifted to an SCM-to-SCM competition rather than corporate-to-corporate competition [3-5].

In global information technology (IT) industry, Apple and Samsung Electronics are the two major global companies, and each choosing different SCM strategies to stabilize production while minimizing inventory and maintaining ongoing partnerships with suppliers [1]. For example, Apple is considering the lifecycle of its products and exhausting the inventory of its existing products by identifying the logistics thereof in real time before the next-generation products are released. Moreover, the parts (display) are secured for sufficient inventory using the economies of scale from the logistics to achieve a yield close to 70% on a production cost basis [6]. In addition, the company ensures a high customer value by means of a mixed supply chain strategy that combines a digital supply chain that provides digital content, such as music or applications, with a physical supply chain that manufactures a product and delivers it to a consumer. At the same time, Samsung Electronics has built the production systems to manage the entire cycle from parts assembly to finished product sales, reflecting its strong technology and long accumulated experience in SCM [7]. As presented, Apple and Samsung Electronics, have adopted different SCM strategies depending on the characteristics of their industries, products, and platforms.

On the other hand, Companies need to maintain ongoing partnerships with suppliers for long-term growth and stable production. The debt ratio of a company is an important piece of information for suppliers that require an ongoing relationship-specific investment (R-S investment). R-S investments refer to investments that are difficult to discontinue because of special relationships with parts suppliers that could result in a loss of value once the supplier goes out of business [8]. A prime example of an R-S investment can be found in the global SCM of Apple and Samsung Electronics. Based on this, this study presupposes that non-financial stakeholders such as the global parts suppliers of Apple and Samsung Electronics are factors that affect the company's capital raising decisions. In addition, this study divided the supply management structure of parts in the smartphone industry into two: Apple's horizontal SCM strategy of procuring parts through international strategic alliances (ISAs) and Samsung's vertical SCM strategy of procuring parts through a vertical integration with primary and secondary vendors. The target debt ratios of the parts suppliers of Apple and Samsung Electronics were calculated to analyze the impact of the two different strategies on debt ratios. This is the first study to analyze the relationship between parts suppliers who are non-financial stakeholders and capital structures. Adopting accounting data to provide reliable results regarding the impact of strategic alliances and vertical integration (vendors) on the debt ratio of parts suppliers, results provide useful insights for supply management strategy in global companies.

Literature Review

Part supplier Management of Global IT Companies

SCM plays an important role in maintaining smooth product flow from the raw materials to the finished product, and is a key source of competitiveness for companies. Studies on sustaining SCM have focused on the need for a cooperation model to establish a sustainable relationship, such as that between supply chain and partnership [3, 9,

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10]; that between supply chain and performance [5, 11, 12]; and the mutual relationship with suppliers, which is based on trust [13, 14].

Supply chain integration involves planning, executing, and evaluating successful relationships between suppliers who are upstream the chain and customers who are downstream the chain. Supplier integration concerns integrating suppliers in a strategic manner, which involves matters such as the involvement of suppliers during new product design, production planning and inventory management phases, the development of quick response order process systems with suppliers, the arrangement of a network of suppliers that guarantees reliable deliveries, and exchanging information with suppliers [5].

In global IT industry, Apple and Samsung Electronics have adopted different SCM strategies to stabilize production. Apple adheres to a horizontal production strategy that includes hardware, design, and content. This allows Apple to focus its core capabilities on high-value sectors, such as product design, marketing, and software, while its contactors handle parts and final assembly processes [15]. In other words, Apple maximizes synergy through a horizontal SCM focused on a single model that allows the company to provide customer value while guaranteeing large order volumes to parts suppliers.

Samsung Electronics, however, has chosen a vertical cost-driven production strategy that internalizes core parts, such as semiconductors, displays, batteries, and materials, and uses affiliates and suppliers of small- and medium-sized parts for raw materials, parts, and finished products [7]. This increases the company's raw material purchasing power and cost competitiveness while minimizing the product development period so that the company can respond quickly to market changes [1]. In this manner, Samsung Electronics has launched a variety of derivative models, from high- to low-end models, to increase its share in the market and offer consumers more choice with various products that are similar to flagship products at lower prices. In other words, Samsung Electronics maintains a high level of manufacturing competitiveness through a vertical production structure that is focused on efficiency.

Moreover, Samsung Electronics is maximizing efficiency through increased productivity and cost saving by building a one-day SCM decision system that reduces production time by expanding modularity. For example, the company has built a system that receives products from its parts suppliers, carriers, and distributors every 30 minutes to one hour. In addition, core components, such as android processors and camera modules, are generalized for use in multiple models, thereby reducing inventory burden (Samsung Business Report 2019).

Owing to the structural nature of the smartphone parts industry, SCM achieves corporate value through inter-company cooperation in the process; consequently, collaboration between companies is important. Such collaboration allows companies to build sustainable partnerships. For parts suppliers, SCM is an important factor in maintaining ongoing trading relationships. Therefore, continuous SCM between companies can be sustained through mutual cooperation. To secure mutual benefits between suppliers and buyers in the smartphone parts industry and maintain a continuous trading relationship, a sustainable SCM model that ensures stable parts supply and mass production shall be presented.

Financial Approach for Sustainable Relationship

To survive the intense competition, companies analyze different environments and implement appropriate funding policies. Although the factors that affect the capital structure of a company such as bankruptcy costs [16], non-debt tax shields [17], information asymmetry [18, 19], market timing [20, 21], target debt ratio [22], agent issues, industrial leverage [20], and debt capacity [23] have been demonstrated through numerous studies. Recent research on capital structure [24] has been conducted and analyzed by expanding its scope to include non-financial stakeholders such as parts suppliers and product purchasers.

For long-term growth and development in the global market, companies need to accurately communicate financial and non-financial information to their stakeholders [2]. However, although companies provide financial information to various stakeholders to meet the stakeholders' information needs, they have not been able to provide useful non-financial information. Prior study on capital structure show that there is an increasing need to expand the concept of stakeholders from financial stakeholders (shareholders, creditors, executives, governments, etc.) to non-financial stakeholders such as parts suppliers, product purchasers, and workers for the analysis thereof [24].

On the other hand, Kale and Shahrur (2007) identified that the higher the research and development (R&D) intensity of suppliers is and the more strategic alliances a company in the United States (US) has, the lower a company's debt ratio is [25]. The low debt ratio can be interpreted as a signal to maintain the continued R-S investment of suppliers. However, there is a gap of research on the relationship between production management and the capital structure. Global IT companies that need reliable production and supply chains are adopting global SCM (GSCM) strategies to maintain ongoing cooperation with parts suppliers and are choosing horizontal and vertical SCM strategies to stabilize production based on the characteristics of their products and platforms. Therefore, this study analyzes the relationship between debt ratios and the corporate characteristics of parts suppliers by dividing production structures of companies into horizontal and vertical cases. For an empirical analysis, this study used the strength of ISAs and vendor-specific types as substitute variables that represent the horizontal and the vertical part supplier management strategies, respectively.

Methodology

Data Collection

Data were collected based on the company's annual reports and global supplier lists. For Apple, data from 2007 to 2018 (i.e., since the release of iPhone in 2007) were collected; for Samsung Electronics, data from 2010 to 2018 (i.e., since the release of Galaxy S in 2010) were collected. The collection of data on the vertical integration of Apple's GSCM's ISAs and Samsung Electronics' GSCM was conducted as follows.

Among the financial data required for this study, financial data from the US, Europe, Taiwan, and Japan were extracted from OSIRIS DB (www.bvdinfo.com), and financial data for Korean companies were collected from KISVALUE (www.kisvalue.com) and FnGuide (www.fnguide.com). Apple's ISAs were divided into non-equity alliances, such as licensing, technology alliances, and R&D alliances, and equity alliances, such as equity investment and joint ventures (Todeva and Knoke, 2005). In addition, the scope was limited to listed companies only among the companies that had established an ISA

with Apple between 2006 and 2018.

Further, the data in this study were collected on the following bases to minimize any biases that may occur in existing studies using accounting variables.

1) The sources of Apple's ISA-related articles were reconfirmed via the company's webpage if the data existed through search and verification processes on Google.

2) Various keywords (technology alliances, R&D alliances, joint ventures, equity investments, etc.) were combined according to the type of strategic alliance.

3) Letters of intent, memoranda of agreement, and memoranda of understanding were excluded.

4) The company's mergers and acquisitions, business name changes, divisions, and changes to the stock listing code were excluded if they overlapped with the timing of strategic partnerships.

5) The sources of articles related to Samsung Electronics' suppliers were reconfirmed via the company's webpage.

The final samples selected by these criteria by region are shown in Table 1. Apple's part suppliers are distributed in the order of US, Taiwan, Japan, Europe, and South Korea. Except for South Korea and Europe, suppliers are distributed evenly in various regions. Further, the types of strategic alliances in Apple's supply chain, the statistics by strategic alliance type include technological alliances (35.9%), R&D alliances (31.7%), joint ventures (24.6%), and equity investments (10.1%). On the other hand, Samsung Electronics' part suppliers are concentrated in South Korea, which accounts for more than 70% of them, followed by Japan, US, Taiwan, and Europe. In vertical production structure, the vendor-specific types include primary vendors (73.6%) and secondary vendors (26.4%) (Table 1).

Methodology

In recent studies related to ISAs and vertical integration, accounting-based measurement variables reportedly increase the validity of empirical variables [26]. This study analyzed the relationship between the target debt ratio and the corporate characteristics of Apple and Samsung Electronics' global suppliers. Moreover, to analyze the effect of the difference between the actual and target debt ratio of global suppliers on the selection of capital structure, models were established as shown in Equations (1) and (2).

Specifically, by using coefficient values that were estimated through a regression analysis of the independent variables, the estimated target debt ratio could be calculated. In addition, corporate characteristic variables including profitability, market-to-book (MB) ratio, tangible assets, and corporate size were used as determinant factors for the capital structure [27-29].

To maintain a continuous R-S investment, buyers and parts suppliers can choose horizontal and vertical SCM strategies. The strength of the strategic partnership and the strength of the vertical integration were used as substitute variables to represent a horizontal SCM and a vertical SCM, respectively.

In the horizontal SCM, parts suppliers need to keep their debt ratios low because the more they continue to invest in R-S investment, the higher the cost of R&D expenditures becomes. The low debt ratio of the parts supplier can then be interpreted as a signal sent by the supplier to continue the R-S investment. This means that the company's debt ratio can be used to maintain bargaining power for the parts supplier. For a substitute variable to measure the R-S investment of parts suppliers, the strength of the strategic partnership was used for the horizontal SCM, while the strength of the vertical integration was used for the vertical SCM. The debt ratio of the parts supplier and the horizontal SCM has a great relevance. Namely, if the R-S investment between the buyer and the supplier is high, the strength of the strategic alliance is high [30]. By contrast, the debt ratio of the parts supplier and a vertical SCM has a minimal relevance. To identify the degree of vertical SCM, we established dummy variables where a value of 1 was given if the company had at least one sub-parts supplier (primary, secondary, tertiary vendors, etc.) and 0 if the company had none.

The dependent variables of the empirical analysis model of this study were measured in two ways: the book debt ratio and the market debt ratio. The book debt ratio is the total debt divided by the total assets in the financial statements; the market debt ratio is the total debt divided by the sum of the market value of the capital and the total liabilities. The main independent variables that affected the debt ratio of companies herein were the strategic partnership's strength (horizontal SCM) and the vertical integration's strength (vertical SCM) of the parts supplier. Moreover, this study included several control variables that affected the debt ratio in the analysis model. First, the R&D intensity of individual companies was used as a control variable to describe the debt ratio because the higher it is, the more

Table 1: Summary of Strategic Alliances and Vendors Samples.

Apple's Global supplier					
Region	**Frequency**	**Percent**	**Alliance Type**		**Frequency**	**Percent**
U.S.	380	28.7	Equity	Equity investment	133	10.2
Europe	156	11.8		Joint ventures	257	19.4
Japan	329	24.9		Cross shareholding	12	0.9
Taiwan	335	25.3	Non-equity	R&D alliances	432	32.7
Korea	123	9.3		Technology alliances	489	37.1
Total	1323	100	Total		1323	100
Samsung's Global supplier					
Region	**Frequency**	**Percent**	**Vendor Types**		**Frequency**	**Percent**
U.S.	62	8.3	Primary vendor		552	73.6
Europe	33	4.4				
Japan	71	9.5				
Taiwan	46	6.1	Secondary vendor		198	26.4
Korea	538	71.7				
Total	750	100	Total		750	100

the debt ratio decreases. Further, the R&D intensity was measured by dividing the R&D cost by total assets. Second, the larger the size of the company is, the higher the debt ratio is. The size was measured by taking the log of the total assets. Third, the higher the profitability is, the greater the internal finance ratio is and the lower the debt ratio is. Profitability was measured by dividing the EBIT by total assets. Fourth, the higher the growth is, the more the financing increases, which, in turn, increases the debt ratio. However, if the growth is high, there are many investment opportunities, and companies reduce debt ratios to reduce agent problems. Growth was measured by dividing the market value by the book value. Fifth, earnings volatility is a factor that affects the interest payment capacity of the company. The higher the earnings volatility is, the lower the debt ratio is. At the same time, a high earnings volatility reduces agent issues and lowers the debt ratio. The earnings volatility was measured by the standard difference of the return on assets (ROA).

Equation (3) is a panel model that describes the relationship between the horizontal SCM-centric parts supplier and the capital structure, while Equation (4) is a panel model that describes the relationship between the vertical SCM-centric parts supplier and the capital structure. The debt ratio representing the capital structure of the two models was measured separately by measuring the book value and the market value.

The panel model verifies the suitability of the model as follows depending on whether the constant term is a cross-section or a time series along with the structure of the error term. First, an analysis was conducted to identify whether there is an individual effect (η_i, λ_t) against the null hypothesis ($H_0: \sigma^2 \eta = \sigma^2 \lambda = 0$) via the Lagrange multiplier method. When the null hypothesis is dismissed, it means that an individual effect is present. Therefore, an efficient estimate cannot be obtained by using the ordinary least squares method. Next, with the Housman test, we hypothesized a probability effect model that assumes a fixed effects model and probability variable based on the null hypothesis ($H_0: E (\eta_i = 0|X_{i,t}) = 0$) that there is no correlation between the corporate effect and independent variables. When the null hypothesis is dismissed, the probability effect estimate will have a mismatch, which will lead us to the fixed effect model.

Because the independent variables used as the lagged variables and the error term of the dependent variables have a correlation, the fixed effects model uses a generalized method of moments (GMM) and an instrumental variable estimation method to solve this endogeneity issue. Therefore, this study analyzed the relationship between the capital structure (debt ratio) and the horizontal SCM (strategic alliance) and vertical SCM (vertical integration) of the parts suppliers using a GMM.

Results of the Empirical Analysis

Estimation of the Target Debt Ratio

The target debt ratio is determined by the trade-off relationship between the cost and benefit from issuing a debt. This section analyzes target debt ratio of the global prat suppliers. Table 2 is a result of estimating the target debt ratio of the global suppliers of Apple and Samsung Electronics. First, the profitability ratio ($EBIT_{i,t-1}$) showed a negative correlation with the target debt ratio, which is consistent with existing studies in that a high profitability of a company increases reserve funds and that the debt ratio will decrease because the use of internal funds is uncomplicated [31]. Second, the MB ratio ($MB_{i,t-1}$) showed a negative correlation with the target debt ratio, which also

confirms the claims of prior studies that companies will want to keep the debt ratio low because the increased debt of a company increases as the cost of bankruptcy while decreasing the future growth [20]. Third, the corporate size ($SIZE_{i,t-1}$) had a positive correlation with the target debt ratio, which confirms the findings of existing research in that the larger the corporate size is, the less likely the company is to go bankrupt, which, in turn, increases a debt capacity [31].

The target debt ratio was obtained by deducting the value of 1 from the coefficient of the independent variable ($LEV_{i,t-1}$), which is the lagged variable of the dependent variable. The target debt ratio of Apple's parts supplier (1–0.62) was 38%, which was slightly higher than that of US companies (33%), whereas that of Samsung Electronics' parts suppliers (1–0.28) stood at 72%, which was lower than that of Korean companies around 80% [28] (Table 2).

Vertical and Horizontal Integration Strength and Capital Structure

In order to analyze the relationship between integration strength and capital structure, this section compares the difference of dynamic relationship on long-term aspect between the vertical and horizontal structures.

At first, through a panel analysis, this study analyzes the dynamic relationship on long-term aspect between the debt ratio and the strength of integration in terms of horizontal structure. Table 3 shows the result of analyzing the relationship between the debt ratio and the strength of the strategic alliances of Apple's global suppliers. Both the book value ratio and the market value ratio showed a negative (−) value that was significant at the 1% level of the strategic partnership strength ($HSCM_{i,t}$) of the parts supplier. Apple's parts suppliers with non-equity alliances, such as technology alliances and R&D alliances, have reduced debt ratios more than companies with equity alliances, such as equity investments and joint ventures, have. In addition, the market value ratio has greater t values and R-squares than the book value ratio. This means that the negative relationship between the debt ratio and the strength of strategic alliance of the parts supplier is stronger when calculating the debt ratio with the market value instead of the book value (Table 3).

The R&D ratio ($RND_{i,t}$) was found to have a statistically significant negative value for both the market debt ratio and the book debt ratio.

Table 2: Estimated Target Debt Ratio for Apple and Samsung Electronics' Global Supply Chain.

Test	Debt Ratio of Apple's Parts Suppliers	Debt Ratio of Samsung Electronics' Parts Suppliers
$Intercept$	0.032 (0.56)	−0.008 (−0.38)
$EBIT_{i,t-1}$	−0.372*** (-4.71)	−0.245*** (−3.63)
$MB_{i,t-1}$	−0.092 (−3.64)***	−0.058 (−3.24)***
$TANG_{i,t-1}$	0.035 (1.31)	0.015 (1.12)
$SIZE_{i,t-1}$	0.028 (3.87)***	0.019 (3.15)***
$DEP_{i,t-1}$	−0.932 (−1.17)	−0.513 (−1.03)
$LEV_{i,t-1}$	0.642 (5.21)***	0.283 (4.11)***
N	1323	750
***p < 0.001 (two-tailed)		

Table 3: Analysis of the Relationship between Debt Ratio and the Strategic Alliance Strength.

Test	Book Debt Ratio	Market Debt Ratio
$Intercept$	−0.263 (−1.98)**	−0.361 (−2.13)**
$HSCM_{i,t}$	−1.258 (−5.62)***	−1.362 (−6.12)***
$RND_{i,t}$	−0.983 (−4.52)***	−0.847 (−5.65)***
$SIZE_{i,t}$	0.312 (3.74)***	0.541 (4.89)***
$ROA_{i,t}$	−0.687 (−1.37)	−0.578 (−1.42)
$RISK_{i,t}$	1.531 (4.87)***	0.874 (3.89)***
$GROWTH_{i,t}$	−0.086 (−6.47)***	−0.017 (−8.42)***
R^2	0.261	0.293
$F-Value$	23.14***	29.32***
N	1323	1323
**p < 0.01, ***p < 0.001 (two-tailed)		

Table 4: Relationship between Debt Ratio and the Vertical Integration Strength.

Test	Book Debt Ratio	Market Debt Ratio
$Intercept$	−0.129 (−0.92)	−0.138 (−1.45)
$VSCM_{i,t}$	−1.065 (−4.63)***	−1.135 (−5.85)***
$RND_{i,t}$	−0.593 (−2.45)**	−0.426 (−2.32)**
$SIZE_{i,t}$	0.175 (3.12)***	0.283 (4.09)***
$ROA_{i,t}$	−0.382 (−1.25)	−0.298 (−1.13)
$RISK_{i,t}$	1.279 (5.12)***	0.835 (4.23)***
$GROWTH_{i,t}$	−0.037 (−5.83)***	−0.013 (−7.52)***
R^2	0.212	0.272
$F-Value$	17.25***	21.38***
N	750	750
**p < 0.01, ***p < 0.001 (two-tailed)		

An increase in R&D costs means an increase in intangible asset ratios. This concurs with the claims of existing studies that the debt ratio should be kept low because an increase in intangible assets makes it difficult for investors to valuate assets and increases financial distress [20].

Corporate size ($SIZE_{i,t}$) showed that both the market debt ratio and the book debt ratio have a statistically significant positive value at the 1% significance level. This is more or less in accordance with the existing analysis that larger companies are less likely to go bankrupt and have a greater debt capacity [32].

Earnings volatility ($RISK_{i,t}$) was found to have a statistically significant positive value for both the book and market debt ratios. This can be interpreted as per the claim that a higher earnings volatility increases debts and reduces agent issues for management [33].

Growth ($GROWTH_{i,t}$) was statistically significant at the 1% significance level with positive values for both the market and book debt ratios. This is inconsistent with the existing research results, which indicate that companies with a higher growth potential have more investment opportunities and are more likely to reduce debts to avoid agent issues [34].

On the other hand, to analyze the dynamic relationship on long-term aspect between the debt ratio and the strength of integration in terms of vertical structure, this study analyzes the relationship between the debt ratio and the strength of vertical integration. Table 4. presents the results of the relationship between the debt ratio and the strength of vertical integration of Samsung Electronics' global parts suppliers. Both the market and book debt ratios showed a significant negative (−) value in the vertical integration strength ($VSCM_{i,t}$) of the parts supplier at the 1% level. This means that, in the case of Samsung Electronics' parts suppliers, primary vendors had a lower debt ratio than secondary vendors. Moreover, in the relationship between the vertical integration of parts suppliers and the debt ratio, the market debt ratio had a higher positive value for the vertical integration strength coefficient and a bigger R-square than the book debt ratio (Table 4).

The R&D ratio ($RND_{i,t}$) was found to have a statistically significant

negative (−) value for both the market and book debt ratios. An increase in R&D costs means an increase in intangible asset ratios, which makes it difficult for external investors to evaluate the value of assets and also increases financial risks. For this reason, it can also be interpreted to mean that Samsung Electronics is maintaining a low debt ratio.

Corporate size ($SIZE_{i,t}$) showed that both the market value and book value were statistically significant at a 1% significance level for both the debt ratio. This is consistent with previous studies, which found that larger companies are less likely to go bankrupt and have a greater debt capacity.

Earnings volatility ($RISK_{i,t}$) was found to have a statistically significant positive value for both the book and market debt ratios. Growth ($GROWTH_{i,t}$) showed a positive value for the market debt ratio and a negative value for the book debt ratio. Both were statistically significant at the 1% level.

The analysis of the above results reveals that companies in horizontal production structure with a greater strength of strategic alliance (technological alliances and R&D alliances) tend to adopt a lower debt ratio policy, while companies in vertical production structure with a greater strength of vertical integration (primary vendor) also tend to adopt a lower debt ratio policy.

Robustness Test

This study conducted a robustness test for the results of the analysis of the relationship between the debt ratio and the strategic partnership strength of parts suppliers as well as the relationship between the debt ratio and the vertical integration strength. The results are shown in Table 5.

Table 5 compares the relationship between the debt ratio and the strategic partnership strength of parts suppliers as well as the relationship between the debt ratio and the vertical integration strength through the fixed effects panel model and the analysis results of the GMM model. The fixed effects panel model used in this study may hinder the reliability of the results of the empirical analysis if there is an endogeneity wherein independent variables can be affected by dependent variables because such an issue cannot be solved. This issue arises because the explanatory variable, which is used as the

Table 5: Robustness Test.

Test	Market debt ratio and the strength of the strategic alliance		Market debt ratio and the strength of the vertical integration	
	Fixed Effects Panel Model	GMM Model	Fixed Effects Panel Model	GMM Model
$Intercept$	−0.361 (−2.13)**	−0.752 (−3.13)***	−0.138 (−1.45)	−0.138 (−1.45)
$HSCM_{i,t}$	−1.362 (−6.12)***	−1.157 (−5.39)***		
$VSCM_{i,t}$			−1.135 (−5.85)***	−1.024 (−4.27)***
$RND_{i,t}$	−0.847 (−5.65)***	−0.623 (−4.17)***	−0.426 (−2.32)**	−0.273 (−1.98)**
$SIZE_{i,t}$	0.541 (4.89)***	0.783 (5.67)***	0.283 (4.09)***	0.527 (6.32)***
$ROA_{i,t}$	−0.578 (−1.42)	−0.322 (−1.12)	−0.298 (−1.13)	−0.213 (−1.03)
$RISK_{i,t}$	0.874 (3.89)***	0.362 (2.19)**	0.835 (4.23)***	0.473 (2.13)**
$GROWTH_{i,t}$	−0.017 (−8.42)***	0.086 (−9.22)***	−0.013 (−7.52)***	−0.075 (−8.28)***
N	1323	1323	750	750

**p < 0.01, ***p < 0.001 (two-tailed)

lagged variable of the dependent variable, has a correlation with the error term in the fixed effects panel model. To solve these endogenic issues with explanatory variables, we used the GMM suggested by Arellano and Bond (1991) as an analysis method using instrumental variable estimation. Using this GMM, we re-analyzed the relationship between the market debt ratio and the strength of R&D of parts suppliers as well as the relationship between the market debt ratio and the strength of R&D of parts suppliers.

The analysis results of Table 5 show that both the strength of the strategic alliance and the strength of vertical integration of parts suppliers have a statistically significant negative relationship. This means that the empirical analysis of this study is robust enough to confirm that parts suppliers who have a greater strategic alliance strength and vertical integration strength are likely to have a low debt ratio despite the endogeneity issue.

Conclusion

Apple is maximizing the synergy effect through a horizontal SCM focused on a single model that allows them to provide customer value while guaranteeing large order volumes to parts suppliers. Samsung Electronics, by contrast, has been maintaining a high manufacturing competitiveness with a cost-driven vertical SCM strategy that internalizes core parts, such as semiconductors, displays, batteries, and materials, and uses affiliates and small- and medium-sized parts suppliers for raw materials, parts, and finished products. This study examined the impact of Apple's strategic alliances with parts suppliers (horizontal structure) and Samsung's vertical integration with parts suppliers (vertical structure) on debt ratios. After extracting variables through a literature review and setting appropriate data collection targets for the empirical analysis, data on the ISAs and vertical integration were collected. In addition, this study calculated the target debt ratios of the parts suppliers of Apple's horizontal supply chain and Samsung Electronics' vertical supply chain and analyzed the relationship between the debt ratio and the capital structure. The results are as follows.

First, the target debt ratio of Apple's parts suppliers was 38%, which was slightly higher than that of US companies (33%). Moreover, the target debt ratio of Samsung Electronics' parts suppliers was 72%, which was lower compared to approximately 80% of Korean companies.

Second, in the relationship between capital structure and SCM, the company's debt ratio decreases if the strength of the strategic alliance and the strength of the horizontal integration of global parts suppliers are higher. Specifically, Apple's parts suppliers with non-equity alliances, such as technological and R&D alliances, have reduced debt ratios more than companies with equity alliances. In the case of Samsung Electronics' parts suppliers, primary vendors had a lower debt ratio than secondary vendors. This analysis means that if the strength of the vertical integration with the ISAs of GSCM companies is greater, they are more likely to adopt a lower debt ratio policy.

This study has the following implications. To begin with, it analyzed the relationship between parts suppliers and capital structures. Parts suppliers are non-financial stakeholders that have not yet been covered in capital structure-related studies. In the present study, we used objective accounting data, the importance of which is increasing in the systems of horizontal structure (strategic alliance) and vertical structure (vertical integration). Second, the study presented reliable results on the impact of vertical integration with ISA on the debt ratio of parts suppliers.

However, this study has the following limitations. First, rather than merely dividing ISAs into equity and non-equity alliances, an analysis of ISAs can be conducted that uses a more detailed classification of the different types of alliances. Second, Apple is enjoying the benefits of networking by implementing a horizontal SCM system with an open ecosystem, thereby leading the platform economy of the new industrial paradigm. To keep this going, further research is required regarding continued growth and development that considers vertical depth rather than the competition of horizontal expansion. Third, Samsung's vertical structure, which involves vertical integration, is limited in that new technologies and added values have to be developed internally and there are risks of technology leaks. To solve this problem, it is necessary to move away from vertical depth and toward horizontal expansion. Finally, Taiwan Semiconductor Manufacturing Company, Limited, a Taiwanese company and Apple's leading parts supplier, maintains the capital adequacy ratio

of more than 70% through its strategic alliance with Apple. This has accelerated facility investment after the financial crisis, resulting in a 14-times increase in net profit in 2019 compared to 20 years ago. Conversely, Samsung Electro-Mechanics, a leading parts supplier of Samsung Electronics, has maintained a low debt ratio and a high capital adequacy ratio, thereby increasing the profit growth. Thus, further research is required for an efficient SCM strategy to identify the role of financial buffers that promote facility investment and R&D by lowering debt ratios and increasing profits.

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