

Center for Economic Institutions
Working Paper Series

CEI Working Paper Series, No. 2005-6

***"The Choice of Group Structure:
Divide and Rule"***

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The Choice of Group Structure: Divide and Rule

September 13, 2005

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Summary

This paper concerns the structure of Korean business groups. We investigate the factors that affect a controlling shareholder's decision regarding the structure of his business group and the location of its member firms, using financial and ownership data on conglomerate groups in Korea. We define new measures that represent the levels of vertical and circuitous structures of a group, and the location of member firms in the group.

We empirically confirm that controlling shareholders strategically choose the structure of their business groups to secure control over the groups and to seek private benefit of control. The risk diversification and propping incentive of controlling shareholders is also found to affect the decisions.

The Choice of Group Structure: Divide and Rule

1. Introduction

This paper concerns the structure of business groups. We investigate the factors that affect a controlling shareholder's decision regarding the structure of his business group and the location of its member firms, using financial and ownership data on conglomerate groups in Korea. We define new measures that represent the level of vertical or circuitous ownership structure of a group, and the location of member firms in the group. By investigating the factors that affect group structure, we shed new light on the incentives of controlling shareholders in the management of their firms.

A business group provides a controlling shareholder with an opportunity to diversify the investment risk through a portfolio of business lines, to minimize the capital requirement to secure control over his group, and also allows him to enjoy the private benefit of control. Even though it is the most important decision that a controlling shareholder of a group can make, few research studies have analyzed the ownership and control structure of conglomerates at the group level, and those that have done so have been theoretical rather than empirical studies.

Wolfenzon (1998), Almeida and Wolfenzon (2004), and Riyanto and Toolsema (2004) provide theoretical models to compare vertical and horizontal structures of conglomerates, and show that the tunnelling incentive of an entrepreneur makes him prefer a vertical structure to a horizontal one. We empirically test the motivation behind the decision regarding group structure, and confirm that control and risk diversification incentives as well as the tunnelling incentive affect the structure of Korean conglomerate groups.

Some empirical studies have compared the group structure of conglomerates at the country level. La Porta, Lopez-de-Silanes and Shleifer (1999), and Claessens, Djankov and Lang (2000) show that pyramidal and circuitous ownership structures are prevalent in emerging countries where the protection of minority shareholders is not well established. Similarly, Claessens, Djankov, Fan and Lang (2002), Mitton (2000), Lins (2003), Lemmon and Lins (2003), and Joh (2003) show that the wedge between the cash right and the control right of controlling shareholders negatively affects firm value. Johnson, La Porta, Lopez-de-Silanes and Shleifer (2000), and Friedman, Johnson and Mitton (2003) reveal the existence of tunnelling or propping among affiliated firms.

However, their analyses do not focus on the choice of group structure, but rather on the discrepancy between the cash right and the control right of controlling shareholders due to a pyramidal structure, the ensuing conflicts of interests between controlling shareholders and minority shareholders, and their negative effects on firm value. In this paper, however, we focus on the step before the incurrence of tunnelling or propping, and investigate the incentives of the controlling family to strategically decide on the group structure or the location of member firms

in order to pursue their private goals.

The second part of the paper investigates the decision on the location of member firms in a business group. In their research on the location of member firms, Bertrand, Mehta and Mullainathan (2000) use the size of family ownership as a measure for the location of a member firm in a group, and show that, in Indian conglomerates, tunnelling goes from those firms at the lower level of pyramids to those firms at the higher level of pyramids, thus indirectly confirming that there is wealth transfer from minority shareholders to controlling shareholders. Similarly, Attig, Fischer and Gadhoun (2004) identify the location of a firm in Canadian business groups using the wedge ratio as a proxy, and check the relationship between the wedge and firm value.

Unlike those studies, we measure the location of a member firm in a group using the investment relationship among the member firms as well as the controlling shareholder's ownership, and identify the factors that affect it. We show that securing control over a business group and tunnelling or propping among member firms is the driving force behind the decisions regarding the locations of member firms in a group structure.

An analysis on group structure or the location of a member firm in a group will shed more light on the driving force behind managerial decisions, and allow us to better understand the incentives of controlling shareholders. For example, securing control over a group and maximizing wealth can be two conflicting goals for a controlling shareholder, since empire building does not come without cost to the entrepreneur. A controlling shareholder has to compare the benefits of a pyramidal structure that helps him secure control over his group with the cost of lower firm value.

Another issue to be considered in the choice of group structure from the perspective of the controlling shareholder is whether to minimize the risk of his investment or to secure maximum control. Given his ownerships in his member firms, horizontal deployment of the firms would maximize the risk diversification effect, since the failure of one firm would not affect the performance of other member firms. However, the cost of the horizontal structure is lower controlling power secured by the entrepreneur.

Another decision he will need to make is whether to have a one-way ownership structure or a circuitous ownership structure. Circuitous ownership allows maximum control over member firms, but increases the investment risks of a controlling shareholder and partially offsets his tunnelling effort.

The fact that firms in emerging countries, where corporate governance and the legal system are not so favourable to minority shareholders, tend to have a pyramidal structure suggests that the private benefit effect of control that increases with a pyramidal structure dominates the lower firm value or higher investment risk effect in those countries. Still, the diversity of group structures, as shown in Korean conglomerates, suggests that controlling shareholders generally face the decision of choosing an optimal group structure, and that different group characteristics can result in different decisions. Our analysis on the determining factors of the structure of a

group or the location of member firms in the group will show what factors dominate the controlling shareholders' decision.

For the analysis, we use financial and ownership data on Korean companies. The Korean economy and its companies are well known for their conglomerate business structure. Most of the listed companies in Korea have affiliates, and an independent firm in its pure sense is rather the exception in the Korean economy. Jang, Kang and Park (2004) report that more than 95% of the manufacturing companies listed on the Korea Stock Exchange as of the end of 2003 had affiliated companies. Also, most of the listed companies on the Korea Stock Exchange have controlling shareholders, a feature that differentiates them from the keiretsu of Japan. For example, in the same paper, Jang, Kang and Park (2004) identified controlling shareholders for 364 out of 425 Korean manufacturing firms sampled.¹ The controlling shareholders of Korean firms actively participate in the management of their companies as well as dominating the board of directors, and so they are properly termed 'owner-managers'.

Another motive behind our investigation of the group structure of Korean conglomerates comes from the fact that we can observe very diverse forms of conglomerate structure in the economy. For example, the Samsung group, which includes Samsung Electronics as a member firm, has a very vertical and circuitous ownership structure. On the other hand, the Anam Group has more horizontal and non-circuitous ownership structure. The structures of some groups have also changed over time so that the LG group, for example, used to be very vertical and circuitous in its group structure in 1997, but now has a horizontal structure where most of its member firms are directly owned by a holding company.

To analyse the determination of a group structure, we need detailed data on the ownership structure of all the member firms of a group, including both listed companies and non-listed companies. In this paper, we use the data source identified by the Korea Fair Trade Commission, which regularly collects ownership and transaction data of Korean groups for the purpose of anti-trust control.

In Section 2, which follows this introduction, we discuss empirical hypotheses based on existing theories and inductive discussions. In Section 3, we develop and define the measures that represent the level of vertical structure of a group, the level of circuitous ownership structure of a group and the location of a member firm in the overall group structure. Section 4 provides an overview of the ownership and business structure of Korean groups, and Section 5 empirically investigates the decision factors relating to group structure and firm location, and Section 6 concludes the paper.

2. Empirical Hypotheses

In this section, we derive empirical hypotheses for empirical models based on existing

¹ A few exceptions are commercial banks, and privatized public corporations such as KT and POSCO.

theories and discussions. As the paper investigates the choice of group structure and the choice of the positions of individual firms in a group structure, we discuss them separately.

2.1. Group Characteristics and Group Structure

We assume that a controlling shareholder has two dimensions of decisions to make regarding group structure: vertical versus horizontal structure and the level of circuitous ownership.

Control Hypothesis

According to existing research, the wealth constraint of a controlling shareholder is a major reason why we can observe pyramidal or circuitous structures as they allow a controlling shareholder to secure control over his group firms with a minimum of his own investments. We assume that a controlling shareholder wants to control a large group of firms, since it provides him with both economic and non-economic benefits of control. There are five variables we consider to test the hypothesis.

The first variable is the ownership of a controlling shareholder and his family. In general, a controlling family will prefer a vertical or circuitous structure, since it minimizes the family's investments needed to secure control over its group. However, the preference for a vertical or circuitous structure would be traded off against lower firm value, as Claessens et al. (2002) demonstrate, and lower firm value would be more costly for controlling families with higher ownership. We expect a negative correlation between family ownership and the level of vertical structure or the level of circuitous structure.

Second, the ownership of member firms, which is practically under the control of the controlling shareholder, helps him secure control over his group, as La Porta et al. (1999) demonstrate, and possibly allows him to maintain a horizontal structure. However, the effect of ownership by affiliated firms on the group structure is not easy to measure, since, by definition, affiliated ownership is an endogenous variable decided by the group structure itself. That is, the more vertical a group structure is, the higher the affiliated ownership tends to be.

Third, we use the number of affiliated firms as the proxy for the difficulty in raising family wealth to be invested in affiliated firms since the family usually has a limited wealth and faces more wealth constraint as the group expands. We expect a positive correlation between the number of affiliated firms and the level of vertical structure or the level of circuitous structure under the control hypothesis, since more affiliated firms requires more family wealth to maintain its control over a group.

Fourth, the proportion of listed firms in the group will also affect the group structure, and its effect can move in two directions. The larger the proportion is, the harder it will be for a controlling shareholder to secure control over the group, since, by definition, there will be more

outside investors. In this case, the controlling shareholder would resort to a vertical or circuitous structure to secure control, and we expect a positive correlation between the proportion of listed firms and the level of vertical or circuitous structure.

On the other hand, if a member firm goes public and the shares issued to outside investors are widely spread, the controlling shareholder can expand the size of his group and still control his member firms with lower ownership. Thus, listing allows the controlling shareholder to redeploy his investments to secure the control of other member firms. In this case, we expect a negative correlation between the proportion of listed firms and the level of vertical or circuitous structure.

Fifth, the existence of a large, dominant company in the group will help the controlling shareholder to secure control over the group, since all he needs to do is obtain the controlling ownership of the dominant holding company as Jang, Kang and Park (2004) show. We expect a negative correlation between the existence of a holding company and the level of vertical or circuitous structure. Family ownership in the holding company is also taken into consideration.

As another proxy for the existence of dominant companies, we calculate a Herfindahl index for a group, where the index is defined as the sum of the squares of the proportion of the equity size of each member firm to the total equity of the group. A larger Herfindahl index implies the existence of dominant firms, and we expect a negative correlation between the index and the level of vertical or circuitous structure.

Sixth, if the holding company is listed, it can also be an easy target for an M&A, and the control over the group can be challenged. The existence of a listed holding company will lead to a higher level of circuitous structure to protect the listed holding company and the group.

Risk Diversification Hypothesis

As Amihud and Lev (1981) argue, managers prefer to expand their business into non-related areas to diversity their investment risk. For the purpose of group risk diversification, a horizontal structure where the controlling shareholder owns the shares of each firm directly, or owns the shares of a holding company that owns the shares of member firms, will be preferred. Circuitous ownership among affiliated firms would increase the possibility of contagious failures of member firms, and therefore will be shunned if the group risk is high.

To measure the risk of controlling shareholders, we use the proportion of firms that are in a related business based on two-digit industry classifications, and the standard deviation of group profitability (return on assets) as the proxies for the risk of a group. We expect that groups with higher business risk would tend to have a horizontal structure or a non-circuitous ownership structure.

Family ownership will also affect the decision regarding the structure of a group from the risk diversification point of view. The larger it is, the more the family would prefer to have a horizontal structure to minimize its investment risk.

Tunnelling and/or Propping Hypothesis

Many studies, including Johnson, La Porta, Lopez-de-Silanes and Shleifer (2000), Claessens et al. (2000); Friedman, Johnson and Mitton (2003), and Almeida and Wolfenzon (2004) show that a pyramidal or circuitous structure is closely related to the tunnelling or propping incentives of controlling shareholders. When there are ownership relations among member firms – that is, when there is a vertical or circuitous structure – it will be easier for the firms to expropriate or subsidize one another. On the other hand, for the controlling shareholder who wants to expropriate the wealth of minority shareholders, a circuitous structure reduces the tunnelling effect, since more of the cost of tunnelling will ultimately be imposed on the controlling shareholder.

The first variable to test tunnelling or propping hypothesis is the free cash flow of the group, which is measured by EBITDA in the empirical model. Since a controlling shareholder has more to gain from a vertical structure, as Almeida and Wolfenzon (2004) show, we expect a higher free cash flow to be correlated with a higher incidence of a vertical or circuitous structure.

The proportion of listed firms in the group will also affect the tunnelling incentive of the controlling shareholder. As Cheung et al. (2004) show, a controlling shareholder prefers to transfer wealth from listed firms to non-listed firms in his group. Accordingly, we expect that the larger the number or the proportion of listed firms in a group is, the more a vertical or circuitous structure would be preferred, since tunnelling is easier and the costs of tunnelling will be shared more by minority investors. In the same vein, we expect that ownership by the controlling family will be negatively correlated with the level of vertical or circuitous structure under the tunnelling hypothesis, as opposed to the control hypothesis.

The difference in the size of family ownership of group firms also functions as a background for tunnelling. We conjecture that the larger the difference is, the larger incentive for tunnelling the controlling family has. Accordingly, a more vertical or circuitous structure will be preferred to expedite the transfer of wealth. On the other hand, the difference in the performance or liquidity of member firms would increase the necessity for propping, and would lead to a more vertical or circuitous structure. We use the standard deviation of ROAs or EBITDAs of member firms to measure the difference in the performance of member firms.

Internal Capital Market Hypothesis

The provision of internal capital is an important function of a business group, as Almeida and Wolfenzon (2004) show. If a business group has financial institutions as its affiliates, or if the size of the free cash flow in the group tends to be higher, they will find it easier to finance

their investments without resorting to external capital markets.² In this case, a controlling shareholder will prefer a pyramidal or circuitous structure, as it allows him more flexibility in deploying internally financed capital among member firms. We also expect that larger difference in the performance or liquidity of member firms would necessitate a vertical or circuitous structure that will facilitate the provision of internal capital.

The debt ratio of a group will also affect the group structure. The larger the leverage is, the more a group will prefer a vertical or circuitous structure, which tends to enlarge the equity base of member firms.

Efficiency (Vertical Integration) Hypothesis

A business group whose member firms are mostly in related businesses may prefer a vertical structure to allow vertical integration between upstream and downstream firms, and to obtain a higher level of operational efficiency (Chang, 2003). Using the level of business concentration as defined above, we expect a positive correlation between this level and the level of vertical structure.

2.2. Firm Characteristics and the Position of Member Firms

The group structure only shows the level of vertical or circuitous ownership structure but does not show where and why a member firm is located in the pyramid. In this section, we identify the factors that will affect the location of a member firm in a group and derive empirical hypotheses to be tested. Depending on the objective of a controlling shareholder, firm characteristics can have diverse effects on the location of member firms in a pyramid.

Control Hypothesis

The size of the wealth of the controlling family will affect the decision regarding the location of a member firm in a group. Other things being equal, a controlling shareholder can maximize his control rights by placing those firms of which he owns relatively more shares on a higher level of the pyramid. We expect that the larger is the ownership of the controlling family, the higher is the position of a member firm in a pyramid.³

² Korean business groups own a wide range of non-bank financial institutions such as securities companies, insurance companies and credit card companies, and there is evidence that these financial institutions expedite the financing of affiliated companies. For example, it is widely known that securities companies that belong to business groups have implicit barter contracts among them where they provide underwriting services for non-affiliated companies of competing business groups under the regulatory restriction on the service to affiliated companies.

³ Inversely, we can also conjecture that controlling family will try to own more of the shares of those firms at the higher level of a pyramid, which is discussed in Jang, Kang and Park (2004). In this case, we would observe that tunnelling tend to go from those firms at the lower level of a pyramid to those firms at

For the purpose of control, firms of larger asset size, larger free cash flow, larger investment amount in affiliated firms, longer years in business or lower debt ratio would also be located on the higher level of a pyramid and play the role of an operating holding company, since they have the capital to invest in their affiliated firms. The financial stability of dominant companies in a group is also important, since a financially distressed holding company can be a serious threat to the control of a group.

Whether a member firm is listed or not will also affect the decision. It is easier for listed firms to finance investments in affiliated firms, and so they tend to be located on the higher level of a pyramid. On the other hand, if it is not easy to secure control over a listed firm since the controlling family has, by definition, a smaller ownership of listed firms, it will be placed on the lower level of a pyramid.

Tunnelling Hypothesis

The tunnelling hypothesis predicts that firms with larger free cash flow, higher profitability or a lower debt ratio can be located on the lower level of a pyramid, since these firms have corporate resources that can be diverted to other upstream firms, as Bertrand et al. and Attig et al. (2004) show. Note that this prediction is opposite to that predicted by the control hypothesis above.

Another variable we can think of in terms of tunnelling is whether a member firm is listed or not. Cheung et al. (2004) define tunnelling as a transaction between member firms that hurts the interests of minority shareholders, and propping as a transaction that benefits them. We expect that listed member firms will tend to be located on the lower level of a pyramid if tunnelling is a more dominant factor than propping, which is again opposite to what the control hypothesis predicts.

Propping Hypothesis

Friedman et al. (2003) and Riyanto and Toolsema (2004) make a case for propping, or negative tunnelling, by firms on the higher level of a group pyramid to affiliated firms in financial trouble. We expect that firms with higher profitability, a lower debt ratio and larger free cash flow will be located on the higher level of a pyramid, which is opposite to what the tunnelling hypothesis predicts.

The controlling shareholder will also locate a member firm that requires a large capital investment in a new project on the lower level of a pyramid, as Almeida and Wolfenzon (2004) argue. We expect that member firms with higher investment growth rates or large R&D investment will be located on the lower level of a pyramid.

the higher level, as Bertrand et al. (2000) argue. We deal with the endogeneity issue in Section 5.

We also expect that transactions between affiliated firms, such as sales or debt guarantees, will affect the location of member firms depending on the dominance of the tunnelling or propping incentives of a controlling family.

3. Definitions of Structural Measures

In this section, we develop measures that will measure the location of member firms in a business group, and the vertical or circuitous structure of a business group.

3.1. Measures of the Position of a Member Firm

To identify the position of a member firm in a group, we define the following measure.

The location of a firm in a group = (Number of direct and indirect investments in other member firms) / (Number of direct and indirect investments in other member firms + Number of direct and indirect ownerships of the firm by other member firms)

The number of direct investments denotes the sum of the numbers of direct investments in the shares of affiliated firms by the subject firm (see Figure 1 below for examples). The number of indirect investments denotes the sum of the numbers of indirect investments in the shares of affiliated firms through other member firms. To measure the number of direct and indirect investments, we identify every chain of investments of a member firm, count the number of direct and indirect investments on each chain, and sum the numbers. The measure usually double counts the number of direct and indirect investments when there is more than one chain of investments for a member firm.⁴

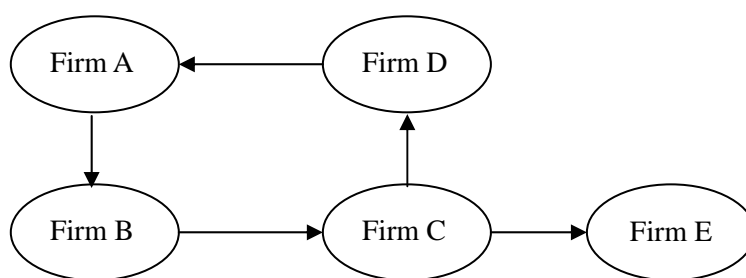
One complication occurs when an investment chain is circuitous. In this case, we assume that the investment chain stops right before the circuitous investment occurs, and count the number of direct and indirect investments in the chain. For example, in Figure 1, firm A has two chains of investments in other member firms. One chain of investments goes to firm B, firm C and firm D which invests in firm A again. It being circuitous, we assume the investment chain stops at firm D, and the number of direct and indirect investments amounts to three in the chain. Another chain of investments goes to firm B, firm C, and stops at firm E, with the number of direct and indirect investments amounting to three in the chain. Therefore, the total number of

⁴ To identify the chains of investments in a business group, we start with the ownership data for each member firm, and identify the affiliated corporate shareholders with more than 1% of ownership. Then, using the merge function of the SAS program, we identify all the chains of investments for each member firm until there is no more investment in another member firm, or until it leads to a circuitous ownership, and count the numbers of direct and indirect investments on all the investment chains identified. In our counting, the number of the chains of investments for each member firm is equal to the number of direct investments of the firm.

direct and indirect investments is six for firm A according to our definition.

The number of direct and indirect ownerships of the firm by other member firms is also calculated by identifying all the chains of ownerships that leads to the firm, and counting the number of firms in the chains. In the example, there is just one chain of ownerships that leads to firm A where firm B owns firm C, which owns firm D, which owns firm A. Therefore the number of direct and indirect ownerships for firm A is three.

<Figure 1> Measure of the Position of a Member Firm



	Number of direct investments(I)	Number of indirect investments (II)	Number of ownerships by other firms (III)	Location of a firm ((I+II)/(I+II+III))
Firm A	2	4	3	0.67
Firm B	2	3	3	0.63
Firm C	2	2	3	0.57
Firm D	2	5	3	0.70
Firm E	0	0	4	0

An index value of 1 implies that the firm is on the top of the pyramid, so it only invests in other member firms but no member firm invests in it. An index value of 0 implies the reverse of this. Of course, there can be multiple firms in a group that have an index value of 1 or 0. The index tends to be higher if a firm invests in more of other member firms, and tends to be lower when more member firms invest in the firm. It also tends to be higher when a firm invests in other member firms which tend to have more subsidiaries. This is why, in the example, firm D has the largest index even though firm A, B, C, and D are all on a chain of circuitous ownership. It eventually owns firm C which has a subsidiary, firm E.

We interpret that a higher index value implies that the firm is located at a higher level of a pyramid in a group. According to the control hypothesis, the controlling family of the group would own more of the shares of firm A since it will maximize its control over the group given the same amount of its capital.

We find that the number of the investment chains increases geometrically with the number of member firms in a group. For example, LG Construction Co. of the LG group has the largest number of direct investments of 79,940, and the largest indirect investments of 857,100 in 1997.

Considering that the LG group has 46 member firms in 1997, it implies that LG Construction Co. has approximately 1,776 (79,940/45) different paths of investments that lead to a member firm in the group.

2.2. Measures of Group Structure

In this section, we define the measures that would represent the level of vertical structure, or the level of circuitous ownership of a group.

Vertical Structure = $1 - (\text{Total number of direct investments}) / (\text{Total number of direct and indirect investments})$

This index measures how vertically member firms are deployed in a pyramid. We use the definition since we found that the relative number of direct and indirect investments changes monotonically with the level of vertical structure. The index will be higher, the more vertically member firms are located, and the index approaches 1 as all the member firms are located on a vertical chain of ownership. In Figure 1 above, the value of the index is 7/11 (1-(8/22)) (see Appendix 1 for other examples). The index attains a value of 0 when all the member firms are located horizontally and owned by a holding company such that no indirect investment exists.

Circuitous Structure = $(\text{Number of firms on circuitous chains of investments}) / (\text{Number of firms in a group})$

This measure counts the number of member firms that are placed on circuitous chains of investments and divides it by the total number of firms in a group. Of course, the index will be higher, the larger the number of member firms that are on circuitous chains of investments. However, the index, based on the number of firms on circuitous chains of investments, can be biased if there is a wide difference in the levels of member firms' direct or indirect investments in other member firms.

For example, depending on whether a member firm that has a relatively large number of direct and indirect investments is on a circuitous chain of investments or not, the level of the circuitous structure can be very different, but the above measure cannot reflect such a difference. For the sake of robustness, we define another measure of the circuitous structure. As Appendix 1 shows, a circuitous ownership structure amplifies the vertical structure.

4. Empirical Models and Data

4.1. Empirical Models

We use random effect models of the panel analysis to investigate the determinants of the group structure.⁵ Excluding those groups where no controlling family exists, we have unbalanced panels of the total sample of 211 groups over a seven-year period. Equation (1) defines the empirical model we employ, where i denotes groups, t denotes panel years (1997 through 2003), x_{it} denotes explanatory variables, u_i denotes random effects and ε_{it} denotes residuals:

$$Y_{it} = \alpha + \beta' x_{it} + u_i + \varepsilon_{it} \quad (1)$$

This equation's explanatory variables and their definitions are as follows. Total assets denotes the sum of the assets of member firms, and debt ratio is the ratio of the sum of the debts of member firms to the sum of the equities excluding stock investments by affiliated firms. Return on assets is the ratio of the sum of net profit to the sum of the total assets of member firms. We exclude financial or insurance companies in the calculation.

The holding company of a group is defined as the firm that has the largest amount of stock investments in other affiliated firms in the group. Ownership by holding company is measured as the simple or weighted average of ownerships in affiliated firms. We also employ a dummy variable that takes a value of 1 if the holding company is listed. The proportion of listed firms and the proportion of financial companies in a group are also used to reflect the financing capability of the group.

The risk of a group is measured in two ways. The first is the business concentration index, which is defined as 1 minus the ratio of the number of business lines based on the two-digit Korea Standard Industrial Classification to the number of member firms in a group. The second measure is the standard deviation of the group ROAs over the past five years. The higher these numbers are, the higher the business risk of a group is.

To measure the difference in the relative sizes of member firms, a Herfindahl index, which is defined as the sum of the squares of the proportion of each member firm in the total assets of a group, is used. A higher Herfindahl index implies that there tends to exist a large firm that plays the role of a holding company in a group.

Family ownership is the weighted average of family ownerships in each member firm. We also employ a simple average for a check. Affiliated ownership is the weighted average of the ownerships by affiliated firms.⁶

For the empirical model that identifies the determinants of the location of a member firm in a group, we use the following specification. To control for the cross-sectional effects and time-series effects of the panel data, we add industrial dummies based on the two-digit industrial

⁵ Hausman's (1978) specification test did not reject the null hypothesis that there is no correlation between independent variables and individual effects in most of the models (Hsiao, 1986).

⁶ We also checked the effect of institutional or foreign ownership, but found their coefficients to be insignificant.

classification, group dummies that identify a specific group and time dummies:

$$Y_{it} = \alpha + group_i + industry_i + year_t + \beta' x_{it} + \varepsilon_{it} \quad (2)$$

The explanatory variables of equation (2) and their definitions are as follows. Asset size is defined as the log of the assets of a member firm, and debt ratio is the ratio of debt to total assets. ROA is the net profit to total assets, and EBITDA is measured as the ratio of operating profit plus depreciation to the total assets of a firm. For the age of a firm, we use the log of the number of years in business.

The listing dummy takes a value of 1 if a member firm is listed, and 0 otherwise. R&D is the ratio of the amount of R&D expenses to total assets, and we also use the standard deviation of ROAs to measure the risk of a member firm. Sales to or from affiliated firms are also included in the model to proxy for the amount of tunnelling or propping.

The heteroskedasticity of error terms can lead to bias in the results of the empirical tests. When we applied the tests for heteroskedasticity suggested by White (1980) and Breusch and Pagan (1979), we actually observed a serious heteroskedasticity problem. We adjusted the standard error terms using the White's (1980) Consistent Covariance Matrix, and calculated test statistics controlled for the heteroskedasticity.

4.2. Selection of Sample Groups and Firms

We use the ownership and financial data on those firms that belong to Korean conglomerates designated by the Korea Fair Trade Commission each year as 'large-sized business groups'. Firms for which the summed ownerships of a controlling shareholder, his family and affiliated firms exceed 30% are defined as member firms of a business group. Firms that do not meet these criteria but are under the actual control of the controlling family are also defined as members of the business group. The data include all the ownership data on the listed and non-listed member firms of a business group, and allow us to identify the ownership and investment relationships among member firms. The data period is from 1997 through 2003, with a total of 263 sample group-years and 5,095 sample firm-years. We exclude financial groups and groups with no controlling family or no financial data.⁷ We obtain other financial data from either the KIS-2000 database or KIS-Line of Korea Credit Evaluation and Information Company, which provides the most extensive database for Korean companies, both listed and non-listed.

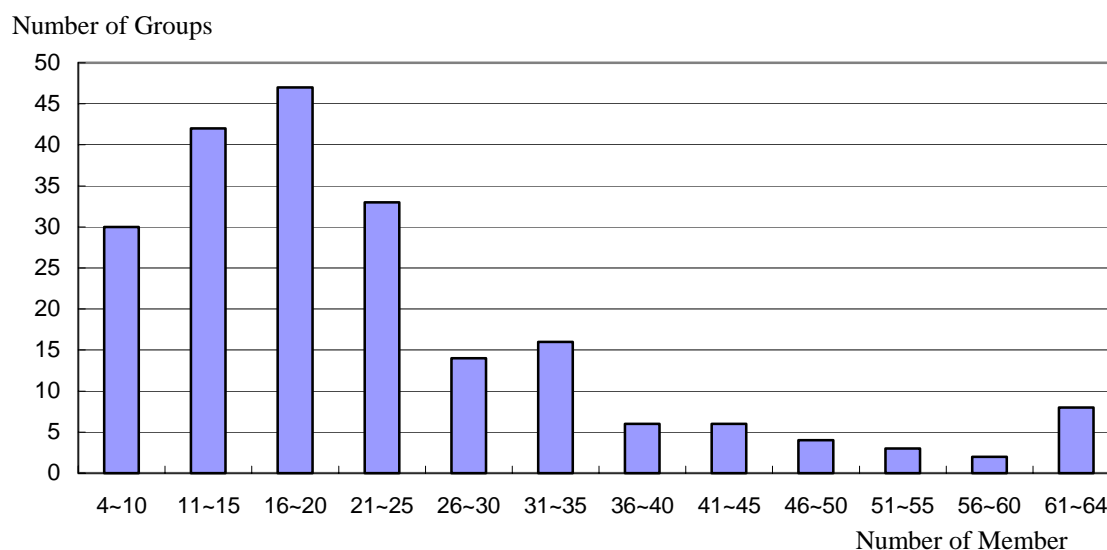
4.3. Summary Statistics of Groups

Table 2 shows the summary statistics of the sample groups. Regarding the financial data, the

⁷ Firms such as Korea Telecom or POSCO that were formerly government-owned companies but had been privatized have no controlling families.

average asset size of the sample groups during the period is about US\$13.2 billion, with a maximum of US\$87.5 billion, for the Samsung Group, and a minimum of US\$0.95 billion. The average ratio of debt to assets is 0.647. The average number of member firms in a group is 22.5, with a maximum of 64, again for the Samsung Group, and a minimum of four for the Buyoung Group. Figure 2 shows the distribution of the numbers of member firms for the sample business groups.

<Figure 2> Distribution of the Number of Member Firms



The groups are involved in 11.9 business areas on average, suggesting that only about two firms are in the same business lines according to the two-digit industrial classification. The average Herfindahl index is 0.229, suggesting that dominant firms often exist in a business group. The average ROA of the sample groups is -0.0002 with a standard deviation of 0.030 over the past five years. The average standard deviation of the ROAs of the member firms of a group is 0.1884, suggesting a large difference in performance among member firms.

Regarding the ownership data, the weighted average of the family ownership of a group is 9.88%, with a maximum of 36.46% and a minimum of 1.11%. The weighted average ownership of an affiliated firm is 37.66%, suggesting that controlling families depend heavily on affiliated ownerships to secure control. The relatively high ownership of affiliated firms also suggests that the issue of group structure would be a concern to the controlling shareholders of Korean business groups.

The holding company of a group, which is defined as the firm with the largest equity capital, provides an average of 21.5% of the total equity capital of the group, and the controlling family owns an average of 17.86% of its shares, which is much higher than the average family ownership of member firms in a group. This suggests that family ownership is concentrated in a few holding companies for the purpose of securing its control over the group with minimum investments by the family. On the other hand, holding companies are more likely to be listed so

that 91.4% of the holding companies are listed on the exchange, while the average proportion of listed firms in the sample groups is only 20.6%.

Regarding the group structure, the average value for the level of vertical structure is 0.5698, with a maximum of 0.91 for the Samsung Group, and a minimum of 0.0. The large standard deviation of 0.25 suggests that there is a wide variation in group structures among the sample groups. The average value of Circuitous Structure is 0.163, suggesting that about 16.3% of the member firms of a group are located in circuitous chains of ownership.

Table 3 shows the changes in the averages and the medians of the summary statistics over the sample periods. An interesting trend is the decreasing level of the vertical structure from 0.669 in 1997 to 0.534 in 2003. We ascribe this to the changing corporate environment in Korea where improved corporate governance and managerial transparency required on Korean firms after the Asian financial crisis made it increasingly difficult for corporate insiders to practice tunnelling. An interesting change is that the largest business groups in year 1997 had been separated into several business groups of smaller sizes as the second or third generations of their controlling families took the control of the groups. For example, the Samsung group has been separated into three independent business groups, and the Hyundai group into five independent business groups by the year 2003. The new business groups tend to have much lower levels of vertical or circuitous structure. For example, the index values of the vertical and circuitous structures of the LG group, which used to be 0.707 and 0.250 respectively in 1997, are 0.330 and 0.0 respectively in 2003 as most of its member firms are directly owned by LG Holdings.

The inside ownership, which is the sum of the ownership of the controlling family and the ownership of affiliated firms, also shows an increasing trend, from 0.442 in 1997 to 0.518 in 2003. The family ownership in the holding company of a group also shows a sharp increase, from 0.150 in 1997 to 0.243 in 2003. These changes possibly reflect the controlling families' concern about the increasing external threat to their control over their group firms.

Other time-series data tend to be stable, except for the large drop in the debt ratio in 1999 that was mainly due to the increased equity investments among affiliated firms when the government temporarily deregulated its restriction on group firms' investments in affiliated firms.⁸

4.4. Summary Statistics of Member Firms

Table 4 shows the summary statistics of the firms that belong to the sample business groups during the period 1997 through 2003. There are about 547 firms for each year, and a total of 2,963 sample firm-years for the final analysis. The simple average of the position indexes of all

⁸ The Korea Fair Trade Commission had restricted the amount of investments in the stocks of affiliated firms to a maximum of 25% of their net equity capital, but deregulated it in 1999 to allow Korean business groups to increase their inside ownerships needed for their defence against hostile takeover attempts by foreign companies.

the member firms is 0.2997, with a maximum of 1 and a minimum of 0.0. The low mean and the median of 0 imply that most of the member firms in Korean business groups are owned by other member firms, having no subsidiaries of their own. It also suggests that a typical Korean business group has a few holding companies that extensively invest in and control other affiliated firms.

The weighted average of the position index of 0.26 is smaller than the simple average, which implies that the average size of those member firms located on the lower levels of a pyramid is larger than the average size of the member firms located on the higher levels. The fact that subsidiaries tend to be larger than parent companies is another interesting piece of evidence that the controlling families of Korean business groups wisely exploit a pyramidal structure for the purpose of expanding their business and controlling more corporate resources. The proportion of member firms that are on a circuitous chain of ownership is 0.2173, and 1.39% even directly cross-owns the shares of affiliated companies.⁹

The proportion of listed firms is 0.2747, suggesting that most member firms are not listed. Table 5 compares the financial characteristics of listed and non-listed member firms. The average location index for listed member firms is 0.6506, which is significantly higher than the figure of 0.1673 for non-listed member firms. This suggests that controlling families place listed firms on the higher level of the pyramid and secure control over non-listed firms through the listed firms.

The average proportion of investments in affiliated stocks out of equity capital is 0.1931 for listed firms, while it is only 0.0129 for non-listed firms. We can also confirm that most of the inside ownership of non-listed firms consists of the affiliated ownerships of 0.6634, which is much larger than the affiliated ownerships of 0.1931 for listed firms. The statistics confirm again that listing a member firm in a group is a very efficient way of obtaining investment capital to control other non-listed member firms. However, the average family ownerships of listed and non-listed firms, 0.0977 and 0.0903 respectively, do not show much difference suggesting that tunnelling may not be an issue.

The proportions of sales and purchases that non-listed firms carried out with affiliated firms are 0.3098 and 0.1297 respectively, while the proportions of sales and purchases that listed firms carried out with affiliated firms are the lower figures of 0.1590 and 0.1077 respectively. On the other hand, the average EBITDA and ROAs of listed member firms are higher than those of non-listed member firms, while non-listed firms show much higher growth rates in fixed assets. These results suggest that non-listed firms depend more on affiliated firms for their revenues, and supports the propping hypothesis or the vertical integration hypothesis.

5. Empirical Results

⁹ In Korea, voting rights are restricted in cases of direct cross-ownerships.

5.1. Choice between Vertical and Horizontal Structures

In Panel A of Table 6, we show the regression results that test the control hypothesis in the choice of the level of vertical structure of a group.¹⁰ The control hypothesis predicts that the controlling family's incentive to secure control of its group affects the level of vertical structure. In regression (1), family ownership is negatively correlated to the index of vertical structure with the 1% significance level. This implies that the smaller the family ownership is, the more the controlling family prefers a vertical structure in order to secure control over the group with smaller family investments.

In regression (2), ownership by affiliated firms has a positive coefficient of 0.4123, which is significant at the 1% level. This result does not support the control hypothesis, since we expected that, *ceteris paribus*, larger affiliated ownership would lead to a horizontal structure. However, as we discussed earlier, the positive correlation is partly due to the tautological relationship between a vertical structure and affiliated ownership. The positive coefficient does support the tunnelling hypothesis, though, if we interpret the affiliated ownership as representing the wedge between the cash right and the control right of controlling shareholders.

In regression (3) and (4), the number of affiliated companies is positively and significantly correlated with the index, which is both consistent with the control hypothesis, and the vertical integration hypothesis. It implies that Korean business groups expand their business in a vertical structure to obtain higher operational efficiency of the groups and to allow easier control for controlling families.

In regressions (5) and (6), the Herfindahl index and the equity proportion of holding company also show respective negative coefficients of -0.5400 and -0.3011, both of which are significant at the 5% level. These results suggest that the existence of dominant firms allows the group to choose a horizontal structure, and support the control hypothesis. On the other hand, in regression (9), the variable, proportion of listed firms, is positive and significant at the 1% level. This implies that a controlling family prefers to maintain a vertical structure if there are more listed member firms in a group, since the vertical structure allows it to secure more control over the group under the distributed ownership structure of listed member firms. It is also consistent with the tunnelling hypothesis, since wealth transfer from listed firms is less costly to the controlling shareholder, who thus prefers a vertical structure for tunnelling purposes.

In regression (11), where we include all the variables, the asset size of a group has a positive coefficient of 0.0397, which is significant at the 1% level. This implies that Korean business groups expand more vertically than horizontally as their sizes grow. In the same regression, however, family ownership and the Herfindahl index lose their significance, suggesting that family ownership is not the major factor in deciding the group structure, since the controlling family can resort to affiliated companies to secure control over its group. Still, the overall

¹⁰ Throughout the regressions in the paper, we controlled for the multicollinearity problem by checking the Variance Inflation Factor (VIF) values and tolerances ($1/VIF$).

empirical results are consistent with the control hypothesis.

In Panel B of Table 6, we show the regression results that test the risk diversification hypothesis. The basic conjecture is that a higher risk of a business group would lead to a more horizontal structure, which offers a better method of risk diversification. The standard deviation of group ROAs shows a negative coefficient of -1.8084 in regression (1), which is significant at the 1% level and consistent with the risk diversification hypothesis. The number of business lines, which represent a well-diversified business portfolio, has a positive coefficient of 0.0192 in regression (2), which is also significant at the 1% level and consistent with the risk diversification hypothesis.

On the other hand, in regression (3), the coefficient of industrial concentration is positive and significant at the 1% level, which is not consistent with the risk diversification hypothesis, but rather supports the vertical integration hypothesis. This implies that Korean business groups tend to pursue higher operational efficiency through a vertical integration of their business lines where upstream firms depend on downstream firms in related business for their materials and intermediary goods. In regressions (4) through (7), where these variables are simultaneously included together with the control variables of asset size and debt ratio, they still maintain their significance. The negative coefficient of family ownership in regression (7) is also consistent with the risk diversification hypothesis.

The results in general suggest that the controlling families of Korean business groups care about their investment risk and prefer to use a horizontal structure when their investment risk is higher, while at the same time paying attention to maximizing the operational efficiency of their groups.

Regressions (8) through (12) test the tunnelling or propping hypothesis and the functioning of a business group as an internal capital market. The coefficient of standard deviation of the cash rights of the controlling family in member firms in regression (8), which is included as a proxy for the tunnelling incentive of a controlling family, is not significant. But, the ownership of affiliated firms in regression (12), which proxies the wedge between the cash right and the control right of a controlling family, shows a positive coefficient that is significant at the 1% level. This result is consistent with the tunnelling hypothesis. The larger the wedge is, the stronger incentive the controlling shareholder has to divert corporate resources away for his private benefit of control, which can be done more easily under a vertical structure.¹¹

The positive coefficients of the proportion of listed firms in a group and asset size are also consistent with the tunnelling hypothesis, since tunnelling usually goes from listed firms to non-listed member firms in a group, and a larger group size offers more corporate resources to be diverted away for the private benefit of a controlling shareholder.

On the other hand, the propping hypothesis is not well supported by the empirical analysis.

¹¹ However, we have to be careful when interpreting the result since there naturally exists a positive correlation between the wedge and the level of vertical structure, since the latter tends to increase the wedge.

In regression (9), the standard deviation of the ROAs of member firms, which we include to test whether a difference in performance would lead to a vertical structure for propping purposes, is not correlated with the dependent variable. The proportion of financial firms and the amount of free cash flow are not correlated with the group structure either, thus the propping or the internal capital market hypotheses are not supported.

In summary, the empirical results support, albeit to different extents, the conjectures we hypothesized to explain the motivations of the controlling shareholders of business groups, and are consistent with existing theories and empirical results.

5.2. Choice of Circuitous Structure

In this section, we investigate the factors that affect the choice of the level of circuitous structure of a group. We use two definitions for the dependent variable to measure the level of circuitous ownership structure. The first definition is the proportion of member firms that are on the circuitous chain of investments, and the second one is the ratio of the number of direct and indirect investments by member firms that are on the circuitous chain of investments to the number of the direct and indirect investments by all member firms in the group.

Table 7 shows the regression results based on the first definition of circuitous ownership structure. Panel A of Table 7 tests the control hypothesis, which predicts that the controlling family's incentive to secure control of its group positively affects the level of circuitous structure. The negative coefficient of family ownership in regression (1), which is significant at the 1% level, implies that lower family ownership leads to a greater degree of circuitous ownership structure in a group, supporting the control hypothesis. However, the positive and significant coefficient of affiliated ownership in regression (2) is not consistent with the control hypothesis, but is consistent with the tunnelling hypothesis, as was discussed previously. In regressions (3) and (4), the coefficient of the number of member firms in a group, which was significant in the regression model for the choice of vertical structure, is not significant anymore.

In regression (5), the Herfindahl index is negatively correlated with the circuitous structure. This suggests that the existence of a dominant firm allows the group to choose a non-circuitous structure. The coefficient of the family ownership of the holding company is also negative and significant at the 5% level in regression (7). These results are all consistent with the control hypothesis. The equity proportion of holding company, which proxies the existence of a dominant firm in a group, or the listed holding company dummy is not significant in regressions (6) and (8).

On the other hand, in regression (9), the proportion of listed firms is positively correlated and significant at the 1% level. This implies that a controlling family prefers to maintain a circuitous structure if there are more listed firms, since the circuitous structure allows it to secure more control over the group given the smaller family ownership of listed firms. In regression (11), where we include all the variables and the control variables of asset size and

debt ratio, the above results are confirmed again, while the equity proportion of holding company in a group becomes significant, which is consistent with the control hypothesis. The overall results support the control hypothesis.

In Panel B of Table 7, we show the regression results that test the risk diversification and the vertical integration hypothesis. The basic conjecture is that a higher investment risk of a controlling family would lead to a less circuitous ownership structure, while the incentive for increasing the operating efficiency of a group might lead to a circuitous structure despite increasing investment risk. In regression (7), family ownership has a significant and negative coefficient, so that larger investments by the controlling family lead to non-circuitous ownership of a well-diversified portfolio, supporting the risk diversification hypothesis. However, the number of business lines, which proxies a well diversified portfolio, is negatively correlated with a circuitous structure, with the significance at the 5% level, which does not support the risk diversification hypothesis. It suggests that the more business areas the group is operating in, the more the group tends to have independent subgroups of member firms.

Regressions (8) through (12) test the tunnelling/propping hypothesis and the functioning of a group structure as an internal capital market. The coefficient of affiliated ownership, which proxies the wedge between the cash right and the control right of a controlling family, is positive and significant at the 1% level, supporting the tunnelling hypothesis again. The larger the wedge is, the stronger incentive the controlling shareholder has to divert corporate resources away for his private benefit of control, which can be done more easily under a circuitous structure. The positive and significant coefficient of the proportion of listed member firms in a group is also consistent with the tunnelling hypothesis, since listing a firm increases the wedge between the cash right and the control right of the controlling shareholder, and a circuitous structure is preferred.

The propping hypothesis is not strongly supported in the regression models. In regression (9), the standard deviation of the ROAs of member firms in a group, which we include to test whether a difference in performance would lead to a circuitous structure for propping purposes, is not significant. The proportion of financial firms in a group and the amount of free cash flow are not correlated with the circuitous structure either. In conclusion, the regression results on the choice of circuitous structure are more consistent with the tunnelling hypothesis than with the propping hypothesis. On the other hand, in regression (12), the coefficient of debt ratio is negative and significant, which is not consistent with the internal capital market hypothesis, but rather supports the risk diversification hypothesis. We expected that the larger the leverage is, the more a group would prefer a circuitous structure that provides more equity capital for each member firm. But the result suggests that higher financial risk would lead to more independent ownership structure in a group to contain the risk of a domino of financial failures.

5.3. Decision regarding the Position of Member Firms

In this section, we show the empirical results of the analyses of the positions of member firms in a group.

Table 8 shows the results of empirical analyses where we regress the location index of member firms on their firm characteristics, and test the control hypothesis. In regressions (1) and (2), listing dummy and family ownership both show positive coefficients, significant at the 1% level, and supporting the control hypothesis. The higher the family ownership is, the more likely it is that a member firm will be located on a higher level of a pyramid, so that the controlling family can maximize its control rights through a chain of investments in the stocks of subsidiaries. Listed companies located on higher levels of a pyramid also allow the controlling family to minimize the required capital for securing control.

The positive coefficients of asset size in regressions (3) and (4), which are significant at the 1% level, also support the control hypothesis. The larger the firm is, the more likely it is to be located on the higher level of a pyramid to own and control other subsidiaries.

In regressions (4) through (6), we add ROA, EBITDA, debt ratio and the number of years in business. The negative coefficient of debt ratio supports the control hypothesis since financially weak firm cannot be utilized to control other member firms. ROA and EBITDA have negative coefficients, both significant at the 1% level. The result implies that member firms which perform well and have large liquidity tend to be located on the lower levels, and their resources would be tunnelled to member firms located on the higher levels of a group pyramid, of which the controlling family tends to own more shares as Attig et al. (2004) conjectured. The result is consistent with the tunnelling hypothesis. Years in business has a positive coefficient with a 1% significance level, and is consistent with Almeida and Wolfenzon (2004), who argue that new firms will be added to their group either horizontally or vertically.

On the other hand, the negative coefficients of fixed asset growth rates and the standard deviation of ROAs in regressions (8) and (9) support the propping hypothesis, which states that fast-growing, but risky firms are located on the lower levels of a firm and are supported by upstream firms of larger, established member firms. In regressions (10), sales to or purchases from affiliated firms have negative coefficients, supporting the propping hypothesis, but lose their significance or have their signs reversed when other variables are added in regressions (11) through (13).

In summary, the empirical results are consistent with the control hypothesis, and also support the tunnelling or propping hypothesis as we conjectured.

5.4. Decision regarding Circuitous Ownership of Member firms

In this section, we show the empirical results of the test of the factors that affect whether a member firm will be located on a circuitous chain of ownership in a group. The dependent variable is a dummy variable that takes a value of 1 if a member firm is on a circuitous chain of investments, and 0 otherwise.

Table 9 shows the results of empirical tests based on logit analyses. In the tests of the control hypothesis in regression (1), family ownership has a positive coefficient, with the significance at the 1% level. This implies that the controlling shareholder prefers to place a member firm of which he owns more shares on a circuitous chain of ownership, so that he can maximize his controlling power. We also conjecture that he owns more of the shares of a member firm that is on a circuitous chain of ownership. Another possible interpretation is that those firms on the circuitous chain of ownership are key member firms for the control of his business group, and the controlling shareholder and affiliated firms tend to own more of the shares, even resorting to cross-ownership.

In regression (2), listing dummy is also positively and significantly correlated with circuitous ownership, supporting the control hypothesis. Due to its dispersed ownership structure, a listed member firm could be a target of an M&A threat and be better protected through the circuitous ownership of other affiliated firms. Asset size and EBITDA also have positive coefficients in regressions (3), (4) and (5). The larger a member firm is, the more it needs to be protected, or the more it can be used to invest in and protect other member firms through circuitous ownership. Debt ratio has a negative coefficient but is not significant. This result suggests that expanding the equity base of financially weak member firms is not the main reason for the circuitous ownership. Years in business also has a positive and significant coefficient, suggesting that old member firms tend to play the important role of a medium for securing control over other member firms.

Regressions (6) through (9) test the tunnelling or risk diversification hypothesis. The general conjecture is that member firms that are newly established or financially weak firms will be on a circuitous chain and obtain subsidy from other member firms. On the other hand, the risk diversification hypothesis conjectures that those firms will be outside the circuitous chain to localize any risk related to new business or financial failure. R&D expenses, growth rates of fixed assets and the standard deviation of ROAs have negative coefficients, supporting the risk diversification hypothesis rather than the tunnelling hypothesis. However, in regressions (10) through (12), they lose their significance with other variables added. The negative coefficient of sales to affiliated firms in regression (9) also fails to support the tunnelling hypothesis.

In sum, the empirical results support the control hypothesis and the risk diversification hypothesis. Controlling shareholders use a circuitous structure mainly for the purpose of securing control, but the tunnelling or internal capital market hypotheses are not supported.

5.5. Simultaneous Regression Models

In the empirical analysis above, we have not considered the endogeneity issues between the dependent variables and the independent variables. Especially, family ownership and listing of each member firm would be decided simultaneously with the position or circuitous ownership of member firms. In this section, we deal with the endogeneity problems by estimating the

following simultaneous regression models using the two-stage least square analysis.

Family Ownership = f (Position Index, Circuitous ownership dummy, Listing dummy, Ln (Assets), ROA, SD of ROAs, Investment in equities, year dummy, group dummy, industry dummy)

Position Index = g (Family ownership, Circuitous ownership dummy, Listing dummy, Ln (Assets), Debt ratio, EBITDA, Fixed asset growth rates, Ln (Years in Business), year dummy, group dummy, industry dummy)

Circuitous Ownership Dummy = h (Family ownership, Position Index, Listing dummy, Ln (Assets), Debt ratio, EBITDA, Ln (Years in Business), year dummy, group dummy, industry dummy)

Listing Dummy = I (Family ownership, Position Index, , Ln (Assets), ROA, , Ln (Years in Business), year dummy, group dummy, industry dummy)

The equation for family ownership is based on Demsetz and Lehn (1985) and Jang, Kang, and Park (2004). The explanatory variables include position index, circuitous ownership dummy, listing dummy, and investment in equities among others. The equations for position index and circuitous ownership dummy are based on the previous models of this paper. Finally, the equation for listing dummy includes asset size, profitability (ROA), and years in business as its explanatory variables.

Table 10 shows the results of the empirical tests. Family ownership is higher when a member firm is located at a higher level of a group pyramid and when it is more profitable, while it is lower when it is listed. The results support the control hypothesis.

A member firm is located at a higher level of a pyramid when its family ownership is larger, and when it is listed and financially stable with a large asset size and a low debt ratio. On the other hand, a member firm is located at a lower level when it shows a fast growth. The results are consistent with the control hypothesis and the propping hypothesis.

A member firm is listed when it has been in business for a long time and it is more profitable. A member firm has a cross ownership with other member firms when it is listed and liquid, but has a high debt ratio. The positive correlation between debt ratio or liquidity and the cross ownership supports the control hypothesis and the propping hypothesis again. Over all, the simultaneous models confirm the previous results.

6. Conclusion

This paper has examined the structure of business groups. We investigated the factors that affect a controlling shareholder's decision regarding the structure of his business group and the location of its member firms, using financial and ownership data on conglomerate groups in Korea.

We empirically confirmed that controlling shareholders strategically choose the structure of

their business groups to secure control over the groups and to seek private benefit of control. The risk diversification incentive of controlling shareholders was also found to affect the decision. We found that controlling shareholders prefer a vertical group rather than a horizontal group for the purpose of securing their control when their family ownerships are lower, there is no dominant holding company, and member firms are mostly listed. On the other hand, higher investment risk leads to a more horizontal structure. The pursuit of higher operation efficiency through vertical integration in groups with a more concentrated business portfolio was also confirmed.

We also found that member firms with higher family ownership and larger asset size tend to be located on the higher levels of a group pyramid, again supporting the control hypothesis. On the other hand, firms with higher profitability or liquidity are located on the lower levels, supporting the tunnelling hypothesis while the fact that riskier member firms are located on the lower levels of a group pyramid supports the propping or risk diversification hypothesis. We also checked the results using simultaneous models to accommodate the endogeneity problem among variables. The overall results strongly support the control hypothesis, while the propping or risk diversification hypothesis is also supported with varying degrees.

The empirical results of the paper are mostly consistent with the existing theories, which argue that the main purpose of a pyramidal group structure is to secure the control of controlling shareholders and to maximize their private benefit of control.

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<Table 1> Selection of Sample Groups

The numbers in parentheses denote the number of business groups.

Year	Number of Firms(A) (Groups) ¹	Groups with no Controlling Family ²	Financial Firms	Independent Firms	No Financial Data	Firms with negative equity values	Final Samples		B/A (%)
							Firms(B) (Groups)	Listed firms	
1997	804 (30)	0 (0)	101	70	101	89	443 (30)	143	55.1
1998	686 (30)	0 (0)	93	64	87	68	374 (30)	126	54.5
1999	544 (30)	30 (6)	78	33	54	24	325 (24)	104	59.7
2000	624 (30)	32 (5)	79	56	40	22	395 (25)	100	63.3
2001	704 (43)	62 (12)	78	77	24	17	446 (31)	105	63.4
2002	841 (49)	98 (14)	85	106	34	26	492 (35)	116	58.5
2003	892 (51)	109 (15)	78	125	67	25	488 (36)	120	54.7
Total	5,095 (263)	331 (52)	592	531	407	271	2,963 (211)	814	58.2

<Table 2> Summary Statistics of Group Structure

The sample includes 211 business groups (unbalanced panel) over the period 1997 through 2003. Vertical index is $1 - (\text{Total number of direct investments}) / (\text{Total number of direct and indirect investments})$. Circuitous index I is the ratio of the number of firms on circuitous chains of ownership to the number of firms in a group, and Circuitous index II is the ratio of the number of direct and indirect investments by the member firms on circuitous chains of ownership to the number of direct and indirect investments by all member firms. Family ownership is the sum of ownerships by a controlling shareholder and his family members, and affiliated ownership is the sum of ownerships by affiliated companies. Inside ownership is the sum of family and affiliated ownerships. Weighted averages are weighted by the equity portion of each member firm in a group. The number of business lines is based on the two-digit industrial classification, and the industrial concentration is $1 - (\text{Number of business lines} / \text{Number of member firms})$. Group ROA is the ratio of total net income to total assets of a group excluding financial companies. Standard deviation of group ROAs is the standard deviation of group ROAs over year -4 through year 0. Herfindahl index is the sum of the squares of the proportion of each member firm's equity in the total equities of a group. Standard deviations of cash flow rights is the standard deviation of cash flow rights of all member firms in a group, where cash flow rights are calculated fully reflecting the direct and indirect ownerships of the controlling family in a group. Standard deviations of ROAs are the standard deviations of ROAs of member firms in a group excluding financial companies. Free cash flow is the ratio of the sum of operating income and depreciation to total assets in a group excluding financial companies, and the equity investment of holding company is the ratio of the equity held by the holding company to the total equity of a group, where the holding company is the member firm that has the largest equity investment in the group. Debt ratio is the ratio of debt to total assets of a group.

Variables	Average	Median	Standard Deviation	Minimum	Maximum
Vertical Index	0.5698	0.6390	0.2492	0.0000	0.9123
Circuitous Index	0.1634	0.1500	0.1686	0.0000	0.7273
Simple Average of Inside Ownerships	0.6848	0.6889	0.0988	0.3226	0.9865
Simple Average of Family ownerships	0.1288	0.1038	0.0981	0.0116	0.4970
Simple Average of Affiliated Ownerships	0.5310	0.5475	0.1141	0.1375	0.7372
Weighted Average of Inside Ownerships	0.4867	0.4861	0.1336	0.1775	0.9760
Weighted Average of Family ownerships	0.0988	0.0752	0.0740	0.0111	0.3646
Weighted Average of Affiliated Ownerships	0.3766	0.3890	0.1320	0.0447	0.7216
Number of Member Firms	22.5261	19.0000	13.4940	4.0000	64.0000
Number of Business Lines	11.9052	12.0000	4.7480	2.0000	29.0000
Industrial Concentration	0.4139	0.4118	0.1469	0.0000	0.7368
Group ROA	-0.0002	0.0101	0.0668	-0.5063	0.1256
SD of Group ROAs	0.0300	0.0231	0.0261	0.0023	0.2271
Herfindahl Index of a group	0.2292	0.1854	0.1540	0.0473	0.7973
SD of Cash Flow Rights of Controlling Families	0.1884	0.1914	0.0886	0.0155	0.4295
SD of firm ROAs	0.1917	0.0961	0.4324	0.0024	5.4489
Free Cash Flow	0.0529	0.0513	0.0357	-0.0965	0.1705
Equity Investments of Holding Company	0.2150	0.2013	0.1046	0.0240	0.7009
Family ownership in Holding Company	0.1786	0.1626	0.1576	0.0000	0.9999
Listed Holding Company Dummy	0.9147	1.0000	0.2800	0.0000	1.0000
Proportion of Listed Member Firms	0.2062	0.1905	0.1009	0.0000	0.4857
Proportion of Financial Companies	0.1200	0.0952	0.1154	0.0000	0.6000
Total Assets(Billion Wons)	13,284.90	4,926.00	18899.30	958.00	87,555.00
Ln (Total Assets)	8.8258	8.5023	1.0575	6.8648	11.3800
Debt Ratio	0.6737	0.6477	0.1790	0.1872	1.3969

<Table 3> Trends of Group Data

See Table 2 for the definitions of the variables. The test of difference is between the current and previous years, using t-statistics for the averages and Wilcoxon z-statistics for the medians. a, b and c denote significance at the 1%, 5% and 10% levels respectively.

Variables	Year 1997		Year 1998		Year 1999		Year 2000		Year 2001		Year 2002		Year 2003	
	Average	Median	Average	Median	Average	Median	Average	Median	Average	Median	Average	Median	Average	Median
Vertical Index	0.669	0.715	0.567 ^c	0.631	0.580	0.674	0.581	0.657	0.525	0.623	0.548	0.631	0.534	0.575
Circuitous Index	0.160	0.154	0.121	0.043	0.180	0.163	0.174	0.156	0.166	0.145	0.173	0.156	0.172	0.137
Weighted Average of Family ownerships	0.098	0.085	0.075	0.059	0.078	0.051	0.085	0.058	0.109	0.100	0.118	0.097	0.114	0.103
Weighted Average of Affiliated ownerships	0.344	0.332	0.380	0.397	0.355	0.372	0.378	0.375	0.378	0.418	0.386	0.432	0.404	0.426
Number of Member Firms	26.800	22.500	22.867	18.000 ^c	21.333	18.500	23.600	19.000	20.645	17.000	21.171	17.000	21.667	16.500
Number of Business Lines	14.600	14.000	12.900	12.500^b	12.083	11.000	12.160	12.000	10.581	10.000	10.743	10.000	10.806	10.000
Industrial Concentration	0.421	0.405	0.385	0.387	0.388	0.390	0.431	0.421	0.415	0.423	0.421	0.455	0.430	0.461
SD of Group ROAs	0.016	0.010	0.032^b	0.021	0.029	0.022	0.032	0.023	0.033	0.031	0.040	0.029	0.027	0.023 ^c
Herfindahl Index of a group	0.166	0.140	0.192	0.172	0.237	0.182	0.230	0.190	0.259	0.195	0.260	0.207	0.251	0.216
SD of Cash Flow Rights of Controlling Families	0.209	0.212	0.186	0.168	0.189	0.177	0.174	0.154	0.172	0.167	0.197	0.211 ^c	0.189	0.202
SD of firm ROAs	0.219	0.083	0.235	0.174^b	0.326	0.084	0.173	0.111	0.139	0.111	0.191	0.084	0.103	0.085
Free Cash Flow	0.052	0.053	0.033^b	0.040	0.048	0.046	0.056	0.051	0.051	0.052	0.058	0.061	0.068	0.066
Equity Investments of Holding Company	0.167	0.160	0.222^b	0.185	0.201	0.191	0.211	0.204	0.227	0.208	0.220	0.212	0.246	0.235
Family ownership in Holding Company	0.150	0.090	0.148	0.103	0.129	0.120	0.163	0.182	0.196	0.184	0.193	0.217	0.243	0.238
Listed Holding Company Dummy	0.867	1.000	0.900	1.000	0.958	1.000	0.960	1.000	0.936	1.000	0.914	1.000	0.889	1.000
Proportion of Listed Member Firms	0.222	0.197	0.229	0.212	0.226	0.211	0.204	0.176	0.192	0.172	0.181	0.167	0.199	0.184
Proportion of Financial Companies	0.119	0.119	0.120	0.118	0.136	0.117	0.123	0.111	0.132	0.095	0.116	0.087	0.102	0.070
Ln (Total Assets)	8.962	8.640	8.990	8.618	9.011	8.644	9.064	8.583	8.678	8.359	8.586	8.314	8.648	8.424
Debt Ratio	0.853	0.825	0.829	0.773	0.664^a	0.628^a	0.620	0.619	0.612	0.606	0.601	0.597	0.563	0.568
Number of samples	30		30		24		25		31		35		36	

<Table 4> Summary Statistics of Member Firms

The sample includes 2,963 firms (unbalanced panel) over the period 1997 through 2003. The location of a firm in a group (position index) is the ratio of the number of direct and indirect investments in other member firms to the sum of the number of direct and indirect investments in other member firms and the number of direct and indirect ownerships of the firm by other member firms. Circuitous ownership dummy takes a value of 1 if a firm is on a circuitous chain of investments, and 0 otherwise. Family ownership is the sum of ownerships of a controlling shareholder and his family members, and affiliated ownership is the sum of ownerships of affiliated companies. Inside ownership is the sum of family, executive and affiliated ownerships. Investment in equity is the ratio of the equity investment of a firm to the total equity investments of member firms in a group. R&D is the ratio of R&D expenses to total assets. Fixed asset growth rate at t is the ratio of fixed assets at t minus fixed assets at t-1 to fixed assets at t-1. Standard deviation of ROAs is the standard deviation of ROAs of a firm over year -4 through year 0. ROA is the ratio of net income to total assets. EBITDA is the ratio of the sum of operating income and depreciation to total assets and debt ratio is the ratio of debt to total assets. Sales to affiliated firms or purchases from affiliated firms are relative to the total sales of a firm.

Variables	Number of Samples	Average	Median	Standard Deviation	Minimum	Maximum
Position Index	2,963	0.2997	0.0000	0.4049	0.0000	1.0000
Number of Indirect Investments	2,963	4,691.0	0.0000	41,364.7	0.0000	857,100
Number of Direct Investments	2,963	512.8	0.0000	4,067.2	0.0000	79,940
Circuitous Dummy	2,963	0.2173	0.0000	0.4125	0.0000	1.0000
Inside Ownership	2,963	0.6533	0.6501	0.2962	0.0000	1.0000
Family ownership	2,963	0.0923	0.0000	0.1796	0.0000	1.0000
Affiliated Ownership	2,963	0.5450	0.5000	0.3309	0.0000	1.0000
Investment in Equities	2,963	0.0624	0.0001	0.1643	0.0000	1.0000
Assets (million won)	2,963	907,433.67	114,349.98	2485463.89	49.0980	39,203,381
Ln (Assets)	2,963	18.6850	18.5548	2.1317	10.8016	24.3920
Debt Ratio	2,963	0.5976	0.6317	0.2338	0.0000	0.9982
ROA	2,963	0.0040	0.0164	0.1592	-2.8037	0.8718
EBITDA	2,963	0.0460	0.0535	0.1625	-3.3694	2.1647
Years in Business	2,963	17.5301	14.0927	14.5794	0.0001	79.0230
Ln (Years in Business)	2,963	2.1824	2.6457	1.6796	-9.2103	4.3697
R&D	2,963	0.0033	0.0000	0.0111	0.0000	0.1482
Fixed Asset Growth Rates	2,744	0.5273	0.0634	3.1409	-0.9951	78.3814
SD of ROAs	2,190	0.0521	0.0322	0.0692	0.0001	0.7848
Sales to Affiliated firms	2,610	0.2645	0.1214	0.3138	0.0000	1.0000
Purchase from Affiliated firms	2,610	0.1231	0.0445	0.1938	0.0000	1.0000
Listing Dummy	2,963	0.2747	0.0000	0.4464	0.0000	1.0000

<Table 5> A Comparison of Listed and Non-Listed Member Firms

The sample includes 2,963 firms, of which 814 are listed firms and 2,149 are non-listed firms. See <Table 12> for the definitions of the variables. The test of difference uses t-statistics for the averages and Wilcoxon z-statistics for the medians.

Variables	Listed Firms		Non-listed Firms		Test of difference (p-value)	
	Average	Median	Average	Median	Average	Median
Position Index	0.6514	0.8578	0.1665	0.0000	<.0001	<.0001
Circuitous Dummy	0.4865	0.0000	0.1154	0.0000	<.0001	<.0001
Inside Ownership	0.3435	0.3097	0.7707	0.8507	<.0001	<.0001
Family ownership	0.0977	0.0397	0.0903	0.0000	0.223	<.0001
Affiliated ownership	0.2326	0.2102	0.6634	0.6669	<.0001	<.0001
Investment in Equities	0.1931	0.0690	0.0129	0.0000	<.0001	<.0001
Ln (Assets)	20.7975	20.8502	17.8849	17.8072	<.0001	<.0001
Debt ratio	0.6287	0.6408	0.5858	0.6236	<.0001	0.013
ROA	0.0114	0.0146	0.0012	0.0171	0.035	0.121
EBITDA	0.0640	0.0608	0.0392	0.0479	<.0001	<.0001
Ln (Years in Business)	3.3293	3.4347	1.7480	2.2086	<.0001	<.0001
R&D	0.0028	0.0003	0.0034	0.0000	0.112	<.0001
Fixed Asset Growth Rates	0.1515	0.0498	0.6839	0.0700	<.0001	0.121
SD of ROAs	0.0415	0.0221	0.0580	0.0402	<.0001	<.0001
Sales to Affiliated firms	0.1590	0.0838	0.3098	0.1672	<.0001	<.0001
Purchase from Affiliated firms	0.1077	0.0550	0.1297	0.0385	0.002	<.0001

<Table 6> The Choice of Vertical versus Horizontal Structure

We use random effects model of panel analysis reflecting cross-sectional factors and time-series factors in the error terms. The dependent variable is vertical index, which is defined as $1 - (\text{Total number of direct investments}) / (\text{Total number of direct and indirect investments})$. The numbers in parentheses denote z-values, and ***, ** and * denote significance at the 1%, 5% and 10% levels respectively.

(Panel A) Test of the Control hypothesis

Family ownership is the sum of ownerships of a controlling shareholder and his family members, and affiliated ownership is the sum of ownerships of affiliated companies. Weighted averages are weighted by the equity portion of a firm in a group. The number of business lines is based on the two-digit industrial classification, and the industrial concentration is $1 - (\text{Number of business lines} / \text{Number of member firms})$. Herfindahl index is the sum of the squares of the proportion of each member firm in the total equities of a group. The equity investments of holding company is the ratio of the equity held by the holding company to the total equity of a group, where the holding company is the member firm that has the largest equity investments in the group. Debt ratio is the ratio of debt to total assets of a group.

Regressions	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Constants	0.6288 (15.68)***	0.3796 (8.16)***	0.3733 (11.20)***	0.1357 (0.65)	0.6655 (18.69)***	0.6027 (14.35)***	0.5500 (16.01)***	0.5725 (10.46)***	0.4349 (9.59)***	-0.0199 (-0.10)	-0.0031 (-0.02)
Weighted Average of Family ownerships	-0.8313 (-3.29)***			-0.5081 (-2.16)**							-0.1036 (-0.48)
Weighted Average of Affiliated ownerships		0.4123 (4.34)***									1.0926 (8.79)***
Number of Member Firms			0.0079 (7.49)***	0.0062 (4.79)***							
Herfindahl Index of a group					-0.5400 (-5.92)***					-0.4206 (-4.56)***	-0.1391 (-1.63)
Equity Proportion of Holding Company						-0.3011 (-2.35)**				-0.2607 (-2.24)**	-1.2500 (-8.50)***
Family ownerships in Holding Company							-0.0744 (-0.91)				-0.0893 (-1.30)
Listed Holding Company Dummy								-0.0414 (-0.84)			
Proportion of Listed Member Firms									0.5050 (2.92)***	0.1973 (1.23)	0.4740 (3.44)***
Ln (Total Assets)				0.0372 (1.59)						0.0789 (4.04)***	0.0397 (2.45)**
Debt ratio				0.0116 (0.16)						-0.0042 (-0.06)	0.0504 (0.80)
R ²	0.3157	0.1178	0.3320	0.4196	0.2552	0.0822	0.0943	0.0063	0.2086	0.4497	0.6770

(Panel B) Test of the Risk Diversification, the Vertical Integration and the Tunnelling Hypothesis

Family ownership is the sum of ownerships by a controlling shareholder and his family members, and affiliated ownership is the sum of ownerships by affiliated companies. Weighted averages are weighted by the equity portion in a group. Standard deviation of group ROAs is the standard deviation of group ROAs over year -4 through year 0. The number of business lines is based on the two-digit industrial classification, and the industrial concentration is $1 - (\text{Number of business lines} / \text{Number of member firms})$. Standard deviations of cash flow rights are the standard deviations of cash flow rights of all member firms in a group, where cash flow rights are calculated fully reflecting the direct and indirect ownerships of the controlling family in a group. Standard deviations of ROAs are the standard deviations of ROAs of member firms in a group excluding financial companies. Free cash flow is the ratio of the sum of operating income and depreciation to total assets in a group excluding financial companies. Debt ratio is the ratio of debt to total assets of a group.

Regressions	Risk diversification / Vertical Integration							Tunnelling or Propping/Internal Capital Market				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Constants	0.5958 (16.61)***	0.3205 (7.64)***	0.2733 (5.89)***	-0.3864 (-2.09)**	-0.1341 (-0.69)	-0.2250 (-1.28)	0.1690 (0.85)	0.5327 (11.75)***	0.5297 (16.52)***	0.5150 (14.33)***	0.5344 (15.01)***	-0.5546 (-2.83)***
Weighted Average of Family ownership							-0.6965 (-3.00)***					-0.1775 (-0.69)
Weighted Average of Affiliated ownership												0.3729 (3.89)***
SD of Group ROAs	-1.8084 (-3.81)***			-1.4558 (-3.22)***	-1.0309 (-2.25)**	-1.4123 (-3.32)***	-1.4440 (-3.28)***					
Number of Business Lines		0.0192 (6.51)***			0.0115 (3.12)***		0.0084 (2.40)**					
Industrial Concentration			0.6505 (7.13)***			0.5166 (5.30)***	0.4746 (4.94)***					
SD of Cash Flow Rights of Controlling Families								0.0116 (0.07)				0.0602 (0.38)
SD of firm ROAs									0.0249 (1.00)			0.0116 (0.48)
Free Cash Flow										0.4109 (1.15)		0.1947 (0.58)
Proportion of Financial Companies											0.0058 (0.04)	-0.1014 (-0.69)
Proportion of Listed Member Firms												0.3820 (2.27)**
Ln (Total Assets)				0.1073 (5.47)***	0.0666 (2.90)***	0.0609 (2.98)***	0.0204 (0.89)					0.0945 (4.86)***
Debt ratio				0.0675 (0.88)	0.0026 (0.03)	0.1091 (1.50)	0.0481 (0.65)					0.0964 (1.20)
R ²	0.0047	0.3214	0.2281	0.2739	0.3439	0.3690	0.4871	0.0137	0.0003	0.0017	0.0433	0.4202

<Table 7> The Choice of Circuitous Structure

We use random effects model of panel analysis reflecting cross-sectional factors and time-series factors in the error terms. The dependent variable is vertical index, which is defined as (Total number of direct investments)/(Total number of direct and indirect investments). The numbers in parentheses denote z-values and, ***, ** and * denote significance at the 1%, 5% and 10% levels respectively.

(Panel A) The Test of the Control Hypothesis

Family ownership is the sum of ownerships by a controlling shareholder and his family members, and affiliated ownership is the sum of ownerships by affiliated companies. Weighted averages are weighted by the equity portion in a group. The number of business lines is based on the two-digit industrial classification, and the industrial concentration is 1-(Number of business lines/Number of member firms). Herfindahl index is the sum of the squares of the proportion of each member firm in the total equities of a group. The equity investments of holding company is the ratio of the equity held by the holding company to the total equity of a group, where the holding company is the member firm that has the largest equity investments in the group. Debt ratio is the ratio of debt to total assets of a group.

Regressions	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Constants	0.2059 (6.66)***	0.0244 (0.65)***	0.1540 (5.24)***	0.2654 (1.39)	0.1950 (6.88)***	0.1560 (4.83)***	0.1790 (7.36)***	0.2158 (4.92)***	0.0638 (1.86)*	0.3189 (1.88)*	0.3127 (1.88)*
Weighted Average of Family ownership	-0.5401 (-2.63)***			-0.5984 (-2.73)***							0.0025 (0.01)
Weighted Average of Affiliated ownership		0.3214 (3.83)***									0.7759 (6.32)***
Number of Member Firms			-0.0004 (-0.40)	-0.0015 (-1.19)							
Herfindahl Index of a group					-0.2055 (-2.47)**					-0.1828 (-2.11)**	0.0419 (0.50)
Equity Proportion of Holding Company						-0.0461 (-0.41)				-0.0983 (-0.88)	-0.7518 (-5.23)***
Family ownership in Holding Company							-0.1680 (-2.44)**				-0.2278 (-3.33)***
Listed Holding Company Dummy								-0.0772 (-1.82)*			
Proportion of Listed Member Firms									0.4111 (2.91)***	0.3580 (2.44)**	0.5382 (4.06)***
Ln (Total Assets)				0.0105 (0.49)						-0.0085 (-0.50)	-0.0316 (-2.05)**
Debt ratio				-0.1632 (-2.36)**						-0.1517 (-2.23)**	-0.1298 (-2.13)**
R ²	0.1131	0.0449	0.0228	0.1214	0.0899	0.0447	0.0662	0.0128	0.1855	0.2454	0.4142

(Panel B) Test of the Risk Diversification, the Vertical Integration and the Tunnelling Hypothesis

Family ownership is the sum of ownerships by a controlling shareholder and his family members, and affiliated ownership is the sum of ownerships by affiliated companies. Weighted averages are weighted by the equity portion in a group. Standard deviation of group ROAs is the standard deviation of group ROAs over year -4 through year 0. The number of business lines is based on the two-digit industrial classification, and the industrial concentration is 1-(Number of business lines/Number of member firms). Standard deviations of cash flow rights are the standard deviations of cash flow rights of all member firms in a group, where cash flow rights are calculated fully reflecting the direct and indirect ownerships of the controlling family in a group. Standard deviations of ROAs are the standard deviations of ROAs of member firms in a group excluding financial companies. Free cash flow is the ratio of the sum of operating income and depreciation to total assets in a group excluding financial companies. Debt ratio is the ratio of debt to total assets of a group.

Regressions	Risk diversification / Vertical Integration							Tunnelling or Propping and Internal Capital Market				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Constants	0.1568 (6.23)***	0.1828 (4.91)***	0.0887 (2.21)**	0.1530 (0.98)	0.0237 (0.14)	0.1704 (1.09)	0.2944 (1.56)	0.1831 (5.29)***	0.1474 (6.92)***	0.1531 (5.91)***	0.1243 (5.15)***	0.1846 (1.07)
Weighted Average of Family ownership							-0.6822 (-3.03)***					-0.2593 (-1.15)
Weighted Average of Affiliated ownership												0.2873 (3.24)***
SD of Group ROAs	-0.3392 (-0.81)			-0.1933 (-0.46)	-0.3895 (-0.90)	-0.2048 (-0.48)	-0.7817 (-1.78)*					
Number of Business Lines		-0.0033 (-1.21)			-0.0066 (-1.91)*		-0.0080 (-2.29)**					
Industrial Concentration			0.1414 (1.64)			0.1108 (1.16)	0.1457 (1.54)					
SD of Cash Flow Rights of Controlling Families								-0.1938 (-1.36)				-0.0895 (-0.63)
SD of firm ROAs									-0.0090 (-0.40)			-0.0055 (-0.24)
Free Cash Flow										-0.1539 (-0.49)		-0.3532 (-1.14)
Proportion of Financial Companies											0.1980 (1.54)	0.1054 (0.82)
Proportion of Listed Member Firms												0.3624 (2.41)**
Ln (Total Assets)				0.0111 (0.67)	0.0330 (1.61)	0.0030 (0.17)	0.0065 (0.30)					-0.0095 (-0.56)
Debt ratio				-0.1396 (-1.98)**	-0.1080 (-1.49)	-0.1283 (-1.81)*	-0.1039 (-1.44)					-0.1211 (-1.67)*
R ²	0.0050	0.0273	0.0308	0.0263	0.0222	0.0280	0.1181	0.0128	0.0065	0.0115	0.0929	0.2658

<Table 8> The Determinants of a Firm's Location in a Group

We use a total sample of 2,963 firms over the period 1997 through 2003. The dependent variable is the location of a firm in a group (position index), which is the ratio of the number of direct and indirect investments in other member firms to the sum of the number of direct and indirect investments in other member firms and the number of direct and indirect ownerships of the firm by other member firms. Family ownership is the sum of ownerships by a controlling shareholder and his family members. ROA is the ratio of net income to total assets. EBITDA is the ratio of the sum of operating income and depreciation to total assets and debt ratio is the ratio of debt to total assets. Listing dummy takes a value of 1 if a member firm is listed, and 0 otherwise. R&D is the ratio of R&D expenses to total assets. Fixed asset growth rate at t is the ratio of fixed assets at t minus fixed assets at t-1 to fixed assets at t-1. Standard deviations of ROAs are the standard deviations of ROAs of firms over the past five years. Sales to affiliated firms or purchases from affiliated firms are relative to the total sales of a firm. Each regression model includes industrial dummy, year dummy and group dummy. The numbers in parentheses denote heteroskedasticity-consistent t-values, and ***, ** and * denote significance at the 1%, 5% and 10% levels respectively.

Regressions	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Constants	0.2531 (1.24)	0.3252 (1.54)	-1.9438 (-7.73)***	-1.9653 (-7.84)***	-1.2225 (-5.40)***	-1.2075 (-5.36)***	0.3969 (1.66)*	0.3995 (1.65)*	0.4551 (1.89)*	0.3425 (1.54)	-1.4099 (-5.32)***	-1.3992 (-5.31)***	-1.7293 (-6.46)***
Listing Dummy	0.4987 (30.25)***				0.2746 (14.74)***	0.2767 (14.79)***					0.2611 (13.09)***	0.2629 (13.11)***	0.2115 (9.14)***
Family ownership		0.7379 (16.78)***			0.6085 (16.61)***	0.6030 (16.41)***					0.6290 (15.83)***	0.6248 (15.67)***	0.6158 (13.58)***
ROA					-0.1213 (-4.63)***						-0.1117 (-3.62)***		
EBITDA				-0.0963 (-3.96)***		-0.0614 (-2.58)***							-0.0437 (-1.62)
Ln (Assets)			0.1257 (38.67)***	0.1271 (38.71)***	0.0832 (19.89)***	0.0822 (19.64)***					0.0868 (17.96)***	0.0861 (17.79)***	0.0939 (14.67)***
Debt ratio					-0.1342 (-5.32)***	-0.1280 (-5.03)***					-0.1119 (-3.55)***	-0.1053 (-3.31)***	-0.0588 (-1.41)
Ln (Years in Business)					0.0111 (3.00)***	0.0109 (2.93)***					0.0171 (3.46)***	0.0166 (3.33)***	0.0767 (4.83)***
R&D							-0.5395 (-0.95)				-0.3310 (-0.82)	-0.2178 (-0.53)	
Fixed Asset Growth Rate								-0.0029 (-2.05)**					-0.0022 (-0.68)
SD of ROAs									-0.8555 (-6.31)***				-0.2624 (-2.49)**
Sales to Affiliated firms										-0.2007 (-7.48)***	0.0221 (1.07)	0.0201 (0.97)	0.0309 (1.16)
Purchase from Affiliated firms										-0.0705 (-1.76)*	0.0504 (1.72)*	0.0547 (1.86)*	0.0690 (1.73)*
Adjusted R ²	0.3937	0.2490	0.4328	0.4340	0.5531	0.5516	0.1587	0.1637	0.1812	0.1893	0.5508	0.5495	0.5472
Number of samples	2,963	2,963	2,963	2,963	2,963	2,963	2,963	2,744	2,190	2,610	2,610	2,610	2,050

<Table 9> Logistic Regression of Circuitous Ownership

We use a total sample of 2,963 firms over the period 1997 through 2003. The dependent variable is the circuitous dummy that takes a value of 1 if a firm is on a circuitous chain of investments, and 0 otherwise. Family ownership is the sum of ownerships by a controlling shareholder and his family members. ROA is the ratio of net income to total assets. EBITDA is the ratio of the sum of operating income and depreciation to total assets and debt ratio is the ratio of debt to total assets. Listing dummy takes a value of 1 if a member firm is listed, and 0 otherwise. R&D is the ratio of R&D expenses to total assets. Fixed asset growth rate at t is the ratio of fixed assets at t minus fixed assets at t-1 to fixed assets at t-1. Standard deviations of ROAs are the standard deviations of ROAs of firms over the past five years. Sales to affiliated firms or purchases from affiliated firms are relative to the total sales of a firm. Each regression model includes industrial dummy, year dummy and group dummy. The numbers in parentheses denote heteroskedasticity-consistent z-values, and ***, ** and * denote significance at the 1%, 5% and 10% levels respectively.

Regressions	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Constants	-7.7542 (-9.52)***	-7.5715 (-9.57)***	-26.0381 (-17.51)***	-23.0914 (-15.06)***	-23.2569 (-15.06)***	-7.2673 (-9.34)***	-6.9568 (-8.98)***	-5.6918 (-7.36)***	-5.9368 (-11.50)***	-21.7552 (-14.19)***	-22.0607 (-14.29)***	-21.7901 (-13.40)***
Listing Dummy	2.3924 (16.13)***			0.9479 (5.25)***	0.9598 (5.30)***					0.8181 (4.31)***	0.8285 (4.34)***	0.6191 (3.00)***
Family ownership		2.4757 (6.73)***		2.3674 (6.07)***	2.2790 (5.84)***					1.8944 (4.96)***	1.8302 (4.81)***	1.9964 (4.34)***
ROA				-1.0405 (-1.38)						-1.0160 (-1.13)		
EBITDA					1.3895 (2.97)***						1.3991 (3.06)***	
Ln (Assets)			0.9831 (19.32)***	0.7853 (13.25)***	0.7846 (13.18)***					0.7676 (11.63)***	0.7718 (11.61)***	0.6959 (9.88)***
Debt ratio				-0.4746 (-1.14)	-0.3026 (-0.72)					-0.1531 (-0.33)	0.0509 (0.11)	0.2515 (0.50)
Ln (Years in Business)				0.2467 (2.55)**	0.2510 (2.52)**					0.3387 (3.11)***	0.3472 (3.05)***	0.9211 (4.25)***
R&D						-9.6915 (-1.99)**				-13.6747 (-1.67)*	-14.2656 (-1.54)	
Fixed Asset Growth Rate							-0.0733 (-2.12)**					-0.0156 (-0.52)
SD of ROAs								-5.0388 (-3.24)***				-0.5575 (-0.38)
Sales to Affiliated firms									-1.0677 (-4.85)***	0.3497 (1.10)	0.3369 (1.06)	0.3974 (1.20)
Purchase from Affiliated firms									-0.4728 (-1.70)*	-0.1262 (-0.32)	-0.0943 (-0.24)	0.1775 (0.39)
Pseudo R ²	0.3571	0.2691	0.4393	0.4707	0.4712	0.2504	0.2520	0.2609	0.2656	0.4577	0.4584	0.4357
Number of samples	2,963	2,963	2,963	2,963	2,963	2,963	2,744	2,190	2,610	2,610	2,610	2,050

<Table 10> Two-Stage Least Square Analysis of Family Ownership, Firm Position, Listing Dummy and Circuitous Ownership Dummy

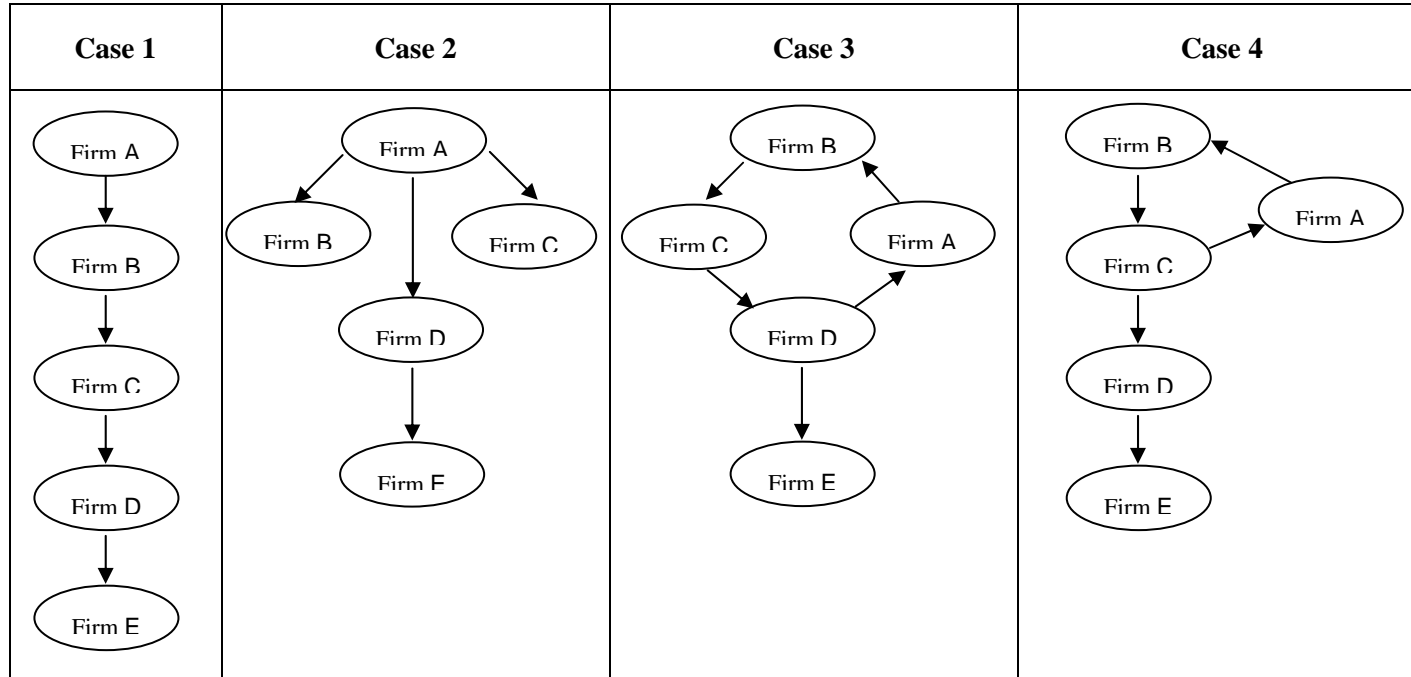
Family ownership is the sum of ownerships of a controlling shareholder and his family members. Position index is the ratio of the number of direct and indirect investments in other member firms to the sum of the number of direct and indirect investments in other member firms and the number of direct and indirect ownerships of the firm by other member firms. Circuitous ownership dummy takes a value of 1 if a firm is on a circuitous chain of investments, and 0 otherwise. Listing dummy takes a value of 1 if a member firm is listed, and 0 otherwise. ROA is the ratio of net income to total assets. EBITDA is the ratio of the sum of operating income and depreciation to total assets and debt ratio is the ratio of debt to total assets. Fixed asset growth rate at t is the ratio of fixed assets at t minus fixed assets at t-1 to fixed assets at t-1. Standard deviations of ROAs are the standard deviations of ROAs of firms over the past five years. Investment in equity is the ratio of the equity investment of a firm to the total equity investments of member firms in a group. Sales to affiliated firms or purchases from affiliated firms are relative to the total sales of a firm.

In the first stage of the two-stage Least Square analysis, we estimate the expected values or probabilities of endogenous variables regressing endogenous ones on all exogenous ones, and regressing endogenous variables on estimated expected values (probabilities) and exogenous variables in the second stage. Each regression model includes industrial dummies, year dummies and group dummies. The numbers in parentheses denote heteroskedasticity-consistent t-values in OLS regressions and z-values in logit regressions, and ***, ** and * denote significance at the 1%, 5% and 10% levels respectively.

Regressions	Simple regressions				Simultaneous equation regressions (2-SLS)			
	OLS regression		Logistic regression		OLS regression		Logistic regression	
	(1) Family ownership	(2) Position Index	(3) Listing dummy	(4) Circuitous ownership Dummy	(5) Family ownership	(6) Position Index	(7) Listing dummy	(8) Circuitous ownership Dummy
Constants	0.0901 (1.00)	-0.9886 (-4.74)***	-37.2718 (-14.33)***	-15.6309 (-8.74)***	0.1431 (0.90)	-0.5821 (-2.46)**	-25.9869 (-5.91)***	-15.9384 (-5.16)***
Family ownership		0.5226 (11.66)***	-3.7376 (-4.87)***	-0.3172 (-0.55)		2.7213 (7.60)***	-25.2538 (-4.67)***	-2.8466 (-0.67)
Position Index	0.1799 (9.25)***		2.5580 (7.49)***	4.9025 (15.00)***	0.1613 (2.03)**		9.2160 (4.32)***	3.4261 (2.27)**
Listing dummy	-0.0678 (-6.22)***	0.1741 (8.95)***		-0.3078 (-1.18)	-0.0710 (-3.78)***	0.2077 (5.54)***		1.0853 (2.71)***
Circuitous ownership Dummy	-0.0189 (-1.41)	0.3707 (20.08)***			0.0281 (1.00)	0.3139 (6.85)***		
Ln (Assets)	-0.0034 (-1.08)	0.0682 (13.19)***	0.9723 (8.86)***	0.2260 (2.88)***	-0.0060 (-0.69)	0.0465 (5.68)***	0.3686 (1.49)	0.2741 (1.48)
Debt ratio		-0.0944 (-2.65)***		0.9951 (1.74)*		-0.2202 (-4.61)***		1.1274 (1.98)**
ROA	0.0910 (3.12)***		-0.0741 (-0.10)		0.0939 (2.96)***		1.8896 (2.35)**	
EBITDA		0.0235 (0.70)		1.5769 (3.04)***		-0.0407 (-0.82)		1.6504 (3.17)***
SD of ROAs	0.0124 (0.24)				0.0147 (0.27)			
Fixed Asset Growth Rate		-0.0010 (-0.43)				-0.0125 (-2.96)***		
Investment in Equities	0.0546 (2.77)***				0.0690 (1.45)			
Ln (Years in Business)		0.0445 (3.54)***	3.9436 (10.51)***	0.9653 (4.51)***		-0.0005 (-0.03)	3.4398 (7.43)***	0.5137 (1.78)*
Adjusted (Pseudo*) R ²	0.3134	0.6437	0.6857	0.5935	0.2397	0.5138	0.6747	0.4433
Number of samples	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190

* Pseudo R² in logit regressions

<Appendix 1> Examples of Group Structures



- Group Structure

Group Structures	Case 1	Case 2	Case 3	Case 4
Vertical Structure	0.6	0.2	0.77	0.69
Circuitous Structure	0	0	0.80	0.60

- Position of Member Firms

Group Structures	Firm A	Firm B	Firm C	Firm D	Firm E
Case 1	1	0.75	0.50	0.25	0
Case 2	1	0	0	0.50	0
Case 3	0.70	0.67	0.63	0.57	0
Case 4	0.75	0.71	0.67	0.25	0

<Appendix 2-1> Top 5 Chaebols in Korea in year 1997

Groups	Total Assets (Billion Wons) (a)	Total Equities (Billion Wons) (b)	Debt Ratio ((a-b)/a)	Number of Member Firms (c)	Number of Firms Without Family Ownerships	Number of listed Firms (d)	Proportion of Listed Member Firms (d/c)	Weighted Average of Family Ownerships	Weighted Average of Affiliated Ownerships	Vertical Index	Circuitous Index
Hyundai Group	72,415	10,670	0.853	62	26	23	0.371	0.116	0.430	0.907	0.290
Samsung Group	63,536	13,492	0.788	61	40	14	0.230	0.023	0.413	0.824	0.148
Daewoo Group	51,791	9,055	0.825	37	29	12	0.324	0.048	0.331	0.707	0.081
LG Group	51,435	8,491	0.835	52	22	14	0.269	0.046	0.370	0.873	0.250
SK Group	29,019	5,109	0.824	45	33	8	0.178	0.090	0.328	0.832	0.200

<Appendix 2-2> Disintegration of the Top 5 Chaebols by year 2003

Groups	Total Assets (Billion Wons) (a)	Total Equities (Billion Wons) (b)	Debt Ratio ((a-b)/a)	Number of Member Firms (c)	Number of Firms Without Family Ownerships	Number of listed Firms (d)	Proportion of Listed Member Firms (d/c)	Weighted Average of Family Ownerships	Weighted Average of Affiliated Ownerships	Vertical Index	Circuitous Index
Samsung Group											
Samsung	81,171	51,881	0.361	63	44	14	0.222	0.014	0.389	0.851	0.143
CJ	4,603	2,212	0.519	41	28	2	0.049	0.091	0.476	0.394	0.000
Shinsegae	5,220	2,194	0.580	12	6	3	0.250	0.155	0.466	0.211	0.000
Hyundai Group											
Hyundai Motor	51,012	24,487	0.520	27	17	6	0.222	0.032	0.498	0.734	0.185
Hyundai Department Store	3,647	1,787	0.510	17	11	3	0.176	0.124	0.434	0.685	0.294
Hyundai Heavy Industries	14,037	4,044	0.712	6	3	2	0.333	0.058	0.414	0.577	0.500
Hyundai	5,164	999	0.807	7	2	3	0.429	0.016	0.233	0.500	0.429
KCC	3,357	1,973	0.412	10	5	1	0.100	0.199	0.443	0.214	0.000
Hyundai Industrial Development & Construction	2,770	1,385	0.500	12	6	1	0.083	0.168	0.093	0.222	0.000
LG Group											
LG	60,050	26,049	0.566	46	37	10	0.217	0.049	0.353	0.330	0.000

LS	5,056	2,189	0.567	12	7	5	0.417	0.100	0.319	0.381	0.000
SK Group											
SK	46,035	15,654	0.660	59	48	11	0.186	0.011	0.510	0.810	0.186

* The Daewoo group went bankrupt in 1999.

<Appendix 3> Correlation Coefficients of Group Variables

We calculate Pearson correlation coefficients using 211 samples of groups over the period 1997 through 2003, where a, b and c denote significance at the 1%, 5% and 10% levels respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1) Vertical Index	1																		
(2) Circuitous Index	0.693 ^a	1																	
(3) Weighted Average of Family ownership	-0.562 ^a	-0.336 ^a	1																
(4) Weighted Average of Affiliated ownership	0.343 ^a	0.212 ^a	-0.315 ^a	1															
(5) Number of Member Firms	0.576 ^a	0.151 ^b	-0.478 ^a	0.323 ^a	1														
(6) Number of Business Lines	0.567 ^a	0.165 ^b	-0.496 ^a	0.264 ^a	0.894 ^a	1													
(7) Industrial Concentration	0.478 ^a	0.176 ^b	-0.326 ^a	0.306 ^a	0.657 ^a	0.351 ^a	1												
(8) SD of Group ROAs	-0.069	-0.071	-0.190 ^a	0.037	-0.046	-0.157 ^b	0.097	1											
(9) Herfindahl Index of a group	-0.505 ^a	-0.300 ^a	0.432 ^a	-0.513 ^a	-0.547 ^a	-0.553 ^a	-0.385 ^a	0.047	1										
(10) SD of Cash Flow Rights of Controlling Families	-0.117 ^c	-0.113	0.255 ^a	0.114 ^c	-0.028	0.020	-0.044	-0.106	-0.029	1									
(11) SD of firm ROAs	0.018	-0.080	-0.100	0.187 ^a	0.034	0.054	-0.006	0.202 ^a	0.022	0.247 ^a	1								
(12) Free Cash Flow	-0.042	-0.107	-0.002	0.038	0.286 ^a	0.165 ^b	0.170 ^b	-0.302 ^a	-0.020	-0.023	-0.118 ^c	1							
(13) Equity Proportion of Holding Company	-0.287 ^a	-0.211 ^a	0.066	0.614 ^a	-0.183 ^a	-0.183 ^a	-0.145 ^b	0.127 ^c	-0.099	0.316 ^a	0.312 ^a	0.033	1						
(14) Family ownership in Holding Company	-0.307 ^a	-0.257 ^a	0.505 ^a	0.147 ^b	-0.216 ^a	-0.245 ^a	-0.129 ^c	-0.160 ^b	0.141 ^b	0.191 ^a	-0.099	-0.058	0.271 ^a	1					
(15) Listed Holding Company Dummy	-0.079	-0.113	-0.103	0.090	-0.012	0.012	-0.149 ^b	0.168 ^b	-0.030	-0.060	0.082	0.087	0.196 ^a	-0.140 ^b	1				
(16) Proportion of Listed Member Firms	0.457 ^a	0.431 ^a	-0.358 ^a	-0.052	0.041	0.092	-0.047	0.049	-0.208 ^a	-0.311 ^a	-0.043	-0.043	-0.156 ^b	-0.252 ^a	0.223 ^a	1			
(17) Proportion of Financial Companies	0.208 ^a	0.305 ^a	-0.282 ^a	0.105	0.032	-0.015	0.200 ^a	0.070	-0.135 ^c	-0.214 ^a	-0.040	-0.111	-0.157 ^b	-0.176 ^b	-0.018	0.242 ^a	1		
(18) Ln (Total Assets)	0.525 ^a	0.244 ^a	-0.553 ^a	0.046	0.712 ^a	0.668 ^a	0.408 ^a	0.028	-0.363 ^a	-0.243 ^a	-0.033	0.238 ^a	-0.315 ^a	-0.391 ^a	-0.009	0.422 ^a	0.119 ^c	1	
(19) Debt ratio	0.0003	-0.057	-0.156 ^b	-0.149 ^b	-0.102	0.023	-0.148 ^b	0.222 ^a	0.010	-0.085	0.368 ^a	-0.339 ^a	-0.129 ^c	-0.250 ^a	-0.013	0.146 ^b	0.153 ^b	0.031	1

<Appendix 4> Correlation Coefficients of Firm Variables

We calculate the Pearson correlation coefficients using the total sample of 2,963 firms over the period 1997 through 2003, where a, b and c denote significance at the 1%, 5% and 10% levels respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Position index	1																
(2) Circuitous ownership dummy	0.612 ^a	1															
(3) Inside ownership	-0.421 ^a	-0.217 ^a	1														
(4) Family ownership	0.323 ^a	0.122 ^a	0.131 ^a	1													
(5) Affiliated ownership	-0.562 ^a	-0.265 ^a	0.820 ^a	-0.439 ^a	1												
(6) Investments in equity	0.545 ^a	0.230	-0.377 ^a	0.180 ^a	-0.438 ^a	1											
(7) Ln (Assets)	0.535 ^a	0.436 ^a	-0.487 ^a	0.041 ^b	-0.441 ^a	0.472 ^a	1										
(8) Debt ratio	0.076 ^a	0.078 ^a	0.027	0.034 ^c	0.017	0.039 ^b	0.261 ^a	1									
(9) ROA	0.051 ^a	0.022	-0.010	0.093 ^a	-0.057 ^a	0.009	0.112 ^a	-0.015	1								
(10) EBITDA	0.069 ^a	0.049 ^a	-0.037 ^b	0.041 ^b	-0.048 ^a	0.025	0.170 ^a	0.089 ^a	0.598 ^a	1							
(11) Ln (Years in Business)	0.402 ^a	0.297 ^a	-0.307 ^a	0.115 ^a	-0.337 ^a	0.267 ^a	0.486 ^a	0.209 ^a	0.141 ^a	0.197 ^a	1						
(12) R&D	-0.055 ^a	-0.042 ^b	0.001	-0.016	0.014	-0.013	-0.036 ^c	-0.035 ^c	-0.048 ^a	-0.003	-0.002	1					
(13) Fixed asset growth rates	-0.040 ^b	-0.044 ^b	0.065 ^a	0.015	0.049 ^a	-0.032 ^c	-0.067 ^a	-0.036 ^c	-0.003	-0.050 ^a	-0.128 ^a	0.003	1				
(14) SD of ROAs	-0.137 ^a	-0.093 ^a	0.056 ^a	-0.053 ^b	0.087 ^a	-0.097 ^a	-0.181 ^a	-0.012	-0.070 ^a	-0.028	-0.175 ^a	0.034	0.032	1			
(15) Sales to affiliated firms	-0.161 ^a	-0.113 ^a	0.196 ^a	0.032	0.157 ^a	-0.177 ^a	-0.267 ^a	-0.018	0.029	0.010	-0.175 ^a	0.061 ^a	0.041 ^b	0.005	1		
(16) Purchase from affiliated firms	-0.022	0.004	0.045 ^b	-0.024	0.055 ^a	-0.025	-0.012	0.030	-0.089 ^a	-0.086 ^a	-0.116 ^a	-0.019	0.044 ^b	0.006	0.025	1	
(17) Listing dummy	0.535 ^a	0.402 ^a	-0.644 ^a	0.019	-0.581 ^a	0.490 ^a	0.610 ^a	0.082 ^a	0.029	0.068 ^a	0.420 ^a	-0.024	-0.077 ^a	-0.114 ^a	-0.220 ^a	-0.052 ^a	1