Does the supply chain matter in the ownership structure? Evidence from Korean business groups*

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Current Version: May 22, 2020

Abstract

This study investigates how the supply chain may affect inter-corporate ownership structure among member firms within the business group. Previous literature suggests that profitable firms are located at the top of the pyramidal structure directly owned by the controlling shareholders. However, profitability may be endogenously determined based on related party transactions. Specifically, suppliers within the business group may generate higher profits through exclusive sales contracts with member firms. Based on a sample of large business groups in Korea, I find that suppliers are more likely to be located in the upper part of the pyramid. This suggests that controlling shareholders' incentive to expropriate corporate opportunity may be an important factor in structuring business groups.

JEL classification: L22, L23, G32, G34

Keywords: supply chain, ownership structure, pyramid, business groups

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1. Introduction

Significant cross-sectional variations in ownership structures have been revealed through many studies in corporate finance around the world. According to Kim (2013), in countries other than the United States and the United Kingdom, the ownership structure of a business group is widespread worldwide, where the business group represents the form in which firms belong to the group and their equity structure is intertwined. The way in which a firm is owned and controlled is a central variable of interest in financial research both as an independent and a dependent variable. Ownership structure affects corporate performance, and economic development, which, in turn, are influenced by the socioeconomic, legal, and financial market environment.

There are various views of how the ownership structure is formed. In the early stages of research, most of studies focus on the impact of ownership structure on corporate performance or decision-making (Bertrand et al., 2002; Claessens et al., 2002; Joh, 2003). On the other hand, a literature has emerged in which the ownership structure is regarded as endogenous (Almeida et al., 2011; Masulis et al., 2011). They argue that the ownership structure is selected by the controlling shareholders for several reasons. In particular, Almeida *et al.* (2011) suggests the *selection hypothesis* to explain the formation of business groups. It hypothesizes that profitable firms are selected to be owned directly by controlling shareholders (the upper part of the pyramid) but firms with low profitability are selected to be owned through affiliates in the business group (lower part of the pyramid) rather than directly.

My paper argues that this selection hypothesis may overlook something important. The high profitability of the companies at the top of the pyramid may be endogenously determined based on the business model or strategy such as related party transaction. It is possible that the firm's profitability may not be fundamentally high but it may appear high. In other words, the

firm's high profitability may be not because of its superior operational capabilities, but because of the supply chain, specifically as an exclusive supplier within its business group. Suppliers within the business group may generate higher profits through exclusive sales contracts with member firms. The firm at the top in the pyramid may not be able to generate profitability unless it is a monopoly supplier to affiliates in the group.

Thus, I present a new industrial organizational approach, that is, the *supply chain* within the business group to investigate whether the supply chain has an important role in the ownership structure. According to my results, the controlling shareholder places the *supplier* higher on the pyramid than the *customer*. This indicates that high profitability may be induced by a position where profits are concentrated in the structure of the supply chain. Therefore, it also implies that the ownership structure can be formed as an incentive of expropriating corporate opportunity.

To test the above hypothesis empirically, I use Korean large-scale business group data. Korean Fair Trade Commission (KFTC) publicly announces the detailed transaction and ownership data of all affiliated firms (public and private) in the large business group. Using this novel data from 2009 to 2016, I construct variables for the supply chain and a position in the pyramid structure. First, the supply chain is identified through the transaction matrix between affiliates in a business group. Using this transaction dataset, for each firm in the business group, I construct variables that are the ratio of sales and purchases between affiliates to its own total revenue respectively. According to a certain threshold in these variables, I assign the *supplier* or *customer* to firms within the business group. Second, according to the methodology of Almeida *et al.* (2011), I calculate a *position* in the pyramid, a particular type of ownership structure in a business group, that measures the distance between the controlling shareholder and its affiliates. In other words, *position* is a variable that quantifies where the

firm is located within the pyramid.

I first conduct the univariate analysis to show the statistical difference between the *supplier* and the *customer* overall. The supplier shows higher ultimate ownership and lower value of the position than the customer. Since a firm with a small position value means that it is close to controlling shareholders, on average, it implies that the supplier is owned more directly by controlling shareholders than the customer in the business group.

I next investigate how the supply chain is associated with the ownership structure. I find the evidence that controlling shareholders tend to place the supplier above the customer in the pyramid. This finding implies that the high profitability of firms at the top of the pyramid is endogenous, and the key is the supply chain because the suppliers can generate high profits through exclusive sales contracts with member firms. However, since there is a possibility that cross-sectional compounders or omitted variable concern may exist, I conduct an additional analysis to address the endogeneity problem. I identify the firm that switches to a supplier in the full sample to investigate how the firm that changes its status in supply chain affects position changes. The firm that switches to a supplier has a statistically significant impact on decrease in position, but not increase in position.

Moreover, I conduct an additional analysis from an industrial point of view. Since *supplier* and *customer* are concepts defined within a business group in this paper, it may not exactly match the supply chain at the entire industry level. For example, *customer* may deliver intermediate goods to other industries, which is called B to B (business to business) even though it is defined as a customer in business group. Using the intermediate demand rate which is the ratio of the amount purchased by intermediate to the total industrial production, I construct *industry supplier* to show how a firm that is defined as a customer in a group, but more likely to be a supplier at an industry level, has a different impact on its position. The

results show that *customer* within the business group is located at the bottom of the pyramid compared to the *supplier*, but the magnitude is weakened as the ratio of production of intermediate goods increases at the industrial level. Thus, it supports the fact that suppliers are chosen to be at the upper pyramid and the ownership structure is likely to be formed as an incentive of the expropriating corporate opportunity.

I believe that this paper contributes to two strands of literature: supply chain and ownership structure. This paper provides a new explanation for the overlooked point of the ownership structure in the previous literature. I try to explain the ownership structure using supply chain, which was previously studied in the operations management field. More recently, research about supply chain or supplier and customer relationship has spurred in finance. While studies related to asset pricing or financial decision are active, the link between ownership structure and supply chain has not been analyzed. Thus, I shed light on this undiscovered link connecting ownership structure with industrial organization literature in this paper.

This paper is organized as follows. Section 2 discusses the hypothesis development and background. Section 3 describes the data and explains the various measures used in this study. Section 4 presents our main findings and discusses additional robustness tests providing the research design. I conclude in Section 5.

2. Hypothesis development and background

2.1. The formation of ownership structure in business group

In this literature, previous studies focus on the consequences of a company's ownership structure. The mainstream research links the ownership structure with corporate financial performance. The papers in the early stage use the concept of cash-flow right, control right, or

wedge which indicates the difference between control rights and cash-flow rights as a proxy for ownership structure and claim that those affect the performance and valuation of group member firms. Bertrand *et al.* (2002) argues that a firm with high cash flow right shows a higher firm value than that with lower cash flow right. This is because the firm value increases by shifting its resources from the firm with a low cash flow right to the firm with a high cash flow right. Claessens *et al.* (2002) insists that aside from cash flow right, the difference between control right and cash flow right, wedge, should be considered. In their results, there is a negative relationship between wedge and firm value. Likewise, Joh (2003) shows the negative relationship between wedge and profitability in Korea.

Subsequent studies begin to focus on how the ownership structure is determined. Almeida *et al.* (2011) argues that the ownership structure is not an exogenous one, as assumed in previous studies, but it reflects the intention of the controlling shareholders who establish the structure on some basis. In other words, controlling shareholders actively build the pyramid according to various firm characteristics, and the key factor which they suggest is profitability. The pyramid structure is formed by placing low profitable firms below and high profitable firms above in the pyramid. Low profitability indicates a smaller amount of pledgeable income, suggesting that raising external capital may be difficult. Thus, the controlling shareholder seeks to use the internal capital of other group members to finance investment in newly added firm to the business group. With this mechanism, the controlling shareholder wants to take advantage of the internal funds of other affiliates by owning the less profitable firm through their affiliates instead of directly owning it. In contrast, a highly profitable firm may use its own internal capital and it is relatively easy to finance externally using its collateral income just in case. This investment motive hypothesis is more investigated in Masulis *et al.* (2011). Using more extensive data than Almeida *et al.* (2011), they propose the benefits of internal

funding within the pyramid, arguing that the pyramid is an effective structure in maintaining control and easing funding constraints.

This is the flow of the development of existing hypotheses, and I present a new explanation in this paper. Including the supplier and customer relationship from an industrial organization point of view gives rise to an interesting finding. Rather than simply high and low profitability, the ownership structure may be affected by the supply chain within the business group. The supplier within the group generates revenue by delivering raw or intermediate goods to their affiliates. It has solid customers and does not need to promote to get business opportunities. Therefore, the decision about how to take corporate opportunity rather than the profitability channel presented previously, also affects the ownership structure. In other words, the ownership structure can be formed as an incentive of expropriating corporate opportunity. The main hypothesis presented in this paper is as follows.

Hypothesis: The controlling shareholder places the *supplier* above the pyramid rather than the *customer*.

I would like to raise the possibility that Almeida *et al.* (2011)'s finding may overlook something important. According to their story, the firm with the high profitability is at the top of the pyramid and the lower one is at the bottom. However, in fact, the firm's profitability may not be fundamentally high but it may appear high. The firm's high profitability is not because of its superior operational capabilities, but because it is an exclusive supplier within its business group. In other words, the firm at the top in pyramid may not be able to generate profitability unless it is a monopoly supplier to affiliates in the group. Sales generated within the business group may result in high profitability.

In addition, they propose profitability variable as a proxy for collateral, but crucially, the analysis of stock measure of pledgeability does not show any clear results. They argue that

the formation of pyramid structures is not intended for tunneling, but the controlling shareholder selects it. However, I propose that it is a selection for tunneling, and the controlling shareholders choose to place the supplier at the top of the pyramid to enjoy high profitability by monopolizing their affiliates through exclusive sale contracts within the business group. Therefore, Almeida *et al.* (2011)'s results can be driven by the tunneling outcomes and the industrial organization-based channel, the supply chain, which is more important in explaining the ownership structure in the business group.

2.2. Vertical integration and supply chain

In all manufacturing industries, one of the important corporate decisions that must be made at the time of operation is 'make or buy'. When a company makes and sells a product, the manager decides whether to make intermediary goods or purchase them from the outside. To be specific, the company may (1) establish a factory to operate the production department internally (manufacturing department or assembly division), (2) have contracts with subcontractors, and (3) set up an affiliated firm in charge of production and purchase intermediates from the affiliate. The case (1) stands for 'make', case (2) means 'buy' and case (3) is a type of 'buy' but not from outside, but from other affiliates in the business group, which is commonly referred to as vertical integration. Cases (1) and (2) are not discussed because they deviate from the content of this paper.

In Case (2), however, various issues can be discussed which are addressed in Kim *et al.* (2020). From the controlling shareholders' perspectives, the supplier from outside (Case 2) and supplier within the business group (Case 3) is different. For transactions with a subcontractor, such as Case (2), formal equity ownership issue is not intertwined, but according to Kim *et al.* (2020), the customer exploits the subcontractor exercising their control beyond

the ownership. In contrast, if purchased from affiliates within the group, such as Case (3), both supplier and customer are rely on the ownership of the controlling shareholders so agency problem may exist. My paper deals with case (3) of creating an affiliated firm in charge of producing intermediate or final goods and constructing a vertically integrated structure. For example, comparing Samsung Electronics with Apple, Apple outsources display panels, batteries, and mobile processors, while Samsung Electronics is supplied by affiliates such as display panel from Samsung Display, batteries from Samsung SDI, and mobile processors from division in Samsung Electronics. There is a big difference in the sourcing policy of the two companies. Apple was the first company to make an iPhone, the world's first booming smartphone, but Samsung has the edge in terms of manufacturing competitiveness. Samsung is rapidly pursuing Apple's iPhone, and some indicators, such as sales, have already outpaced Apple.

As the example of Samsung Electronics and Apple shows, vertical integration is one of the competitive strategies that gives a firm control over one or more stages in the production networks from top to bottom. In other words, a firm owns both the value chains between its upstream supplier and downstream buyers in vertically integrated structure. With this structure, a firm can achieve the competitive advantage through price differentiation or non-price differentiation. The vertical integration makes it easier to secure confidentiality related to trade secrets, priorities in production and sales, and internally accumulate relevant know-how compared to non-vertically integrated groups. In addition, firms can reduce transaction cost, enabling efficient business processing.

There are types of vertical integration strategies. For example, an automobile company creates (or acquires) firm A that produces auto parts (backward integration), firm B that handles the logistics of completed cars, and firm C that is in charge of sales and after-sales services for

cars (forward integration). One of the representative examples of backward integration is that GM acquired Fisher Body, a company that makes automobile bodies in order to solve the hold-up problem. However, there is a difference between the U.S. and Korea in this vertical integration. In the example of GM and Fisher Body in the United States, when GM acquired Fisher Body and vertically integrated, GM obtained 60 percent of Fisher Body in 1919 and bought the remaining 40 percent of Fisher Body in 1926. Since Fisher Body was incorporated into the GM Assembly Division in 1984, it no longer exists as a GM division. As such, in the US, it is common to own 100% of subsidiaries not only in vertical integration but also in general M&A cases, whereas in Korea, the parent company rarely takes 100% of its affiliates, which causes various agency problems. For instance, Hyundai Steel which was incorporated into Hyundai Motor Group in 2001, owned by Hyundai Motor Company with only 4.7 % and by controlling family with 7.17 % at that time. In 2019, the controlling shareholders' ownership in Hyundai Steel increased to 11.81%. Therefore, it suggests that there is a possibility of agency problems arising from differences in ownership of each affiliate if vertical integration occurs within a business group.

2.3. Supply chain in finance

Although research on supply chain has been conducted in operations management, it also has been spurred in finance. The initial studies try to connect product networks and asset prices, which focus on predictability of stock returns through supplier-customer links (Cohen and Frazzini (2008); Menzly and Ozbas (2010)) or across different production layers (Gofman *et al.* 2018). In addition, there are a growing literature about the supplier-consumer relationship related to corporate finance. Corporate customers who are socially responsible can apply similar socially responsible business behavior to their suppliers (Dai *et al.* 2019). There is

spillover effect of IPO along supply chains (Kutsuna *et al.* 2016); (Bae *et al.* 2019). On the other hand, there is a paucity of research to connect the supply chain with the ownership structure so I try to fill this gap in this paper.

3. Data

3.1. Data Source and Sample Selection

This section describes the data sources and variables used for the empirical analysis. The sample period ranges from 2009 to 2016, since related party transaction data within the business group required to create the supply chain became publicly available due to the introduction of business group disclosure system of Korean Fair Trade Commission (KFTC) in 2009. To construct our main and control variables, I hand collect the transaction matrix between affiliates within a business group from the DART, which is managed by the Financial Supervisory Service (FSS). Ownership data is obtained from eGroup, a database of large business group information disclosure system managed by KFTC. I use annual financial data from the Dataguide provided by Fn-guide, and industrial input-output tables are obtained from the Economic Statistical System (ECOS) provided by the Bank of Korea.

3.2. Variable Construction

In this section, I explain how I construct each variable used in the analysis. Table 1 briefly summarizes the definition of the variables.

3.2.1. Supply chain

Supply chain is identified through the transaction matrix between affiliates in a business group. Most of the existing research on related party transactions are analyzed by

obtaining data from TS2000, which has the limitation that it serves only transactions between listed and unlisted companies are shown and transactions between unlisted companies are not provided. However, my hand-collected data includes all transactions between all affiliates, public and private firms. Moreover, one important feature of this data source is that it collects information on how much firms buy and sell between all affiliates in the business group from Fair Trade Commission Disclosure. This large-scale group-level database on the transaction between affiliates allows me to construct the supply chain variables within business groups and to assign *supplier* or *customer* for firm in the business group based on the ratio of sales and purchases between affiliates to its total sales. I define the supply chain variables, *supplier* and *customer* based on two criteria.

A. BLSM(Buy Less & Sell More between affiliates)

According to BLSM criterion, a firm that buys less than median from its affiliates and sells more than median to its affiliates is defined as a *supplier*. In opposition way, a firm that buys more from its affiliates and sell less to its affiliates is defined as a *customer* within the business groups.

B. NS (Netsell between affiliates)

I create a netsell variable by subtracting purchases from the sales between affiliates. Within a business group, if the netsell variable is greater than the median, the firm is defined as a *supplier*, otherwise it is defined as a *customer*.

The two variables have similar meanings, but differ somewhat in that the BLSM is a more rigorous measure that separates purchases from affiliates and sales to affiliates, but the number of samples is reduced in half. On the other hand, NS can use the whole sample because it is divided by median, but there is an aggregated part compared to BLSM, which does not

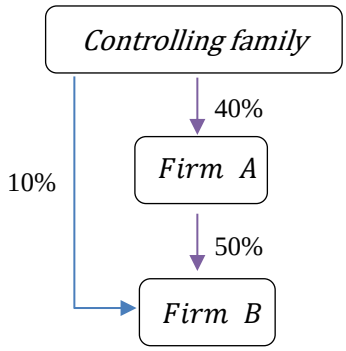
clearly distinguish between buying and selling respectively because it subtracts purchases from sales between affiliates.

3.2.2. Ownership structure

The methodology of computing ownership structure variables, ultimate ownership and position, is based on Almeida *et al.* (2011). See their paper on how to build the variables in detail. I briefly give the intuitive explanation for the variables.

A. Ultimate ownership (cash flow rights)

Business groups are controlled by families (controlling shareholders) who hold stakes in the group affiliates directly or indirectly through other affiliates in the group. Thus, the ultimate ownership which refers to the cash flow rights of the controlling shareholders is defined as the sum of indirect holdings through their affiliates in addition to direct holdings.



$$CFR_i = DirectCFR_i + \sum_{j=1}^{N} CFR_j \times Affiliate_CFR_{ji}$$

$$\begin{cases} CFR_A = 0.4 \\ CFR_B = 0.1 + 0.4 \times 0.5 = 0.3 \end{cases}$$

Firm A

B. Position

Position is a variable that represents the location of each firm within the pyramid structure. If the controlling shareholder builds a business group using the pyramid structure, there is a firm directly owned by the controlling shareholder (firm A), and another firm indirectly owned through other affiliates (firm B) as shown in the figure above. Since firm A is directly owned by the controlling shareholder, it is layer 1 of the pyramid. Firm B is layer 2 of

the pyramid because it is owned through firm A. However, since the direct ownership of the controlling shareholder in firm B exists, position is determined by the weighted average of direct and indirect ownership as follows.

$$Position_A = \frac{0.4}{0.4} \times 1 = 1$$

$$Position_B = \frac{0.1}{0.3} \times 1 + \frac{0.2}{0.3} \times 2 = 1.7$$

In short, position implies a kind of layer which adjusts a direct and indirect ownership of controlling shareholders.

3.2.3. Industry supplier

I measure *industry supplier* using the intermediate demand rate which is the ratio of the amount purchased by intermediate to the total industrial production, which means that how much of the industry's total output is sold to the intermediate sector. The components of this measure are extracted from the input-output table provided by the Bank of Korea. This is the matrix table showing the process in which outputs produced in each industry are directly or indirectly consumed by intermediate and final users. Generally, the intermediate demand rate is higher for the items consumed as basic raw materials or intermediate goods. I match intermediate demand rate at the three-digit Korean standard industrial classification (KSIC) level, which is called *industry supplier*.

The input–output accounts provides the industry classification based on I–O industry codes that do not exactly match Korean standard industrial classification (KSIC). To match I–O industry codes with the Korean standard industrial classification, I need to adjust both codes. There are 165 subdivisions of I-O industry code and 232 subdivisions of Korea's standard industry classification at the three digits level. In order to match these two codes, I rearrange

I-O industry codes into standard industry classification codes through the process of integrating or separating codes.

3.2.4. Control Variables

Following the existing literature on ownership structure in business groups, I control for firm characteristics that may affect a firm's ownership structure. All variables are computed for firm *i* over its fiscal year *t*. The control variables include (1) firm size (*Size*) measured by the natural logarithm of total asset; (2) firm age (*Age*) is measured by number of years since the company's establishment and this measure is logged; (3) public company (*List*) equals value of one if the company is listed. (either in KSE or KOSDAQ); 0 otherwise; (4) leverage (*Lev*) is measured by the ratio of book value of total debt to total asset; (5) profitability (*Ebit/assets*) is measured by operating income scaled by total asset, and (*Ebit/sales*) is measured by operating income scaled by total sales.

--- Insert Table 1 ---

3.3. Descriptive summary

Table 2 contains the summary statistics of key variables for firm-year observation. To minimize the impact of outliers, all continuous variables are winsorized at the top and bottom 1% of each variable's distribution. Related party transactions within the business group are measured with RPT, RP_sell, RP_buy and RP_netsell to identify the *supplier* and *customer*. The mean value of supply chain, *supplier* (BLSM) and *supplier* (NS), are 0.4975 and 0.4850, respectively. It means that by definition of BLSM (NS), on average 49.75% (48.50%) is allocated to *supplier* and the other is assigned to *customer*. The numerical difference between the two variables BLSM and NS is caused by the definition described in section 3.2.1.

On average, the controlling shareholders ultimately own 28.50% of the shares in the affiliates across all firm-years in my sample. The mean (median) *position* of a firm is 2.39 (2.26) and the 75th percentile of the *position* variable is 3.00, which indicates that the pyramid structure has, on average, more than two layers and about 25% of firms are more than three layers away from the controlling shareholders in the pyramid. Moreover, 55.75% of firms are classified as intermediate suppliers at the industry level.

--- Insert Table 2 ---

4. Empirical results

This section shows univariate and multivariate analysis to show whether the supply chain plays an important role in the ownership structure.

4.1 Univariate results

Table 3 shows the statistical differences in key variables between *supplier* and *customer*. Panel A is the result of the BLSM criterion and Panel B is the result of the NS criterion. As mentioned in section 3.2.1, which describes the construction of the variables, BLSM is a variable measured in a more rigorous method than NS, so the magnitude of the difference resulted from the BLSM criterion is greater than that from the NS criterion. However, the statistical power of BLSM is lower than that of NS due to the small sample size.

--- Insert Table 3 ---

Since the results of two panels show similar patterns, I describe the results based on panel A and leave panel B as a robustness check. The supplier shows higher ultimate ownership and lower value of the position than the customer. In other words, controlling shareholders ultimately own more the supplier than the customer, and place the supplier to an upper position

in the pyramid within their business group. In the univariate test, the position is normalized to the maximum value of each business group. The reason is that the position value, 3 in one business group has a different meaning to 5 in another business group because the position is determined at the group level. Thus, it is meaningless to compare the raw value of the position without the group fixed effect. The supplier has a higher proportion of intermediate industry than the customer, which provides evidence that it is within a range that does not deviate significantly from the supply chain at the industrial level, even though it is defined as a supplier within a business group. Moreover, the supplier has less proportion of being listed, smaller size, and it is younger than the customer. A higher proportion of a privately held company of the supplier can result in a smaller size.

4.2 Baseline specification (OLS)

Table 4 provides the important estimates of how the supply chain is associated with the ownership structure. According to Almeida *et al.* (2011), they propose the selection hypothesis, which is that the less profitable firm is more likely to be selected by the controlling shareholder and placed in the lower pyramid. In this section, I replicate the previous results based on Almeida's empirical model and present the results for interpreting this phenomenon from a different perspective. I measure *position* following their methodology and control for size, age, public status, and leverage. In panel A, I use operating income scaled by assets to measure profitability, and panel B uses operating income scaled by sales for profitability. In addition, I include year and group fixed effects to measure within-group effect, as *position* and *ultimate ownership* are representative corporate decisions made at group level in South Korea. The standard errors are clustered at firm level.

$$Position_{i,t} = \alpha \cdot \ profitability_{i,t-1} + \beta \cdot supplier_{i,t} + \boldsymbol{Controls_{i,t-1}} + \ \sum_j group_j +$$

$$\sum_t year_t + \varepsilon_{i,t}. \quad (1)$$

--- Insert Table 4 Panel A---

In panel A, column 1 indicates that α is significantly negative, which supports the *selection hypothesis* which Almeida *et al*. (2011) argues. On the other hands, columns 2 to 6 show a different perspective to interpret the same phenomenon proposed in Almeida *et al.* (2011). Controlling for lagged profitability, column 2 and 3 indicate that the *supplier* is negatively correlated with the *position*. A firm with a small position value implicates that controlling shareholders tend to place the supplier in a higher position than the customer of the pyramid. A *supplier* is a variable that takes into account both sales and purchases between affiliates within the group, but columns 4 and 5 analyze sales and purchase separately. *Sell (buy) High* is a dummy variable indicating whether a company sells (buys) more to (from) affiliates than the median value in the group. Column 4 shows that a firm which sells more to affiliates is placed in a higher position than a firm which sells less to affiliates in the group. However, a firm which buys more from affiliates is placed in a lower position than a firm which buys less from affiliates in the business group.

In order to check the robustness, the measure of profitability is replaced by operating profit to sales ratio in panel B. Since I use the same regression specification except for the measure of profitability, the results show similar patterns for the supplier but profitability loses its significance.

--- Insert Table 4 Panel B---

4.3. Endogeneity control

In this section, I conduct an additional analysis to address the endogeneity issue. Specifically, there is a possibility that cross-sectional compounder or omitted variable concern may exist. I construct another independent variable, *Become a supplier,* for the firm that switches to a supplier in the full sample to investigate how the firm that changes its status in supply chain affects position changes. Moreover, I construct the variables of change in position according to the previous literature. The variable *position increase* takes the value of one if position increased by more than 0.10 from one year to the next, and zero otherwise. The variable *position decrease* takes the value of one if position decreased by more than 0.10 from one year to the next, and zero otherwise.

--- Insert Table 5 ---

Table 5 reports the result of univariate analysis to show the statistical differences in key variables between *become a supplier* and *others*. It presents that the number of firms whose position decrease is larger in the group that switches to supplier than in the group that does not.

In Table 6, I then replace the variable *position* with *position increase* and *position decrease* in Eq.(1). Dependent variables indicate a change in position in both directions, increasing and decreasing, and value of one is given to the firm whose position changes in the next period based on a certain threshold value. In column (1) and (2), dependent variables take a value of one if position changed by 0.10 in the next period in either way, following Almeida et al.(2011). In column (3) and (4), dependent variables take a value of one if position changes in the next period is the top 10% within my sample in either way.

--- Insert Table 6 ---

As a result, the firm that become a supplier has a statistically significant impact on decrease in position, but not increase in position. It implies that the firm which becomes a supplier is more likely to be at the top of the pyramid. Thus, it is consistent with the hypothesis that controlling shareholders tend to place the supplier in the upper part of the pyramid. This indicates that high profitability may be induced by a position where profits are concentrated in the structure of the supply chain. Therefore, it also implies that the ownership structure can be formed as an incentive of expropriating corporate opportunity.

4.4. Additional Test: from an industrial point of view

The results of the analysis above consistently suggest that the controlling shareholder places the supplier in the upper pyramid. However, since *supplier* and *customer* are concepts defined within a business group in this paper, it may not exactly match the supply chain at the entire industry level. In other words, although a firm is defined as customer within the group, if it does not manufacture consumer durable goods, the products may not be sold directly to a consumer. It may be delivered as an intermediate product in another industry, which is called B to B (business to business) rather than B to C (business to customer). This section describes how a firm that is defined as a *customer* in a group, but more likely to be a *supplier* at an industry level, has a different impact on its position using the intermediate demand rate.

I measure *industry supplier* using the intermediate demand rate which is the ratio of the amount purchased by intermediate to the total industrial production, which means that how much of the industry's total output is sold to the intermediate sector. The components of this measure are extracted from the input-output table provided by the Bank of Korea.

--- Insert Table 7 ---

Table 7 shows that the coefficients of *customer* are significantly positive, which implies that the controlling shareholder places the *customer* in the lower pyramid than the *supplier*. However, the coefficients on the interaction variable *customer* x *industry_supplier* are negative and statistically significant after controlling for firm characteristics, year, and group dummies. It is interpreted to that fact that *customer* within the business group is located at the bottom of the pyramid compared to the *supplier*, but the magnitude is weakened as the ratio of production of intermediate goods increases at the industrial level.

5. Conclusion

This study investigates how supply chain affects the ownership structure in Korean business group. To construct the supply chain within the business group, I use affiliates-level transaction data and identify the supplier and the customer in the group. The result shows that the controlling shareholder places the supplier higher on the pyramid than the customer. This evidence casts doubt on the previous study claiming that profitable firms are at the higher place of the pyramid. My finding suggests the high profitability of the companies at the top of the pyramid is endogenous, and the key is the supply chain because the suppliers generate high profits through exclusive sales contracts with member firms.

To address the endogeneity issue, I identify the firm that switches a supplier in the full sample to investigate how the firm that changes its status in supply chain affects position changes. The firm that changes its status in the supply chain to a supplier has a statistically significant impact on decrease in position, but not increase in position. It implies that the firm which becomes a supplier is more likely to be at the top of the pyramid.

Moreover, I conduct an additional analysis from an industrial point of view to support the relationship between the supply chain and ownership structure. Using the intermediate demand rate which is the ratio of the amount purchased by intermediate to the total industrial production, I construct *industry supplier* to show how a firm that is defined as a customer in a group, but more likely to be a supplier at an industry level, has a different impact on its position. The results show that *customer* within the business group is located at the bottom of the pyramid compared to the *supplier*, but the magnitude is weakened as the ratio of production of intermediate goods increases at the industrial level. Thus, it supports the fact that suppliers are chosen to be at the upper pyramid and the ownership structure is likely to be formed as an incentive of the expropriating corporate opportunity.

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Table 1

Variable Definitions

This Table provides the definitions of the variables used in this study.

Variable	Definition
measure of supply chain	
Supplier(BLSM)	1, if a firm's RP_buy is less than median and RP_sell is more than median (Buy Less and Sell More); 0 if a firm's RP_buy is more than median and RP_sell is less than median (Buy More and Sell Less)
Supplier(NS)	1, if RP_netsell is greater than the median within the business group
Sell High	1, if RP_sell is greater than median
Buy High	1, if RP_buy is greater than median
Industry_supplier	The ratio of the amount purchased by intermediate to the total industrial production
Industry_supplier(D)	1, if the Industry_supplier is greater than median; 0 otherwise.
RPT	Sum of purchases and sales between affiliates scaled by its total sales
RP_sell	The amount of sales to affiliates scaled by its total sales
RP_buy	The amount of purchase from affiliates scaled by its total sales
RP_netsell	The ratio of subtracting purchases from the sales between affiliates to its total sales
measure of ownership	
Ultimate ownership	The sum of indirect holdings through their affiliates in addition to direct holdings; Defined in the text in detail
Position	A measure of distance how far away from controlling shareholders in pyramidal structure. Defined in the text in detail
Position(normalize)	The normalization of position to the maximum value of each business group
control variables	
Size	Natural logarithm of total assets
Age	Natural logarithm of the number of years since the company's establishment
List	1, if the company is listed. (either in KSE or KOSDAQ); 0 otherwise
Leverage	Ratio of book value of total debt to total asset
Ebit/asset	Ratio of operating income to total asset
Ebit/sales	Ratio of operating income to total sales

Table 2

Summary Satistics

This Table reports summary statistics for the sample firm-year observations constructed using all affiliated firms (public and private) in the large business group. The sample observations are from 2009 to 2016. For the measure of supply chain, the transaction matrix between affiliates within a business group is hand-collected from the DART. Ownership data are from the Korean Fair Trade Commission (KFTC) and financial and accounting variables are from DataGuide provided by Fnguide. Detailed definitions of variables are provided in Table 1.

	MEAN	SD	p25	p50	p75	N
measure of supply chain						
Supplier(BLSM)	0.4975	0.5001	0.0000	0.0000	1.0000	2971
Supplier(NS)	0.4850	0.4998	0.0000	0.0000	1.0000	6016
Sell High	0.4852	0.4998	0.0000	0.0000	1.0000	6016
Buy High	0.4877	0.4999	0.0000	0.0000	1.0000	6016
RPT	0.5151	0.9052	0.0802	0.2768	0.7069	6016
RP_sell	0.2729	0.3346	0.0062	0.0926	0.4808	6016
RP_buy	0.2356	0.7999	0.0141	0.0547	0.1733	6016
RP_netsell	0.0418	0.8416	-0.0573	0.0024	0.3547	6016
Industry_supplier	0.6198	0.2670	0.5263	0.7065	0.8311	6016
Industry_supplier(D)	0.5575	0.4967	0.0000	1.0000	1.0000	6016
measure of ownership						
Ultimate ownership	0.2850	0.2657	0.0926	0.1943	0.3844	5807
Position	2.3943	0.9052	1.9553	2.2607	3.0000	5702
Position(normalize)	0.6506	0.2193	0.5000	0.6645	0.7986	5702
control variables						
Size	26.0329	1.9328	24.4805	25.7935	27.3502	6016
Age	2.6639	0.9246	2.0794	2.7081	3.4012	6012
List	0.2429	0.4288	0.0000	0.0000	0.0000	6016
Lev	0.5137	0.2383	0.3319	0.5312	0.6849	6015
Ebit/asset	0.0426	0.0864	0.0064	0.0369	0.0786	6016
Ebit/sales	0.0027	0.5495	0.0079	0.0412	0.1033	6016

Table 3

Univariate results

This Table reports the statistical differences in key variables between the *supplier* and *customer*. The sample firm-year observations are constructed using all affiliated firms (public and private) in the large business group from 2009 to 2016. Panel A is the result of the BLSM criterion and Panel B is the result of the NS criterion. With BLSM criterion, the supplier is identified as a firm which buys from affiliates less than median and sells to affiliates more than median. With NS criterion, the supplier is identified as a firm whose netsell variable is greater than the median within the business group, where a netsell variable is made by subtracting purchases from the sales between affiliates. Detailed definitions of variables are provided in Table 1.

Panel A. Supplier(BLSM)

	Supplier			Customer			Difference			
	Mean	Median	N	Mean	Median	N	Mean	P	Median	P
Ut_own	0.3376	0.2168	1465	0.2537	0.1811	1437	0.0839	0	0.0357	0
Position(nornalize)	0.6229	0.6303	1444	0.6579	0.6624	1406	-0.035	0	-0.0321	0.0001
Industry_supplier(D)	0.59	1	1478	0.4997	0	1493	0.0903	0	1	0
Size	25.5648	25.2056	1478	26.5167	26.4388	1493	-0.9519	0	-1.2332	0
Age	2.6208	2.6391	1475	2.6436	2.7726	1493	-0.0228	0.4913	-0.1335	0.1855
List	0.1644	0	1478	0.3302	0	1493	-0.1658	0	0	0
Lev	0.5152	0.5312	1478	0.5127	0.5262	1493	0.0025	0.7752	0.005	0.677
Ebit/asset	0.0467	0.0379	1478	0.0432	0.0408	1493	0.0035	0.2851	-0.0029	0.9694
Ebit/sales	0.0724	0.038	1478	-0.1086	0.0465	1493	0.181	0	-0.0085	0.3879

Panel B. Supplier(NS)

	Supplier			Customer			Difference			
	Mean	Median	N	Mean	Median	N	Mean	P	Median	P
Ut_own	0.3058	0.2029	2864	0.2647	0.1885	2943	0.0411	0	0.0144	0.0002
Position(nornalize)	0.6384	0.6512	2818	0.6626	0.6667	2884	-0.0242	0	-0.0155	0.0001
Industry_supplier(D)	0.586	1	2918	0.5307	1	3098	0.0553	0	0	0
Size	25.6914	25.3645	2918	26.3544	26.2594	3098	-0.663	0	-0.8949	0
Age	2.6467	2.7081	2914	2.6802	2.7726	3098	-0.0335	0.1599	-0.0645	0.0318
List	0.1827	0	2918	0.2995	0	3098	-0.1168	0	0	0
Lev	0.5094	0.5262	2917	0.5177	0.5347	3098	-0.0083	0.1796	-0.0085	0.2854
Ebit/asset	0.0441	0.0367	2918	0.0413	0.0371	3098	0.0028	0.2064	-0.0004	0.3885
Ebit/sales	0.0573	0.0391	2918	-0.0488	0.0435	3098	0.1061	0	-0.0044	0.6408

Table 4

Ownership structure and supply chain

This Table presents the results of OLS regression of the position on the supplier to show how the supply chain is associated with the ownership structure (Eq. (1)). *Position* represents the location of each firm in the pyramid structure. The *supplier*(BLSM) is identified as a firm which buys from affiliates less than median and sells to affiliates more than median. The *supplier*(NS) is identified as a firm whose netsell variable is greater than the median within the business group, where a netsell variable is made by subtracting purchases from the sales between affiliates. *Sell (Buy) High* is a dummy variable which is given a value of one if a company sells (buys) more to (from) affiliates than the median value in the group. In panel A, I use Ebit scaled by assets to measure profitability, and panel B uses Ebit scaled by sales for profitability. All control variables are lagged and detailed definitions of control variables are provided in Table 1. ***, **. * indicate significance at 1%, 5%, and 10% level, respectively.

Panel A. Profitability= Ebit/asset (following Almeida et al.(2011))

	Position					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Ebit/asset	-0.4347*	-0.3233	-0.4625**	-0.4333*	-0.4390**	-0.4485**
	(-1.943)	(-1.207)	(-2.074)	(-1.930)	(-1.994)	(-2.007)
Supplier(BLSM)		-0.2978***				
		(-5.377)				
Supplier(netsell)			-0.2026***			
			(-5.194)			
Sell High				-0.1188***		
				(-3.040)		
Buy High					0.1560***	
					(4.017)	
Supplier(netsell>0)						-0.1932***
						(-4.717)
Size	-0.1056***	-0.1367***	-0.1148***	-0.1087***	-0.1109***	-0.1147***
	(-6.937)	(-7.303)	(-7.364)	(-7.066)	(-7.193)	(-7.355)
Age	-0.1257***	-0.0977***	-0.1172***	-0.1253***	-0.1158***	-0.1167***
	(-5.183)	(-3.173)	(-4.837)	(-5.162)	(-4.768)	(-4.809)
List	-0.1527**	-0.1854**	-0.1724***	-0.1675**	-0.1564**	-0.1654**
	(-2.313)	(-2.436)	(-2.638)	(-2.565)	(-2.366)	(-2.528)
Leverage	0.0689	-0.2117*	0.0551	0.0634	0.0756	0.0596
	(0.744)	(-1.830)	(0.600)	(0.685)	(0.827)	(0.648)
Constant	5.6358***	6.5496***	5.9802***	5.7871***	5.6706***	6.0144***
	(14.291)	(13.434)	(14.719)	(14.409)	(14.370)	(14.701)
Observations	5,430	2,705	5,430	5,430	5,430	5,430
R-squared	0.352	0.372	0.364	0.357	0.360	0.363
Year & Group FE	YES	YES	YES	YES	YES	YES
Clustered by firm	YES	YES	YES	YES	YES	YES

Table 4 (cont')

Ownership structure and supply chain

Panel B. Profitability= Ebit/sales

	Position					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Ebit/sales	-0.0574*	-0.0226	-0.0416	-0.0493	-0.0447	-0.0428
	(-1.906)	(-0.574)	(-1.351)	(-1.618)	(-1.475)	(-1.390)
Supplier(BLSM)		-0.2975***				
		(-5.235)				
Supplier(netsell)			-0.2001***			
			(-5.040)			
Sell High				-0.1255***		
				(-3.180)		
Buy High					0.1488***	
					(3.776)	
Supplier(netsell>0)						-0.1884***
						(-4.501)
Size	-0.1066***	-0.1391***	-0.1159***	-0.1101***	-0.1117***	-0.1156***
	(-6.934)	(-7.326)	(-7.354)	(-7.080)	(-7.174)	(-7.332)
Age	-0.1218***	-0.1011***	-0.1163***	-0.1225***	-0.1146***	-0.1158***
	(-4.828)	(-3.161)	(-4.616)	(-4.854)	(-4.548)	(-4.598)
List	-0.1423**	-0.1711**	-0.1610**	-0.1577**	-0.1453**	-0.1543**
	(-2.155)	(-2.242)	(-2.464)	(-2.417)	(-2.197)	(-2.357)
Leverage	0.0956	-0.1991*	0.0847	0.0910	0.1030	0.0886
	(1.028)	(-1.719)	(0.921)	(0.982)	(1.120)	(0.963)
Constant	5.6078***	6.5890***	5.9570***	5.7749***	5.6490***	5.9857***
	(13.961)	(13.181)	(14.371)	(14.104)	(14.050)	(14.321)
Observations	5,334	2,656	5,334	5,334	5,334	5,334
R-squared	0.349	0.373	0.361	0.354	0.356	0.359
Year & Group FE	YES	YES	YES	YES	YES	YES
Clustered by firm	YES	YES	YES	YES	YES	YES

Table 5

Univariate analysis of become a supplier

This table reports the statistical differences in key variables between become a supplier and others. *Become a supplier* indicates the firm that switches to a supplier in the full sample. According to the previous literature, the variable *position increase* takes the value of one if position increased by more than 0.10 from one year to the next, and zero otherwise. The variable *position decrease* takes the value of one if position decreased by more than 0.10 from one year to the next, and zero otherwise. Detailed definitions of other variables are provided in Table 1.

	Become a Supplier		others		Difference	
	Mean	N	Mean	N	Mean	P
Position Increase	0.0605	248	0.0581	4097	0.0024	0.8759
Position decrease	0.1008	248	0.0674	4097	0.0334	0.044
Size	25.8291	275	26.0426	5741	-0.2135	0.0736
Age	2.7138	274	2.6616	5738	0.0522	0.3607
List	0.1782	275	0.246	5741	-0.0678	0.0105
Leverage	0.5077	275	0.514	5740	-0.0063	0.669
Ebit/asset	0.0409	275	0.0427	5741	-0.0018	0.7418

Table 6

Become a supplier and position changes

This Table shows the effect of changes the status in supply chain on the position changes. Dependent variables are changes in position in both directions, increasing and decreasing. In column (1) and (2), dependent variables take a value of one if position changed by 0.10 in the next period in either way, following Almeida et al.(2011). In column (3) and (4), dependent variables take a value of one if position changes in the next period is the top 10% in either way. *Become a supplier* indicates the firm that changes its status to a supplier in supply chain within the business group. All control variables are lagged and detailed definitions of variables are provided in Table 1. ***, **. * indicate significance at 1%, 5%, and 10% level, respectively.

	Standards in previous literature		Top 10 pencentile change	
	Position Increase	Position Decrease	Position Increase	Position Decrease
VARIABLES	(1)	(2)	(3)	(4)
Become a supplier	0.0009	0.0341**	0.0062	0.0380*
	(0.057)	(1.963)	(0.329)	(1.786)
Ebit/asset	-0.0020	0.0593	-0.0103	0.0200
	(-0.039)	(1.273)	(-0.159)	(0.325)
Size	-0.0058**	-0.0043**	-0.0017	-0.0073**
	(-2.513)	(-1.995)	(-0.484)	(-2.361)
Age	0.0009	0.0007	-0.0066	-0.0091
	(0.247)	(0.182)	(-1.095)	(-1.630)
List	0.0431**	0.0176	0.0307	-0.0069
	(2.569)	(1.126)	(1.328)	(-0.323)
Leverage	0.0069	0.0124	0.0118	0.0192
	(0.696)	(1.243)	(0.767)	(1.386)
Constant	0.1859***	0.1447**	0.1056	0.2754***
	(3.023)	(2.383)	(1.142)	(3.259)
Observations	4,341	4,341	4,341	4,341
R-squared	0.097	0.138	0.023	0.025
Year & Group FE	YES	YES	YES	YES
Clustered by firm	YES	YES	YES	YES

Table7

Additional Test: from an industrial point of view

This table show how a firm that is defined as a customer in a group, but more likely to be a supplier at an industry level, has a different impact on its position using the intermediate demand rate. *Industry - supplier* is measured by the intermediate demand rate which is the ratio of the amount purchased by intermediate to the total industrial production extracted from the input-output table provided by the Bank of Korea. The *customer*(BMSL) is identified as a firm which buys from affiliates more than median and sells to affiliates less than median. Detailed definitions of control variables are provided in Table 1. All control variables are lagged and detailed definitions of variables are provided in Table 1. ***, **. * indicate significance at 1%, 5%, and 10% level, respectively.

	Position						
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ebit/asset	-0.4347*	-0.4484**	-0.3310	-0.4570**	-0.4369*	-0.4504**	-0.4394**
	(-1.943)	(-2.013)	(-1.239)	(-2.052)	(-1.946)	(-2.059)	(-1.970)
Industry_supplier(ratio)		0.0508	0.0422	0.1441	0.1769*	0.1069	0.1281
		(0.573)	(0.333)	(1.369)	(1.671)	(0.984)	(1.199)
customer(BMSL)			0.3211**				
			(2.576)				
customer(BMSL) x Industry_supplier(ratio)			-0.0389				
			(-0.208)				
customer(netsell)				0.3559***			
				(3.928)			
customer(NS) x Industry_supplier(ratio)				-0.2479*			
				(-1.832)			
Sell Low					0.2959***		
					(3.362)		
Sell Low x Industry_supplier(ratio)					-0.2842**		
					(-2.127)		
Buy Low						-0.0783	
						(-0.898)	
Buy Low x Industry_supplier(ratio)						-0.1237	
						(-0.941)	
customer(netsell>0)							0.3142***
							(3.365)
customer(NS>0) x Industry_supplier(ratio)							-0.2103
							(-1.485)
Size	-0.1056***	-0.1049***	-0.1361***	-0.1144***	-0.1085***	-0.1108***	-0.1114***
	(-6.937)	(-6.882)	(-7.202)	(-7.324)	(-7.042)	(-7.156)	(-7.172)
Age	-0.1257***	-0.1254***	-0.0975***	-0.1171***	-0.1257***	-0.1156***	-0.1180***
	(-5.183)	(-5.161)	(-3.166)	(-4.849)	(-5.190)	(-4.751)	(-4.871)
List	-0.1527**	-0.1520**	-0.1860**	-0.1732***	-0.1678**	-0.1552**	-0.1670**
	(-2.313)	(-2.300)	(-2.442)	(-2.653)	(-2.568)	(-2.341)	(-2.561)
Leverage	0.0689	0.0733	-0.2109*	0.0568	0.0612	0.0779	0.0631
	(0.744)	(0.786)	(-1.804)	(0.612)	(0.655)	(0.849)	(0.677)
Constant	5.6358***	5.5881***	6.2097***	5.6741***	5.5543***	5.7612***	5.6639***
	(14.291)	(13.883)	(12.506)	(13.915)	(13.729)	(14.014)	(13.877)
Observations	5,430	5,430	2,705	5,430	5,430	5,430	5,430
R-squared	0.352	0.353	0.372	0.366	0.358	0.360	0.363
Year & Group FE	YES	YES	YES	YES	YES	YES	YES
Clustered by firm	YES	YES	YES	YES	YES	YES	YES