Beyond cash flow and voting rights: Valuation and performance of firms in complex ownership structures*

Heitor Almeida
Sang Yong Park
Marti Subrahmanyam
Daniel Wolfenzon

(*This Draft: July 22, 2008*)

Abstract

We propose new measures to describe the ownership structure of family business groups that go beyond the standard measures of cash flow and voting rights. Our measures include the degree of pyramiding in the ownership structure of a group firm, and the centrality of a firm in the group structure (e.g., whether a given firm is used by the family to control other group firms). We use a unique dataset of Korean family business groups (*chaebols*) to provide evidence that relates these new ownership variables to the performance and valuation of group firms. In particular, we show that firms with high investment requirements and/or low profitability are more likely to be set up in pyramids (a selection effect). In addition, central firms appear to have lower market valuations than public group firms that do not hold large equity stakes in other group firms (a valuation effect). Our results suggest that cash flow and voting rights are not the only ownership variables that are associated with performance and valuation of group firms. These results also support Almeida and Wolfenzon's (2006) arguments that the family selects pyramidal ownership to take advantage of the cash retained in the central firms of the group, and that pyramidal investments are not beneficial for the minority shareholders of the central firms (who discount the value of their shares accordingly).

Key words: Business groups, family firms, firm performance, pyramids, cross-shareholdings, parent company discount
JEL classification: G31

*Almeida is at the University of Illinois at Urbana-Champaign. Park is at Yonsei University, Subrahmanyam is at New York University, and Wolfenzon is at Columbia University. We wish to thank Utpal Battacharya, Mara Faccio, Radha Gopalan, Raghu Rau, Woochan Kim, and seminar participants at the 2008 WFA meetings, University of Minnesota, Notre Dame University, University of Texas at Austin, Washington University at St Louis, Indiana University, Purdue University, University of Toronto, University of Washington, Duke University, SIFR, FGV-Rio, and NYU for helpful comments. Ki Beom Binh, Yong Hyuk Choi, Jiyoon Lee and Andre De Souza provided outstanding research assistance. All errors are our own.

Groups of firms under common ownership are prevalent in many countries around the world. Indeed, these so called business groups account for a large fraction of the economic activity of many countries.[1] Most of these groups are controlled by families, which hold not only direct stakes in group firms, but also indirect stakes through other firms in the group. For example, one typical ownership structure is referred to as a pyramid. In this structure, the family achieves control of the constituent firms by a chain of ownership relations: the family directly controls a firm, which in turn controls another firm.[2]

Despite the widespread presence of family business groups, the causes and consequences of their ownership structures are not well understood. In particular, the previous literature has focused mostly on the effects of the group structure on the cash flow and voting rights that the controlling shareholder holds in each group firm (see, e.g., La Porta et al., 1999, Bebchuk, Kraakman and Triantis, 2000, Claessens et al., 2000, Bertrand et al., 2002, and Faccio and Lang, 2002). However, it is not clear that these standard ownership variables are sufficient statistics to describe group ownership structures.

In this paper, we propose new measures to describe the ownership structure of business groups that go beyond the standard measures of cash flow and voting rights. These measures include a measure of the *position* of any group firm relative to the controlling shareholder (a measure of the degree of pyramiding in the ownership structure of that firm), and a measure of the *centrality* of a firm for the group structure (e.g., whether a given firm is used by the family to control other group firms). Almeida and Wolfenzon (2006) argue that position and centrality should be related to firm performance and valuation in systematic ways. First, the theoretical arguments (reviewed below in Section 2) suggest that group firms that are owned through pyramids should have lower profitability and should be more capital intensive than group firms that are owned directly by the family. Essentially, the family selects pyramidal ownership for such firms to take advantage of the cash retained in the central firms of the group. Second, the theory predicts that central firms should have lower market valuations than public group firms that are not used by the family to set up and acquire new group firms. This valuation discount compensates minority shareholders of the central firms for value-destroying pyramidal investments that the central firm is expected to make in the future.

We use a unique dataset of Korean business groups (*chaebols*) to test these implications. *Chaebols* are an ideal object for our tests, given the complexity of their ownership structures. In addition, the political and regulatory context of *chaebols* in Korea allows us to obtain extremely detailed ownership data on *chaebol* firms. Since the mid-1990s, the top Korean *chaebol*s have had to report their complete ownership information to the Korean Fair Trade Commission (KFTC). These reports include detailed ownership and accounting data on *private* firms in each *chaebol*, and, for some firms, accounting data for years prior to the year in which the firm becomes a member of the *chaebol*. These types of data are not generally

[1] Claessens, Fan, and Lang (2002) find that, in eight out of the nine Asian countries they study, the top 15 family groups control more that 20% of the listed corporate assets. In a sample of 13 Western European countries, Faccio and Lang (2002) find that in nine countries the top 15 family groups control more than 20% of the listed corporate assets.

[2] Pyramids are very common throughout the world. See, among others, Claessens, Djankov, and Lang (2000), for the evidence on East Asia, Faccio and Lang (2002) and Barca and Becht (2001) for Western Europe, Khanna (2000) for emerging markets, and Morck, Stangeland and Yeung (2000) for Canada.

accessible to acdemic researchers.

Nevertheless, the complex ownership structures of *chaebol*s also present some measurement challenges. The typical *chaebol* has dozens of firms with several ownership links among them. This level of complexity makes it difficult for the researcher to directly compute the ownership variables of interest, including the standard measures of cash flow and voting rights (which are important controls in the empirical specifications that we use), except in simple cases. Therefore, we provide algorithms that can generate the ownership variables for group structures of any degree of complexity. Some of our calculations borrow from previous literature, in particular the formula to compute cash flow rights derived by Brioschi et al. (1989), and Flath (1992). Other formulas that we propose are novel, including the measure of position and an algorithm that can identify the presence of cross-shareholdings involving any number of firms.[3]

We also develop a new measure of the controlling shareholder's voting rights in group firms, which we call "critical control threshold". As we argue in Section 2, the most common method used in the literature to compute voting rights (the *weakest link* measure) does not work well for ownership structures that have either multiple ownership links leading to the same firm or substantial cross-shareholdings. Both of these characteristics are common in Korea.[4] The critical control threshold is a modification of the weakest link that is well defined and easy to compute for any possible group structure. In addition, to show that our results are robust to the definition of voting rights, we also compute an alternative measure of voting rights used in the literature, which we call "consistent voting rights."[5]

We use these ownership variables to provide a description of the ownership structure of Korean *chaebol*s in the period of 1998 to 2004. In particular, both pyramids and cross-shareholdings are very common in Korean *chaebol*s. In contrast, only a few group firms are classified as being central to the control of the group. Older, larger and public firms are more likely to be central to the group structure, suggesting that the largest, most important group firms tend to be those that are used by the family to control other firms. In addition, firms with high positions (those owned through pyramids) are younger than firms that are at the top of the group. Overall, the snapshot of ownership structure that we provide is largely consistent with the historical evolution of *chaebol*s: The *chaebol*s grow as the family uses established group firms to set up and acquire new group firms that are most commonly placed at the bottom of the group.[6]

Next, we relate the group's ownership structure to firm profitability. First, we provide evidence that firms that are owned through pyramids (those in the bottom layer of the group) have lower profitability than firms that are controlled directly by the family, but which are not central for the control of the group. These results also hold after controlling for the

[3]The measure of centrality that we derive is similar (but not identical) to that proposed by Kim and Sung (2006).

[4]The weakest link measure is used, among others, by Barontini and Caprio (2004), Claessens et al (2000, 2002), and Faccio and Lang (2002). Faccio and Lang show that multiple links and cross-shareholdings are not common in Europe. In such cases, the weakest link measure can be easily computed.

[5]This is also the measure of voting rights used by Korean regulators. This measure of voting rights is similar to those used by La Porta et al. (1999), Lins (2003) and Aganin and Volpin, (2005).

[6]Aganin and Volpin (2005) also report similar evidence for one particular Italian business groups (the Pesenti group).

degree of separation between ownership and control induced by pyramids, suggesting that the relationship between pyramids and profitability that we uncover is not due to the degree of separation. Second, we provide some evidence that firms owned through pyramids are more capital intensive than firms owned directly by the family. Third, we show that the negative correlation between pyramids and profitability also hold when we measure firms' profitability using the year *before* they become a *chaebol* firm. Thus, the negative correlation is unlikely to be explained by a reverse causality story whereby pyramidal ownership decreases firm performance (see, e.g., Claessens et al. (2002) and Joh (2003). These results confirm the theoretical prediction that firms with high investment requirements and/or low profitability are more likely to be set up in pyramids (a selection effect).

Finally, we examine the relative valuation of central firms in the chaebol. We find a robust negative correlation between centrality and market-to-book ratios (Tobin's Q), which holds after controlling for standard variables and also for the measures of separation between ownership and control. This valuation discount confirms the prediction that minority shareholders of the central firms incorporate the expected effect of value-destroying pyramidal investments into the security value of the central firm (a valuation effect).

The outline of the paper is as follows. Section 1 provides a brief review of the literature on the financial performance of family group firms. Section 2 develops the empirical implications that we seek to test in the paper. Section 3 introduces our methodology to compute ownership variables for group firms. In Sections 4 and 5, we describe the legal and regulatory framework of Korean *chaebol*s, and the data that we use. In Section 6, we present the results that describe the ownership structure of Korean *chaebol*s, and in Section 7 we relate the ownership variables to performance and valuation. Section 8 concludes.

1 Literature review

There is a vast literature on family business groups.[7] In this section, we discuss briefly the part of the literature that links ownership structure to financial performance.

The existing literature recognizes that business group's ownership structure is a potentially important determinant of firm performance and valuation.[8] Nevertheless, the focus of much of the literature is on cash flow and voting rights. For example, Bertrand et al (2002) use a sample of Indian business groups to show that group membership is harmful to performance because it provides incentives for the family to tunnel resources from firms in which the controlling shareholder has low cash flow rights, to those in which the shareholder's cash flow rights are high. In the context of Korean *chaebol*s, Baek, Kang and Lee (2007) argue that discounted equity issues are more likely when the controlling shareholder has higher ultimate ownership in the acquirer than in the issuer. Bae, Kang and Kim (2002) argue that intra-*chaebol* acquisitions transfer wealth from firms in which the family has low cash

[7] For a detailed review, see Morck et al. (2005).

[8] This does not mean that ownership is the only dimension of group structure that is interesting. Khanna and Thomas (2005), for example, show that stock price comovement in Chilean firms is greater when directors overlap than when firms belong to the same pyramid. Bertrand et al. (2004) link group structure to the history of the familes of controlling shareholders. See also Khanna (2000), and the survey by Khanna and Yafek (2007).

flow rights (typically the acquirer) to those in which the family has higher cash flow rights.[9] Claessens et al. (2002) show that firm value is negatively related to separation between ownership and control in East Asia, and Lins (2003) finds similar results for a sample of firms from the emerging markets. Joh (2003) finds that the separation between ownership and control is negatively related to profitability in Korea.[10] The latter three papers use samples that also include non-business group firms. However, as discussed by Morck et al. (2005), pyramiding is likely to be the primary reason for cash flows to diverge from control rights in these samples, suggesting that these findings are largely driven by separation between ownership and control in business groups.

Some papers have also related financial performance to variables that indicate whether a firm has some indirect (e.g., pyramidal) ownership. In particular, Claessens et al. (2002) and Volpin (2002) provide evidence that firms with indirect ownership have lower Tobin's Q than other firms. Holmen and Hogfeldt (2004) suggest that this undervaluation is greater if the controlling shareholder has lower ultimate ownership in the pyramidal firm. In addition, the literature has examined the relationship between valuation and firm membership in business groups, without taking the group's ownership structure into account (Khanna and Rivkin (2001), Khanna and Palepu (2000), Fisman and Khanna (2000), and Claessens, Fan and Lang (2002)). Khanna and Palepu (2000), for example, find a positive effect of group membership in their sample from India. However, their effect is limited to the largest business groups. Baek et al. (2004) focus on the effects of Asian crisis on Korean firms, and show evidence for a stronger impact of the crisis on *chaebol* firms.

Finally, the literature has provided some evidence on the correlation between ownership variables and firm characteristics. In particular, there is some evidence that firms that are owned through pyramids are smaller and younger than firms at the top of the group (those that own shares in other firms). Aganin and Volpin (2005) describe the evolution of the Pesenti group in Italy, and show that it was created by adding new subsidiaries to the firms the Pesenti family already owned. One of their conclusions is that in Italy, business groups expand through acquisitions when they are large and have significant cash resources. Claessens, Fan and Lang (2002) find that firms with the highest separation of votes and ownership (i.e., those most likely to be owned through pyramids) are younger than those with less separation. Pyramidal firms also seem to be associated with larger scales of capital investment. Attig, Fischer, and Gadhoum (2003) find evidence consistent with this implication, using Canadian data. Claessens, Fan and Lang (2002) also find that in East Asia, group firms tend to be larger than unaffiliated firms. Bianchi, Bianco, and Enriques (2001) find similar evidence for Italy.

[9] In a related fashion, Cheung, Rau and Stouraitis (2006) find that connected transactions between Hong Kong listed companies and their controlling shareholders (such as transfer of assets across firms under the shareholder's control) result in value losses for minority shareholders. Their sample includes both group and non-group firms.

[10] Bennedsen and Nielsen (2006) find that valuation is negatively related to the separation between ownership and control in Continental Europe, but also that profitability is unrelated to measures of separation in the same region.

2 Hypotheses regarding family groups

As discussed in Section 1, the previous empirical literature takes the group ownership structure as given, and focuses on its effect on firm performance and valuation. According to the literature, group structure affects performance through its effect on the cash flow and voting rights held by the controlling shareholder. For example, because a pyramid generally induces greater separation between ownership and control, firms that are owned through pyramids are predicted to have lower performance than other similar firms. There has been less focus in trying to understand the group structure itself. The traditional informal explanation for pyramidal corporate structures is that they are formed to allow the controlling shareholder (the family) to achieve control of a firm using only a small cash flow stake. For instance, a family that directly owns 50% of a firm that in turn owns 50% of a different firm achieves control of the latter firm with an *ultimate* cash flow stake of only 25%. Notice that these existing arguments are explicitly or implicitly based on the effects of group structure on ownership concentration, and separation between ownership and control.

In contrast, Almeida and Wolfenzon (2006) present a model that provides a rationale for the existence of pyramids that does *not* rely on the separation of cash flow from voting rights. Their model is based on the assumption that the family can extract private benefits from the firms it controls at the expense of minority shareholders. In the model, the family has the choice of setting up a new firm (call it firm B) either through a pyramid (that is, using an existing group firm to buy a controlling equity stake in the new firm) or directly (that is, buying the equity stake directly with the family's personal wealth). Under the pyramidal structure, firm B is owned by all the shareholders of the original firm (call it firm A). As a result, the family shares the security benefits (but not the private benefits) of firm B with nonfamily shareholders of firm A. In addition, it has access to all of the retained earnings (cash) of firm A to acquire equity stakes in firm B. Under the alternative, non-pyramidal ownership structure, nonfamily shareholders of firm A have no rights to the cash flows of firm B, and thus the family captures all of its security benefits. However, in this case, the family has access to only its share of the retained earnings of the original firm (for example, through dividend payments).

This argument generates predictions about the relationship between the characteristics of firm B and the ownership structure that is chosen by the family. In particular, firms with low investment requirements and/or high profitability are less likely to be set up in pyramids. External financing is less costly for such firms, and thus, the ability to use the cash retained in firm A is less important for the family. In addition, high profitability firms generate higher security benefits for minority shareholders, and hence, the family is more likely to choose a direct ownership structure for firm B to avoid sharing these benefits with the minority shareholders of firm A. Conversely, the family is more likely to select pyramidal ownership when firm B has low profitability and high investment requirements. For such firms, using the cash retained in firm A through an equity investment in firm B is beneficial for the family.

Importantly, in the theory, these relationships hold irrespective of the degree of separation between family ownership and control in firm B. While we would expect firms owned through pyramids to show higher separation between ownership and control than firms owned directly by the family (an argument that is almost mechanical), the financing advantage of using a

pyramid to control firm B is independent of the deviation between cash flow and voting rights in firm B.

The model also generates implications about the valuation of pyramidal investments by the shareholders of firm A. Because the family selects low profitability, high private benefit firms in the base of the pyramids, minority shareholders of firm A should not expect high returns from pyramidal investments. For example, an unanticipated announcement of a pyramidal investment of significant size should generate a negative return for the shareholders of firm A. In addition, if shareholders anticipate significant future pyramidal investments by firm A, then they should discount the shares of A to compensate for low returns in the future.

Finally, the model generates implications about the timing of pyramid creation. In the model, the pyramid allows the family to use firm A's financial capacity to reduce the financing costs of setting up firm B. This argument implies that pyramids tend be created over time, following good performance of existing family firms. In other words, we expect firms at the top of the pyramid (those that are like firm A in the model) to be older than the firms at the bottom of the pyramid (those that are like firm B). In addition, we expect firms at the top of the pyramid to have been successful in the past, in order to allow the family to use their financial resources to acquire and set up new firms in the bottom of the group.

We summarize this discussion with a list of the implications about the structure of business groups, which can be tested with our data on Korean *chaebol*s:

Implication 1 Group firms that are at the top of the pyramid are older than firms at the bottom of the group.

Implication 2 Group firms that are owned through pyramids have lower profitability than group firms that are owned directly by the family.

Implication 3 Group firms that are owned through pyramids are more capital intensive than group firms that are owned directly by the family.

Implication 4 Public group firms that are used by the family to set up and acquire new group firms should have lower valuations than public group firms that are not used to set up and acquire new group firms.

Some additional observations are in order. Regarding implication 2, the previous literature has shown that the separation between ownership and control induced by pyramids is negatively related to firm profitability (see Section 1). However, the theoretical arguments above suggest that implication 2 should hold *controlling for* measures of separation between ownership and control. In addition, while the previous literature has interpreted this negative association as evidence that pyramids reduce profitability, implication 2 is driven by the opposite direction of causality - lower profitability firms are selected into pyramids. Our empirical tests explore the dynamics of group structure to provide evidence on the direction of causality between pyramids and profitability. Specifically, we examine a sample of firms for which we have profitability data before and after they become *chaebol* firms. The standard argument predicts that pyramidal ownership would lead to a decrease in the firm's profitability, while the argument above suggests that past low profitability would predict the firm's position in the group.

We believe implication 4 is new to the literature on business groups. As discussed above, the previous literature focuses mostly on the relation between a given group firm's valuation and its own ownership structure. That is, the previous literature has related the family's ownership concentration and separation between ownership and control in firm i to the valuation of firm i. In contrast, implication 4 has nothing to do with the ownership structure of firm i, but rather it is driven by whether firm i is used by the family to acquire equity stakes in other group firms or not. Naturally, when testing implication 4, it is important to control for variations in ownership concentration that could be correlated with a firm's status in the group.

3 Metrics of group ownership structures

In order to test the empirical implications described in Section 2, we need to provide empirical counterparts for the variables suggested by the theory. In particular, we need to identify those firms that are used by the family to control other group firms, and to measure the ownership structure of a group firm (pyramidal versus direct ownership). In addition, we need to compute the standard metrics of cash flow and voting rights in order to show that the new measures of ownership structure contain information that is not captured by the separation between cash flow and voting rights.

As discussed above, most of the previous literature on group ownership structure focuses on measuring cash flow and voting rights. We base our discussion on the existing literature. However, we also show how the standard formula that is used to calculate cash flow rights can also be used to measure the position of a firm in the group structure (that is, whether a group firm is owned through a pyramid). In addition, we argue that the standard measure of voting rights (the weakest link) is difficult to apply to groups with complex ownership structures such as the Korean *chaebol*s. We propose an alternative measure that captures an intuition similar to that behind the weakest link, and use this measure to compute a variable that allows us to identify the firms that are used by the family to control other group firms.

3.1 Computing ultimate cash flow rights

The definition of *ultimate* cash flow rights of the (controlling) family in a particular firm is the fraction of the dividends paid by that firm that is (eventually) received by the family.[11] Because the ownership structures of business groups are usually quite complex, typically involving a fair number of inter-company holdings (e.g., pyramids and cross-shareholdings), only part of the dividends that the controlling family receives are due to its direct stake. To incorporate the effect of indirect holdings on the ultimate cash flow stake, we use the formula originally proposed by Brioschi et al. (1989) and Flath (1992). This formula is general enough to accommodate *any* number of firms and *any* possible ownership structures (i.e., any possible configuration of inter-company holdings). In addition, we show how the same formula can be used to generate two measures of group ownership structure that have not been previously discussed in the literature.

[11] For brevity, we refer to the controlling shareholder as the "family" in the ensuing discussion.

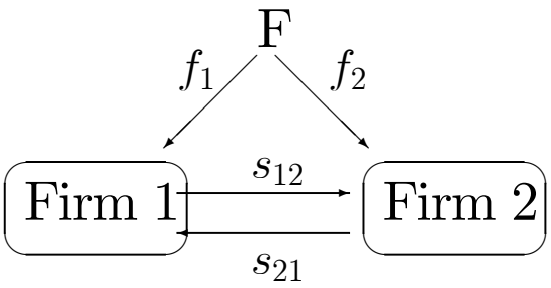


Figure 1: Cross-shareholdings

We illustrate the computation of cash flow rights with a simple example (Figure 1). The family, F, has a direct proportional stake of f_1 and f_2 in firms 1 and 2, respectively. Also, firm 1 holds a proportional stake of s_{12} of firm 2, and firm 2, in turn, holds a stake of s_{21} in firm 1. Thus, firms 1 and 2 have cross-shareholdings with each other.

Suppose firm 2 pays one dollar in dividends. The family receives f_2 and firm 1 receives s_{12}. Out of the s_{12} dollars received by firm 1, the family owns $f_1 s_{12}$, and firm 2 owns $s_{21}s_{12}$. Out of the $s_{21}s_{12}$ dollars owned by firm 2, the family owns $f_2(s_{21}s_{12})$, and firm 1 owns $s_{12}(s_{21}s_{12})$. As it is clear, the ownership chain will continue indefinitely. From the pattern that emerges, we can compute the fraction of the dividend that is owned by the family as:

$$\begin{aligned} u_2 &= f_2 + f_1 s_{12} + f_2(s_{21}s_{12}) + f_1 s_{12}(s_{12}s_{21}) + f_2(s_{21}s_{12})^2 + f_1 s_{12}(s_{12}s_{21})^2 + ... \qquad (1) \\ &= \frac{f_2}{1 - s_{21}s_{12}} + \frac{f_1 s_{12}}{1 - s_{21}s_{12}} \end{aligned}$$

The computation of cash flow rights can be generalized using the formula proposed by Brioschi et al., (1989) and Flath (1992).

3.1.1 A general formula

Consider a business groups with N firms. We define the matrix of inter-corporate holdings A as follows:

$$A = \begin{bmatrix} 0 & s_{12} & ... & s_{1N} \\ s_{21} & 0 & ... & s_{2N} \\ \vdots & \vdots & \vdots & \vdots \\ s_{N1} & ... & s_{N\,N-1} & 0 \end{bmatrix} \qquad (2)$$

where s_{ij} is the stake of firm i in firm j. In other words, column j contains the stakes of the corporate direct owners of firm j in all other firms, $1, 2...i..N, i \neq j$ We also define a vector with the direct stakes of the family in each of the N firms:

$$\mathbf{f} = \begin{bmatrix} f_1 \\ f_2 \\ \vdots \\ f_N \end{bmatrix} \qquad (3)$$

Proposition 1 *The ultimate ownership of the family in each of the n firms is given by* $\mathbf{u} = [u_1\ u_2\ ...\ u_N]'$*:*

$$\mathbf{u}' = \mathbf{f}'(I_N - A)^{-1} \tag{4}$$

where I_N *is the* $N \times N$ *identity matrix.*

Despite the fact that this formula is known, we would like to illustrate its derivation with the simple example presented earlier to clarify the derivation of the two new metrics that we propose below (*position* and *loop*). In Figure 1, the matrix of intercompany holdings is:

$$A = \begin{bmatrix} 0 & s_{12} \\ s_{21} & 0 \end{bmatrix}, \tag{5}$$

and $f = [f_1\ f_2]'$. Suppose we want to compute the ultimate ownership of the family in firm 2. To do so, the idea is to follow the path that a dollar of dividends paid by firm 2 through the group structure. In vector form the initial dividend is given by:

$$\mathbf{d}_2 = \begin{bmatrix} 0 \\ 1 \end{bmatrix}. \tag{6}$$

In general, we let $\mathbf{d}_i$ be the vector of zeroes with a 1 in the i^{th} position.

We can now rewrite the computations above in matrix form. First, the family receives $\mathbf{f}'\mathbf{d}_2 = f_2$ and corporate owners receive $A\mathbf{d}_2 = [s_{12}\ 0]'$ due to their direct stakes (that is, firm 1 receives s_{12} dollars). It is useful to think of this as *stage 1* of the computation. While this is irrelevant for the calculation, it is also useful to assume that all group firms pay out any dividends that they receive from other group firms. That is, suppose that firm 2 pays out the s_{12} dollars that it received in stage 1. The family will then receive $\mathbf{f}'A\mathbf{d}_2 = f_1 s_{12}$ and corporate owners will receive $A(A\mathbf{d}_2) = A^2\mathbf{d}_2 = [0\ s_{21}s_{12}]'$. This is *stage 2* of the computation. We can then continue the process indefinitely. In stage 3, the dividend is $A^2\mathbf{d}_2$. The family receives $\mathbf{f}'A^2\mathbf{d}_2$ and corporate owners receive $A^3\mathbf{d}_2$, and so forth.

A pattern emerges: starting from dividend $\mathbf{d}_2$ and after n stages, the fraction of the original dollar held by corporate owners is $A^n\mathbf{d}_2$ and the dividend received by the family in this stage $\mathbf{f}'A^{n-1}\mathbf{d}_2$. The same algorithm can be repeated for any firm i. Thus, we obtain:

$$u_i = \sum_{n=1}^{\infty} \mathbf{f}'A^{n-1}\mathbf{d}_i = \mathbf{f}'\left(\sum_{n=1}^{\infty} A^{n-1}\right)\mathbf{d}_i = \mathbf{f}'(I_N - A)^{-1}\mathbf{d}_i. \tag{7}$$

This shows how formula 4 is derived. We will now use the objects in this formula to define two new measures of group structure. Both of these measures involve only matrix computations, and do not require the researcher to manually examine the flow chart with cross-ownership links (as some prior studies do).

3.2 Firm's position in a group

We can think of a firm's position as the distance between the family and a given firm in the group. For example, in the case of a simple pyramid with two firms, the firm at the bottom of the pyramid is farther away from the family than the firm in the top of the pyramid.

In order to operationalize this notion of position, it is useful to consider the *stages* of the computation above. Recall that $\mathbf{f}'A^{n-1}\mathbf{d}_i$ is the dividend that the family gets in stage n from a dollar that originates in firm i. If a family owns a direct stake in firm i, it will receive a dividend in the first stage. Thus, $\mathbf{f}'A^{n-1}\mathbf{d}_i$ is strictly positive for $n = 1$. Nevertheless, this does not show that the firm's position is equal to 1, because dividends can also reach the family from paths other than the direct one. For example, if the family holds a stake in another firm j, which holds a stake in firm i, then $\mathbf{f}'A^{n-1}\mathbf{d}_i$ is also positive for $n = 2$.

In order to compute a measure of position that takes all such paths into account, we define the position of a firm i as a weighted average of all the stages in which the family receives dividends from firm i. We use as weights the fraction of the ultimate cash flow rights contributed by the particular path/stage. This measure can be formally defined as follows:

Definition 1 *The position of firm i in the group is defined as:*

$$pos_i = \sum_{n=1}^{\infty} \frac{\mathbf{f}'A^{n-1}\mathbf{d}_i}{u_i} \cdot n \tag{8}$$

where u_i is the ultimate ownership in firm i as defined in Equation (7) above.

In order to illustrate the computation of position, take the group in Figure 1 with the assumption that $s_{21} = 0$ (no cross-shareholdings). In this case, firm 2 is owned both directly (through the stake f_2), and indirectly, through the stake s_{12}. So we have:

$$pos_2 = \frac{f_2}{f_2 + f_1 s_{12}} \cdot 1 + \frac{f_1 s_{12}}{f_2 + f_1 s_{12}} \cdot 2, \tag{9}$$

which is simply a weighted average of the direct path, and the indirect one through firm 1. If f_2, the direct stake in firm 2, f_2 is very small, for example, then the position of firm 2 will be close to 2, meaning that the ownership of firm 2 is approximately pyramidal. In contrast, if the direct stake f_2 is large and the indirect stake s_{12} is small, then pos_2 is close to one.

Notice that this definition of position is also applicable to the case of cross-shareholdings ($s_{21} > 0$). In this case, equation 8 will contain a sum of infinite paths, each one weighted by the ownership contributed by that path:

$$pos_2 = \frac{f_2}{u_2} \cdot 1 + \frac{f_1 s_{12}}{u_2} \cdot 2 + \frac{f_2(s_{21}s_{12})}{u_2} \cdot 3 + \frac{f_1 s_{12}(s_{12}s_{21})}{u_2} \cdot 4 + ... \tag{10}$$

It is possible to simplify the expression in Equation (8) as follows:

Proposition 2 *The position of firm i can be wrtitten as :*

$$pos_i = \frac{1}{u_i}\mathbf{f}'(I_N - A)^{-2}\mathbf{d}_i \tag{11}$$

where I_N is the $N \times N$ identity matrix.

3.3 Identifying general cross-shareholdings

We can also use the objects involved in formula (4) above to check whether a given firm is part of a cross-ownership pattern, and to compute the number of firms involved in this cross-ownership loop. The idea behind this calculation is the following. If firm i pays a dividend, and after n stages the dividend reappears in firm i, then it must be that the firm is part of a loop. Also, the number of (finite) stages needed for the money to reappear for the first time in firm i measures the number of firms in the shortest loop.

Definition 2 *Let*

$$loop_i = \min\{n \mid n \geq 1 \text{ and } \mathbf{d}_i' A^n \mathbf{d}_i > 0\}, \tag{12}$$

then firm i is in a loop if and only if $loop_i < \infty$. The number of firms in the shortest loop firm i is involved in is given by $loop_i$.

Recall that $A^n \mathbf{d}_i$ is a vector with the dividends received by each group firm after n stages, following a dollar that originated in firm i. Since we are interested in the dividends received by firm i itself, we pre-multiply by $\mathbf{d}_i'$ to get the i^{th} element.

3.4 Computing Control Rights

The computation of control rights in a complex group is challenging because it is not clear what fraction of the votes held by intermediate firms is controlled by the family. We start by discussing the weakest link idea that is frequently used in the literature. As we will show, this methodology is not readily implementable in groups with extensive cross-shareholdings. In view of this problem, we propose an alternative to the weakest link method that captures its intuition, but that is well defined for any possible group structure. We define the metric of our proposed method as the critical control threshold, CC).

3.4.1 The weakest link

Consider the following example of a simple pyramid in Figure 2. Clearly, the family controls 21% of the votes of firm 1 through its direct stake. But what about firm 2? The *weakest link* method assigns to the family the minimum voting stake in the chain of control. That is, the family is assumed to hold 21% of the votes of firm 2 as well. One way to think about this measure is to consider the minimum equity stake that an outsider would need to acquire to challenge the family's control of firm 2. If an outsider acquires 21% of firm 1, it would have as much control of firm 2 as the family has.

However, it is not clear how to extend this calculation to groups with complex ownership structures with cross-ownership loops. The first problem arises when there are multiple chains leading to the same firm. The weakest link rule calls for computing the minimum votes along each chain and then adding these values. In Figure 3, for example, this procedure would lead to voting rights greater than 100% for firm 3, suggesting that there might be some *double-counting* of family votes arising from the presence of multiple links. This double-counting problem arises from the fact that there are two chains of control that go through

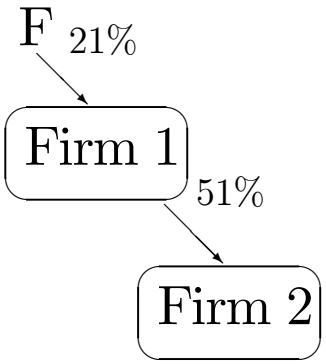


Figure 2: A simple pyramid

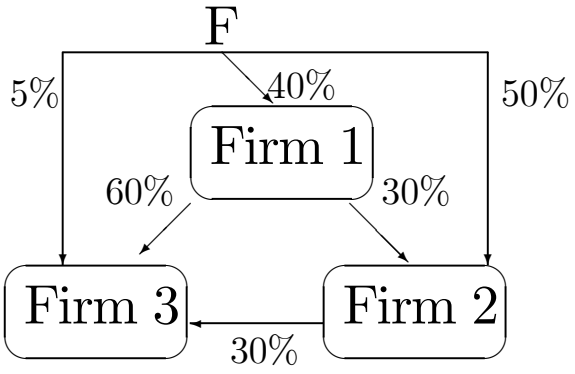


Figure 3: A more complex group

firm 2 and end up in firm 3. In this case, the minimum link procedure adds up all of them. In fact, the family's control of firm 3 depends on control of firm 1, which holds 60% of the shares of firm 3. However, the family holds only 40% of the shares of firm 1. In principle, an outsider could acquire control of firm 3 through an acquisition of more than 40% of the shares of firm 1.

The existence of cross-shareholdings also poses problems for the calculation of the weakest link. For example, in Figure 1, it is not clear what the weakest control link between the family and firm 2 is. To compute the weakest link, one needs to know what is the degree of control that the family has over firm 1. According to the weakest link idea, the degree of control over firm 1 should be equal to the weakest link between the family and firm 1. However, because firm 2 holds shares in firm 1, in order to calculate the weakest link between the family and firm 1 we also need to know the weakest link between the family and firm 2. The weakest link formula, as discussed in the literature, does not tell us how to solve this *circularity* problem that arises from the presence of cross-shareholdings.

Because multiple links and cross-shareholdings are very common in our data, it is difficult to directly apply the minimum link idea to the Korean data.[12] We turn now to an alternative measure that can accommodate the cross-shareholding issues.

3.4.2 An alternative measure: the critical control threshold (CC)

We first define the set of firms controlled by the family for any arbitrary control threshold. Next, for each firm, we define the critical control threshold, CC, as the maximum threshold for which the firm belongs to the set of firms controlled by the family. It turns out that this measure is equivalent to the weakest link when cross-shareholdings and multiple links are absent (that is, for simple pyramids).

The set of firms controlled by the family To compute the set of firms controlled by the family, we make two assumptions:

Assumption 1 *A family controls a firm if and only if it holds more than T votes in it.*

Assumption 2 *The votes that a family holds in a firm is the sum of its direct votes plus all the direct votes of firms under family control, where control is defined in Assumption 1.*

This definition of control is a combination of the idea of a control threshold (Assumption 1), plus the assumption that, if a family controls a firm, it controls the votes that this firm holds on other firms.

The following proposition establishes the formal condition that the set of firms controlled by the family must satisfy (for a given control threshold T). Suppose we start the analysis with a set N, which contains all candidate firms that could be controlled by the family. This set can represent all firms in a country, or a pre-identified subset of those firms.

Proposition 3 *For a given threshold T, the set of firms controlled by the family is given by:*

$$C(T) = \{i \in N : f_i + \sum_{j \in C(T),\ j \neq i} s_{ji} \geq T\}. \tag{13}$$

In other words, the set $C(T)$ is the solution to a fixed point problem.[13] In the appendix we describe an algorithm that can be used to find $C(T)$ in any situation.

[12] Naturally, the empirical relevance of the double-counting and the circularity problems depends on the extent to which cross-shareholdings and multiple links are important. For example, Faccio and Lang (2002) show that neither problem is very prevalent in their European sample. In such a case, it is straightforward to compute the minimum link by ignoring the effect of cross-shareholdings. For example, in Figure 1, one can define the minimum link between the family and firm 2 as $\min(f_2, f_1 s_{12})$.

[13] Let $F(X) = \{i \in N : f_i + \sum_{j \in X,\ j \neq i} s_{ji} \geq T\}$. $C(T)$ satisfies $F(C(T)) = C(T)$.

The critical control threshold: definition We can now define our new measure of control rights:

Definition 3 *For any firm $i \in N$, the* critical control threshold *is given by*

$$CC_i = \max\{T \mid i \in C(T)\} \tag{14}$$

The critical control threshold is the *highest control threshold that is consistent with family control of firm i*. In other words, if the control treshold were higher than CC_i, then firm i would not be part of the set of firms controlled by the family.

Let us now illustrate the calculation of CC using the examples in Figures 2 and 3. In Figure 2 (a simple pyramid), notice that as long as $T \leq 21\%$ the family controls firm 1, and therefore controls firm 2 as well. Thus, $C(T) = \{1, 2\}$ for any $T \leq 21\%$. As T increases beyond 21%, firm 1 is dropped from the control set. This also causes firm 2 to be dropped because the family no longer controls firm 1's votes in firm 2. Thus, we conclude that the critical control thresholds are 21% for both firms (coinciding with the weakest link solution).

Consider Figure 3 once again. While we could not compute the voting rights of the family in firm 3 using the weakest link, it is easy to see that $CC_3 = 40\%$. Once T reaches 40% the family no longer controls firm 1 with its direct stake. Without firm 1, the family controls only 35% of the shares of firm 3, and so firm 3 is dropped from the control set as well. The intuition is that while an outsider can only buy 5% of the shares of firm 3 directly in the market, it can contest the control of firm 3 by purchasing a 40% stake in firm 1.

For simple pyramids, it is clear from the example illustrated in Figure 3 that CC and the weakest link will coincide. In more general ownership structures, CC corresponds to the minimum equity stake that an outsider needs to acquire in any group firm, to contest the control of a given group firm. We believe this definition captures the same idea as the weakest link with the advantage that it is not subject to the double-counting and circularity problems explained above.

3.5 Measuring the centrality of a firm for the control of the group

We can use the CC measure to compute a statistic that summarizes how important a given firm is for the control of the overall group (*centrality*). In terms of the empirical implications developed in Section 2, we use the centrality variable to identify which firms are used by the family to control other group firms.

For example, take the group in Figure 3. In this example, firm 1 is likely to be a central firm for the control of the group, because firm 1 holds significant stakes in firms 2 and 3. Firm 3, in turn, is not (because it does not hold shares in other firms). An easy way to capture this difference is to drop all firms (one by one) from the group's ownership matrix, and then calculate the decrease in CC for the other group firms. For example, if firm 3 is dropped from Figure 4, CC_1 and CC_2 are unchanged. In contrast, if firm 1 is dropped, CC_3 goes down from 40% to 35%. Notice, in contrast, that CC_2 does not change since the firm controls 50% of firm 2 directly. Even though firm 1 holds shares in firm 2, this stake is not important for the control of firm 2 given the large direct stake.

These calculations suggest the following definition for a firm's centrality in the group control structure:[14]

Definition 4 *We define the* centrality *of a firm i as:*

$$central_i = \frac{\sum_{j \neq i} CC_j - \sum_{j \neq i} CC_j^{-i}}{\sharp N - 1}, \tag{15}$$

where CC_j^{-i} is the critical control threshold of firm j, computed as if firm i held no shares in the other group firms.

In words, we compute the centrality of firm i as the average decrease in CC across all group firms other than firm i, after we exclude firm i from the group. This formula, as the previous ones, can be implemented for any group structure.

One potential drawback of this definition of centrality is that it is based on the CC measure of voting rights, which is arguably only an imperfect proxy for the degree of family control on a group firm. As discussed above in Section 2, the goal of this measure is to identify the group firms that are used by the family to set up and acquire other firms in the group. In order to show that the empirical results are not driven by the control proxy that we use, we also experiment with an alternative measure of centrality that is based only on the *direct* equity stakes that each firm holds in other group firms. If we let A_j be the total assets and E_j be the total equity of firm j, we have the following definition:

Definition 5 *We define the aggregate equity* stake *of firm i in other group firms as:*

$$stake_i = \frac{\sum_j s_{ij} E_j}{A_i}, \tag{16}$$

This measure is essentially the total size of the equity stake that firm i holds in other group firms, weighted by the total assets of firm i. A firm that is used by the family to control other firms should own substantial equity stakes in other firms. We weight by the assets of firm i because firm i's valuation is more likely to be affected when the equity stakes are large relative to the size of firm i.[15]

3.6 Consistent voting rights

Besides the weakest link, the previous literature has also used an alternative measure of voting rights, namely the sum of the direct stakes held by the controlling shareholder, and direct stakes held by firms controlled by this shareholder (LaPorta et al., 1999, Aganin and

[14] Kim and Sung (2006) compute a similar variable for Korea, using cash flow rights instead of voting rights. They show that their measure of centrality is inversely related to the probability that the firm goes public. In contrast, we show below that central firms are much more likely to be public in our sample.

[15] We also experimented with alternative measures including the number of firms in which firm i holds equity stakes, and the total ownership of firm i in other firms (unweighted by equity and assets). The results using these alternative proxies are similar to those we report below.

Volpin, 2003, and Lins, 2003).[16] We do the same in the context of our proposed CC measure, i.e., use the set of firms controlled by the family to implement this measure of control rights:

Definition 6 *Given a threshold T, the* consistent voting rights *of the family in firm $i \in C(T)$ are defined as:*

$$VR_i(T) = f_i + \sum_{j \in C(T),\ j \neq i} s_{ji} \tag{17}$$

In words, to compute the sum of the votes held by the family in firm i we simply add the direct votes held by the family in firm i with all the indirect votes held by other firms that belong to $C(T)$. The resulting distribution of voting rights,$\{VR_1(T), VR_2(T)...\}$ is *consistent* with the control threshold T, in the sense that $VR_i(T) \geq T$ for all i. For example, in the group of Figure 3 we would have $\{VR_1(T), VR_2(T), VR_3(T)\} = \{40\%, 80\%, 95\%\}$, for $T \leq 40\%$. The VR measure is also the measure that is used by Korean regulators to compute the separation between ownership and control in *chaebol* firms.

4 Korean *Chaebol*s: Definition and Regulatory Framework

A *chaebol* is a South Korea's business group consisting of many firms in diverse business areas that are owned and controlled by family members. *Chaebol*s exert significant economic influence in Korea. For example, as of 2004, *chaebol*s accounted for 14% of the value added of the entire manufacturing sector, 2.95% of the nation's employment, and more than half (52.3%) of the total market value of all listed companies.

4.1 Regulatory Framework for *Chaebol*s

*Chaebol*s are mainly regulated by laws pertaining to competition policies. This contrasts with legal regimes addressing regulation of corporate groups in other countries: laws relating to holding companies in the US, a specialized law of corporate groups, Konzernecht, in Germany, and special provisions addressing group-related issues in European company laws.[17] Although the main purpose of regulating business groups in other countries is to protect creditors and minority shareholders against the opportunism of controlling shareholders, its main purpose in Korea is to deter excessive concentration of economic power in a small number of large companies. In the absence of a legal regime to address concentration of economic power, Korea has relied on the Monopoly Regulation and Fair Trade Act (hereafter just Fair Trade Act or FTA) to regulate *chaebol*s. The government agency that oversees the FTA is the Korean Fair Trade Commission (KFTC), which was established in 1981 along with that law.

[16] Some researchers attribute the weakest link measure to the paper by La Porta et al. (1999), but, in fact, they use a different definition of voting rights which is closer to the VR measure that we define below. Specifically, they measure indirect ownership in a firm i as the percentage of votes that other group firms hold *directly* in firm i, provided that these other group firms are also controlled by the family (under control thresholds of either 10% or 20%).

[17] For different legal regimes addressing business groups in different countries, see Kraakman et. al. (2004),

The legal expression for *chaebol* is "Large Business Group," which is precisely defined in the FTA. A business group is legally designated as a *chaebol* based on its size, which is defined as the value of the the combined total assets of affiliated companies in the group. From 1987 to 2001, the KFTC designated annually the 30 largest *chaebol*s in Korea. The firms in the designated 30 *chaebol*s were prohibited from cross shareholdings and also subject to limitations on equity investment in the domestic firms. From 1998 onwards, immediately after the outbreak of the financial crisis, these firms were also prohibited from cross debt guarantees among affiliated companies. From 2002 onwards, the KFTC changed its scheme for designating *chaebol*s. For the first time, the KFTC first designated a group of *chaebol*s that are prohibited from cross shareholding and cross debt guarantees.[18] Legally, these *chaebol*s are termed "business groups subject to limitation on cross shareholding and cross debt guarantees." Currently, these are business groups with combined assets greater than two trillion won.[19] Among these business groups, the largest ones are further "subject to ceiling on total equity investment in other domestic companies."[20] In this paper, the term *chaebol* hereafter refers to those family-controlled business groups subject to legal limitations on cross shareholding and cross debt guarantees.

4.1.1 Legal definition of members of *Chaebol*s

A *chaebol* in the FTA is defined as a business group where "an 'identical person' de facto controls member firms' businesses." An identical person is defined rather broadly to include a controlling shareholder and his or her "related persons" which, in turn, includes relatives and affiliated companies. There are two criteria for a de facto control of a company called "affiliated company": de facto ownership of more than 30 per cent, excluding preferred shares, of a company and de facto exercise of controlling influence on a company. The latter criterion, de facto exercise of controlling influence, in turn, is further detailed to include cases of exchange of directors and managers, and also substantial business transactions between a firm directly controlled by an identical person and the company in question. Because this criterion of "controlling influence" is interpreted very broadly, some companies legally belong to a group even though neither families from the controlling group nor other affiliated companies in the group own shares of those companies.

5 Data Description

This section describes the sources for the ownership, accounting and financial data that we use in this study.

[18] Non-financial affiliates cannot provide other affiliated companies with financial guarantees for credits supplied by domestic financial institutions. In addition, cross-shareholding among a *chaebol*'s affiliates is prohibited by the FTA. Financial institutions of *chaebol*s are exempt from this regulation, if they invest funds obtained from outside investors. However, these finance companies of *chaebol*s, cannot exercise the voting rights of shares of domestic companies in the same *chaebol*.

[19] Based on the won/dollar exchange rate of 946 on March 9th, 2007, two trillion won amounts to 2.1 billion US dollars.

[20] The threshold asset size of "very large business groups" used to be five trillion won until 2005, but increased to six trillion won in 2006.

5.1 Ownership Data

The ownership data of our study are from the Korean Fair Trade Commission (hereafter KFTC). These data contain the stock ownership information for the largest 30 business groups from 1998 to 2001, and the large business groups subject to regulations on cross-shareholding and debt guarantees of affiliates of the same group from 2002 to 2004, which are designated by the KFTC. As explained above, KFTC has supervised the former group from 1987 to 2001, and the latter larger group, since 2002, based on the Monopoly Regulation and Fair Trade Act (hereafter the Fair Trade Act) and its enforcement ordinance.

The largest 30 business groups (from 1998-2001) and the set of business groups under cross-shareholding and debt guarantee prohibition (after 2002) are required to report the status of affiliate shareholders and persons with special interest and the financial status of group companies on April 30 of each year, following the Fair Trade Act and its enforcement ordinance. From the ownership and financial database that the KFTC has maintained, we obtained data for the period 1998-2004. However, we focus only on business groups with the ownership of a natural person (i.e., family business groups), exclude other business groups such as government-controlled business groups. The ownership structures of 800 companies of 30 groups in 1998, 681 companies of 30 groups in 1999, 518 companies of 25 groups in 2000, 590 companies of 25 groups in 2001, 638 companies of 31 groups in 2002, 739 companies of 35 groups in 2003, and 776 companies of 36 groups in 2004 are available. The total size of our sample in firm-years is 3,545.

The ownership status of the affiliates and the person with special interest of each firm in the above ownership data of KFTC is recorded in relative detail. In our ownership data, the shareholders are categorized into seven types; family owner, the relatives of family owner, affiliates, nonprofit affiliate, group officer, treasury stock, and others. In addition, the name, the holding quantity, and the ratio of common stocks and preferred stocks of each individual shareholder are also recorded. For example, take the ownership information of Samsung Corporation in Samsung group. In 2004, the family owner held 1.42%, the relatives of the family owner 0.01%, two nonprofit corporations 0.23%, four affiliates 9.64%, thirty seven group officers 0.15%, Samsung Corporation itself 2.20% (treasury stock), and others 86.52% of its common stock.

5.2 Financial data

In addition to the data obtained from the KFTC, we also used two other databases developed by Korea Listed Companies Association (KLCA) and Korea Investors Service (KIS), respectively, to obtain additional financial information. KLCA and KIS's databases contain information not only on listed companies, but also some private firms which are subject to external audit. Combining all these databases, we have accounting data for 3,470 firm-years that match the 1998-2004 ownership data.

6 Ownership Structure of Korean *Chaebol*s

In this section, we provide a detailed description of the ownership structure of Korean *chaebol*s during the period of 1998 to 2004. As we will argue, understanding the typical *chaebol*

structure allows us to sharpen the implementation of the empirical implications described in Section 2. In addition, in this section, we relate the ownership variables to firm characteristics other than accounting variables and valuation measures (which are analyzed in Section 7), and present a test of Section 2's implication 1. The other implications are discussed in the following section.

We first illustrate the complexity of the structure of a typical *chaebol* using the example of Hyundai Motor. We then present summary statistics for our whole sample, using the metrics presented in Section 3.

6.1 An example - Hyundai Motor

Figure 4 and Table 1 present a summarized picture of the 2004 ownership structure of the Hyundai Motor *chaebol*. The total number of firms in the group is 27, but the figure only depicts the ownership relations among 11 of them. This example is fairly typical of a Korean *chaebol*. The individual at the top (Jung Mong Koo in the case of Hyundai Motor) controls some firms directly, with no cross-shareholdings (e.g., Changwon and Glovis), and also several firms that own equity stakes in each other.

Table 1 shows some variables of interest for the firms depicted in Figure 4. Hyundai Motor, Hyundai Mobis and Kia Motors are the most important firms for the control of the Hyundai Motor *chaebol*, given that these are the firms with the highest values for the *centrality* variable. These firms are also among the largest firms in the *chaebol* in terms of number of employees; they tend to be amongs the older firms, as well. In addition, these firms (central, larger, older) are also the ones that are publicly traded (in addition to BNG Steel and INI Steel). The figure shows that these firms indeed hold stakes in several other *chaebol* firms. Although it is a bit difficult to follow the ownership links with the naked eye, our variable loop show that these central firms are also part of a cross-ownership loop, usually consisting of three firms (variable "steps"). For example, notice that Kia owns 18% of the shares of Mobis, which owns 14% of the shares of Motor, which owns 37% of the shares of Kia.

6.2 Summary statistics

Table 2 shows the average values for the ownership variables across all firm-years in our sample (Panel A), and the cross-correlation matrix (Panel B). There are a total of 47 groups and 1085 firms that were present at any point in the sample between 1998 and 2004. The controlling family holds 13% of the cash flows of the median firm, but it holds substantially more votes according to our two alternative measures of voting power. The VR (consistent voting rights) measure yields the largest voting power. The family and the affiliate firms hold 68% of the votes of the median firm in the sample. In contrast, the critical control threshold of the median firm is 30%. Thus, the separation between ownership and control is substantially larger if one uses VR to measure voting power (the separation variables are computed as voting rights minus cash flow rights for the two measures of control).

The data also indicate a substantial degree of pyramiding in Korean *chaebol* firms (the median position of a firm is 2.06), but with substantial cross-sectional variation. Some firms are owned directly (25% of the firms show an average position lower than 1.40), with few

ownership links with other group firms. Finally, only a few firms have positive values for the centrality variable (the 75th percentile is zero), indicating that only a small fraction of group firms are central for group control. Similarly, the median aggregate stake held by group firms in other firms is zero, and the 75th percentile is just 3.5%. Again, this statistic suggests that only a small fraction of firms hold substantial stakes in other firms. The summary statistics also show that 26% of the firm-years involve listed firms, while 74% involve private firms, and 25% of the firm-years involve firms in indirect cross-shareholding loops.

The fraction of firms participating in cross-shareholding loops may seem surprising given the Korean regulation restricting direct cross-shareholdings. However, Panel C shows that the overall majority of cross-shareholding loops has three firms in it (72% of all loops). The high incidence of cross-shareholdings also underscores the importance of using measures of cash flow and voting rights that can handle the impact of cross-shareholdings.

Finally, we present in Panel B the simple correlations among the ownership variables. Consistent with the Hyundai Motor example, the correlations show that public firms, central firms and firms in loops tend to be higher up in the group structure (negative correlation with position). These variables are also correlated among themselves, that is, central firms are more likely to be public and belong to loops.

We have also calculated the ownership variables separately for each one of the 47 groups in our sample.[21] Each group has on average 16 affiliated firms. Out of these firms, an average of four firms are public, and an average of 2.93 firms belong to cross-shareholding loops. Also, on average, three firms have a centrality measure greater than 0.01. Finally, if we define direct ownership as a position lower than 1.2, then an average of 3.12 firms are owned directly by the family.

6.3 Ownership structure and firm characteristics

As explained in Section 2, theory suggests that pyramidal business groups are created as the controlling family uses existing and successful group firms to set up and acquire new firms. Thus, firms at the bottom of the group should be younger than firms at the top of the group (implication 1). We test this implication by relating firm age to the position measure described above. In addition, we examine the correlations between our other new ownership variables (centrality, stake and loop) and basic firm characteristics including size, age, and public status. The regressions include group and year dummies, and the standard errors are clustered by firm. The results are similar if we do not use group dummies.

The results in Table 3 (columns I and II) show very clearly that older, larger and public firms are more likely to belong to cross-shareholding loops and to be central to the group structure. Older firms are also more likely to hold larger stakes in other group firms. These results confirm the pattern suggested by the Hyundai Motor example, in that the largest, most established group firms tend to be those that are used by the family to control other firms. The results also confirm implication 1, in that firms with high position values (those at the bottom of the pyramids) are clearly younger than firms that are at the top of the group. These results also hold when we control for the measures of ownership concentration and separation between ownership and control, suggesting that the correlation between age

[21] The related tables are omitted for brevity, but are available from the authors.

and position is not simply due the standard ownership variables.

Overall, this snapshot of *chaebol* structure is largely consistent with the historical evolution of *chaebol*s. *Chaebol*s grew as the controlling family used successful (e.g., large, public) group firms to set up and acquire new group firms that are placed at the bottom of the group i.e., those with high position values).[22]

6.4 Summary: the average structure of a Korean *Chaebol*

Figure 5 summarizes the analysis above by charting the ownership structure of the average Korean *chaebol*. There are roughly three layers in the *chaebol* ownership structure. Some firms (firms 1, 2 in the figure) are owned directly at the very top of the group (a position value close to 1), without ownership links to the other firms (like Changwon in the Hyundai Motor example above). The middle layer contains the firms that belong to cross-shareholding loops such as Kia Motors in the example above. The typical loop contains three firms, given the prohibition on *direct* cross-shareholding links. The firms in this middle layer are more likely to be public, and they are larger and older than other *chaebol* firms. The firms in this layer are also the firms that are likely to be central for the group control structure (i.e., they own substantial stakes in other firms in the bottom layer). In this bottom layer, we have firms that are more likely to be private, smaller and younger (i.e., Ajumetal in the Hyundai Motor example). They are also less likely to own substantial stakes in other firms (less central, less cross-shareholdings). The number of firms in this layer of private/non-central/no loop firms is much higher than those in the upper layers (roughly 11 out of the 16 firms).[23]

The picture depicted in Figure 5 allows us to sharpen the tests of implications 1 to 3 of Section 2. Implications 1 and 2 compare firms that the family chooses to control through other firms (e.g., through pyramids) with those that the family chooses to control directly. Importantly, this comparison does *not* refer to the firms that the family uses to control other firms (e.g., the central firms). With reference to Figure 5, these implications refer to a comparison between firms like firms 1 and 2 with the firms owned through pyramids (such as firms 6 to 16). Accordingly, the empirical tests that we perform below will relate the profitability and capital intensity of group firms to their position in the group, excluding the central firms from the regressions. Implication 3, in contrast, is specifically about the valuation of firms that are used by the family to control other firms. Figure 5 suggests that Korean *chaebol*s have a well defined group of firms that the family uses to set up and acquire new firms (firms 3, 4 and 5 in the Figure). The empirical tests below will compare the valuation of these central firms with the valuations of other publicly traded firms in the group. In addition, we also use the variable stake as an alternative measure of the extent to which a given firm is used to control other firms.

[22] Aganin and Volpin (2005) also report similar evidence for one particular Italian business groups (the Pesenti group).

[23] Nevertheless, we stress that this average picture hides substantial variation across firms in the group. For example, some publicly traded firms (such as BNG Steel in the Hyundai Motor example) do not own shares in other firms. This particular source of variation will be important in the valuation results that we present below.

7 Profitability, valuation and ownership structure

In this section, we present the empirical tests of implications 2 to 4 of Section 2, which relate the profitability, capital intensity and valuation of group firms to measures of group structure.

7.1 Measures of profitability and valuation

To correctly measure the profitability of each *chaebol* firm, we need to ensure that reported profits are not affected by equity stakes that a *chaebol* firm holds in other firms. Starting in 1999, the financial statements of Korean *chaebol* firms became subject to the *equity method* reporting rule. The basic idea behind this accounting rule is to record firm A's share of firm B's equity as an asset for firm A, and firm A's share of firm B's profits as a source of non-operating income for firm A. Fortunately, the financial statements contain enough information to allow us to back out the exact amount by which accounting figures have been adjusted because of equity stakes. We use this information to calculate our measures of assets and profits for *chaebol* firms, which we denote "Operating Assets" and "Operating Profits". The details are in Appendix B.

There are similar issues involved in the computation of a measure of valuation for *chaebol* firms. The market value of a publicly-listed *chaebol* firm includes the value of the equity stakes that this firm holds in other *chaebol* firms, both listed and unlisted. However, unlike the adjustment to the accounting items, there is no unambiguous method to calculate the market value of each *chaebol* firm's operating assets without introducing some measurement error. First, we need to make an assumption about the valuation of the private firms in the *chaebol*, in order to deduct the value of equity stakes held in private firms. Second, in order to calculate a measure such as a market-to-book ratio we need both the ownership (to compute the value of equity stakes) and the accounting data (to compute the book value of operating assets). However, in general, the accounting and ownership data refer to different months of the year. Most of the accounting data is from December (the fiscal month for a majority of firms), while the ownership data refers to April of a given year.

Because of these measurement problems, we use in our benchmark regressions a measure of Tobin's Q that is not adjusted for the market and book value of equity stakes held in other *chaebol* firms (unadjusted Q, defined as Q_{una}):

$$Q_{una} = \frac{EV + \text{Book Value of Liabilities}}{\text{Book Value of Assets}}. \tag{18}$$

The observed equity value of a *chaebol* firm, EV, incorporates the value of the equity stakes held in other firms. Also, the firm's total book value of assets includes an accounting adjustment for book value of equity held in other firms, as explained above. As far as we know, all of the previous literature on business groups uses a similar valuation measure.

Nevertheless, we also check whether the results are sensitive to correcting Q for equity stakes. In order to do this, we derive implied operating asset values from market prices, and divide by the book value of operating assets. To derive the implied operating asset value we use the book value of equity to value the private firms in the *chaebol* (if book equity is positive), and use the ownership matrix to deduct the value of equity stakes that each

chaebol firm holds in other firms. The resulting Q measure can be interpreted (conditional on measurement issues) as the Q that a group firm would have if it were valued as a stand-alone entity (stand-alone Q, defined as Q_{sa}):

$$Q_{sa} = \frac{EV + \text{Book Value of Liabilities - Value of equity stakes}}{\text{Book Value of Operating assets}}. \tag{19}$$

Our results are qualitatively identical if we use Q_{sa}, suggesting that the standard practice of using an unadjusted measure of valuation does not introduce much of an error.

Table 4 reports the summary statistics for the accounting and valuation variables. Our benchmark measure of profitability is operating ROA, defined as operating profits divided by operating assets (see the appendix for the definitions). For comparison, we also report a measure of profitability unadjusted for the equity stakes (total profits/total assets). The average unadjusted measure overstates average profitability by a small amount. Naturally, operating assets are lower than total assets because of the adjustment for equity stakes (on an average, an approximately 10% decrease). Next, we present statistics on the two measures of Q (which have very similar properties), and the equity values that we use to compute them. There are a total of 889 firm-years available for public firms between 1998 and 2004. Q_{una} is based on the total market value of equity, while Q_{sa} is calculated using the stand-alone value of equity (which is lower than the market value due to the adjustment for equity stakes). Notice that Q_{sa} and Q have very similar distributions.[24] We use capital expenditures divided by operating assets to measure capital intensity, and non-current liabilities divided by operating assets to measure leverage.

7.2 Pyramids, profitability and capital intensity

As explained above, some of the predictions that we wish to test are based on a comparison of firms that are owned through pyramids with firms that are owned directly by the family. In addition, the comparison does not include the firms that the family uses to control other firms (i.e., the central firms). The theory predicts that firms that the family chooses to control through the central firms should have lower profitability and higher capital intensity than the firms that the family chooses to control directly (that is, without any ownership by the central firms). These are implications 2 and 3 described in Section 2.

In order to test implications 2 and 3, we implement the following empirical procedure. First, we construct a variable called *pyramid*, which is equal to one if the average position of a group firm is larger than two, and equal to zero if the average position is in the 25th percentile or lower (the 25th percentile of the position variable is equal to 1.4). This discrete variable is more likely to capture the contrast between pyramidal and direct ownership that is the focus of the theory. Then, we restrict the sample to firms that have a centrality variable less than or equal to 0.015, which is equal to the average value for centrality in Table 2.[25]

[24] This is consistent with the results in Bohren and Michalsen (1994), who compute distortions due to double counting of value of firms with cross shareholdings in Norway. Valuation metrics such as price-earnings ratio are relatively unaffected by cross-shareholdings, since there is double counting in both the numerator and the denominator. However, French and Poterba (1991) report a substantial effect on cross-shareholdings on price-earning ratios in Japan in the 1980s.

[25] The results presented below are not sensitive to small variations in the cutoffs used to compute the *pyramid* variable and to define non-central firms.

This filter restricts the empirical test to non-central firms, for which implications 2 and 3 should apply.[26] We end up with a sample of 2,515 firm-years, 77% of each with a pyramidal ownership structure ($pyramid = 1$).

Our empirical model is the following:

$$\begin{aligned} Pyramid_{i,t} &= \alpha_1 OperROA_{i,t} + \alpha_2 Capex_{i,t} + \beta Controls_{it} + \\ &\quad + \sum_j industry_j + \sum_t year_t + \varepsilon_{i,t,} \end{aligned} \tag{20}$$

where the controls include firm size (measured by the log of operating assets), age and public status, and, in some specifications, the measures of separation between ownership and control. This specification also controls for industry and year fixed effects. The industry classification corresponds roughly to a 2-digit SIC classification in the US (there are 45 different industries in the sample). In some specifications, we also include group fixed effects to measure within-group effects. The standard errors are clustered at the level of the firm. Implication 1 suggests that the coefficient α_1 should be negative, and implication 2 suggests that the coefficient α_2 should be positive.

The results are reported in Table 5. Column (1) suggests that firms owned through pyramids are indeed less profitable and more capital intensive than those that the family chooses to own directly. Since the pyramid variable is likely to be highly correlated with the proxies for separation between ownership and control (which can also affect firm profitability according to traditional stories about pyramids), in the next regressions (columns (2) and (3)), we include our two proxies for separation between ownership and control ($separVR$ and $separCC$). As expected, these variables are highly correlated with *pyramid*. Nevertheless, profitability remains highly correlated with the *pyramid* variable.

These results suggest that the relation between profitability and pyramidal ownership that we uncover is *not* due to the separation between ownership and control induced by pyramids. The inclusion of the ownership variables does reduce the significance of the capital intensity variable, which is still significant in column (2) but not in column (3). Finally, in columns (4) to (6), we introduce group fixed effects. The results suggest that *within each group* firms owned through pyramids are less profitable and more capital intensive than those owned directly (though the latter relation is not always significant). These results are broadly consistent with implications 1 and 2 of Section 2.

7.2.1 Does profitability predict pyramidal ownership?

The results on Table 5 show that pyramidal ownership has a robust negative contemporaneous correlation with firm profitability. While this result is consistent with implication 2 (which suggests that low profitability makes it more likely that the firm is owned through a pyramid), it is also potentially consistent with the traditional argument that pyramidal ownership reduces firm performance because it separates ownership from control (see Section 1). Thus, it is desirable to present more direct evidence that is consistent with the direction of causality suggested by implication 2.

[26] In unreported regressions, we have also used the variable *stake* to eliminate from the regressions the firms that the family uses to control other firms (those with high values for *stake*). The results were similar to those reported below.

In order to do this, we explore the fact that our dataset contains some data for group firms for years other than those in which the firm is classified as a group firm, provided that the firm is covered by the KLCA or KIS databases. Specifically, we have 320 firm-years in which a given firm first appears as a *chaebol* firm in the dataset. Out of those, 33 firms are added to one of the groups with a direct ownership structure (position < 1.4, as in Section 7.2), and 249 firms are added to one of the groups with a pyramidal ownership structure (position > 2). We have data on lagged operating performance for 147 of these firm-years from KLCA/KIS. While the size of this sample is drastically reduced when compared to that in Table 5, examining a firm's profitability *before* it is added to a *chaebol* allows for a sharper test of the direction of causality suggested by implication 2. To wit, if lower profitability does predict pyramidal ownership, then the relationship uncovered in Table 5 should also hold if we replace $OperROA_{i,t}$ with $OperROA_{i,t-1}$, and use only firms which first appear in a *chaebol* in year t. Presumably, a firm's profitability in the year prior to becoming a *chaebol* firm cannot be affected by the ownership structure chosen by the *chaebol*'s controlling family. However, the firm's lagged profitabilty should explain its ownership structure according to implication 2.

We report the results in Table 6. In column (1), we examine the contemporaneous correlation between profitability and pyramids using only the sample of added firms. Similarly to Table 5, there is a negative correlation between pyramids and profitability. In column (2) we show that this result also holds when using lagged profitability. Thus, a firm's low profitability makes it more likely that the family will choose to control the firm through a pyramid. We can also reverse the logic of this test and examine the impact of pyramidal ownership on firms' future profitability (one-year ahead). As the results in column (3) show, pyramidal ownership is not significantly related to future profitability. Finally, in columns (4) to (6) we introduce a proxy for separation between ownership and control ($separCC$), which has essentially no effect on the results. The results in Table 6 are consistent with the direction of causality suggested by implication 2, and are inconsistent with the traditional argument that pyramidal ownership reduces firm performance.

7.3 Valuation and ownership structure

We now examine the valuation of group firms, and test implication 4 which states that central firms in the group should trade at a discount relative to non-central firms in the group. According to implication 4, this valuation discount is due to the minority shareholders' anticipation of future pyramidal investments by the central firm. To test this implication, we run the following regression:

$$\begin{aligned} Q_{i,t} &= \alpha_1 central_{i,t} + \alpha_2 Capex_{i,t} + \beta Controls_{it} + \\ &\quad + \sum_j industry_j + \sum_t year_t + \varepsilon_{i,t,} \end{aligned} \tag{21}$$

where the controls include firm size (measured by the market value of total assets), age and public status, leverage, capital expenditures (to control for growth opportunities), operating ROA (to control for current profitability) and in some specifications measures of ownership concentration and separation between ownership and control. To measure centrality, we use

both the benchmark measure (Equation 15), and also the firm i's aggregate equity stake in other firms normalized by firm i's assets (Equation 16). We also include the loop variable among the controls to verify whether there is any relationship between loop and valuation. As explained in Section 6.3, central firms also tend to be part of cross-shareholding loops. We control for industry and year fixed effects, and the standard errors are clustered at the level of the firm. Implication 4 suggests that the coefficient α_1 should be negative.

Table 7 presents the results of this regression. Column (1) suggests that centrality is indeed negatively related to valuation. The other variables have the expected signs. Large and younger firms have higher Q, as do firms with high growth opportunities, proxied by their capital expenditures. These results remain after controlling for the proxies for separation between ownership and control (columns (2) and (3)). Interestingly, only the measure based on the critical control threshold is significant in these regressions, showing the standard negative sign. In addition, there is some evidence that firms in cross-shareholding loops have lower valuations as well (though the correlation is weaker than that for centrality and not statistically significant).

In columns (4) to (6), we use *stake* to measure the extent to which a group firm is used to control other firms. The results are similar to those in columns (1) to (3), suggesting that those results are not driven by the specific way in which we measured centrality. Esssentially, group firms that hold large equity stakes in other firms trade at a discount relative to other group firms.[27]

7.3.1 Anecdotal evidence: the SK example

There is also some anecdotal evidence of the low valuation of central *chaebol* firms. A well known case is that of SK Corporation. In December 2003, the market capitalization of SK Corporation (the largest oil refinery in Korea) was approximately 2.9 billion dollars. Besides several stakes in private group firms, SK Corporation had a stake of 20% on SK Telecom (the largest mobile telecom company in Korea), which was worth 13.6 billion dollars, and a 39% stake in SK Networks, which was worth 4.3 billion dollars.[28] As a result of these equity stakes, SK corporation was the most central firm in the ownership structure of the SK group (centrality = 0.09, which is in the 92% percentile of our entire sample).

The value of these equity stakes alone (i.e., assuming a zero value for the stakes in private firms) was 4.4 billion dollars.[29] Thus, the implied equity value of SK corporation's operating assets was -1.5 billion dollars. One possible explanation for SK corporation's negative equity value is that the firm had a large amount of liabilities (book value equal to 8.1 billion dollars). If we add the entire amount of the book liabilities to SK corporation's operating equity value, we obtain a market value of 6.6 billion dollars for the operating assets of SK corporation (i.e., the value of the assets not including the equity stakes in other group firms). For comparison, the book value of the operating assets in December 2003 was 9.75 billion dollars. Thus, SK corporation's market-to-book ratio of operating assets (Q_{sa}) was 0.68 in December 2003.

[27] In unreported regressions we also include group dummies to Equation 21. The results are qualitatively identical to those reported in Table 7, indicating that within each group, central firms trade at a discount.

[28] The ownership data are as of April, 2003.

[29] SK Telecom and SK Networks also own shares in a private firm that owns shares in SK corporation, that is, they belong to a cross-shareholding loop.

This relatively low valuation for SK corporation attracted the interest of an activist investment fund that specializes in emerging market stocks (the Sovereign Fund), which amassed 15% of SK Corp. shares in the market during 2003 and started issuing takeover threats. Sovereign's attack subsequently raised SK Corporation's equity value. As a result, by December 2004 SK corporation's Q had increased to 0.92.[30]

7.3.2 Other explanations for the relation between centrality and valuation: discussion

We note that the logic behind implication 4 is not the only possible explanation for the valuation discount on central firms. The key characteristic of these firms is that they hold substantial equity stakes in other firms. Furthermore, these stakes might be *non-marketable* for the parent company, in the sense analyzed by Longstaff (1995).[31] If the stakes are necessary to retain control of subsidiary firms, then the parent company might be restricted from selling them. In Longstaff's model, this restriction introduces a discount on the valuation of the security for the investor who holds it but is restricted from selling it, relative to the market value of the security for other investors (such as the minority shareholders of the subsidiary).[32] Thus, the value of the equity stakes held by the parent company could be lower than the value of an identical stake held by other investors in the subsidiary company.

The finding that central firms have low valuations bear some resemblance to the closed-end fund puzzle (see, i.e, Shleifer (2000)). Closed-end mutual funds tend to trade at substantial discounts relative to the NAV (net asset value) of the securities in their portfolios.[33] In particular, some of the explanations developed to explain the closed-end fund puzzle bear some resemblance to implication 4 and also to the marketability stories above. It is possible that shareholders of the closed-end fund expect poor portfolio management in the future (similarly to implication 4), or that the closed-end fund might hold shares that have trading restrictions such as privately placed stock (the liquidity/marketability explanation). Nevertheless, not all arguments regarding the closed end fund puzzle seem equally relevant. For example, the investor sentiment story explained in Shleifer (2000) applied to the chaebol context would require individual investors to be more likely to trade shares of the parent company relative to the subsidiaries. There is no reason to expect that condition to hold in the Korean data.

Cornell and Liu (2001), Mitchell, Pulvino and Stafford (2002) and Lamont and Thaler (2003) provide some evidence that parent company discounts have also been observed in the US market. For example, in the period of 1985-2000, Mitchell, Pulvino and Stafford (2002) identify 70 firms in which the market value of the equity stake that the parent holds in the subsidiary is higher than the market value of the parent (similarly to the SK example above). Lamont and Thaler (2003) show some extreme examples of potential misvaluations

[30] SK corp's equity value went up to 6 billion dollars, while the value of the equity stakes went up to 4.7 billion. Liabilities were 6.8 billion, and the book value of operating assets was 8.1 billion.

[31] There is also a connection to the literature on the effect of illiquidity. See, for example, Silber (1991) regarding the discount in the pricing of restricted shares.

[32] In Longstaff's model, the discount comes from the fact that investors have market timing ability, which they cannot be taken advantage of if there is a binding restriction to sell.

[33] See Buysschaert, Deloof and Jegers (2004), for related evidence using data from Belgian holding companies.

(such as the Palm and 3Com example), in which a commitment by the parent to spin-off the shares of the subsidiary at a fixed rate in a future date creates an apparently clear arbitrage opportunity.[34] The standard explanation for this phenomenon in the US is that it is due to noise traders bidding up the prices of the subsidiary stocks,and arbitrage costs that make a price correction difficult to sustain.[35]

It is possible that this inefficient markets explanation is also behind the low valuations of central firms in Korea. However, we believe this story on its own is less likely to explain the Korean parent company discount. First, the Korean phenomenon seems to be more general and persistent than the internet bubble-related discounts in the US. It is linked to the characteristics of the ownership structures of business groups, rather than stemming from particular industry characteristics of the subsidiary firms. For example, if we use the same criteria used by Mitchell, Pulvino and Stafford (2002) to identify potential cases of misvaluation, we find 90 firm-years out of a total of 889 in which the market value of equity stakes are larger than the market value of the parent company, about 10% of the entire sample. In contrast, all the papers cited above suggest that this phenomenon is rather rare in the US market, partly because it is less common to observe a structure in which both the parent and the subsidiary are publicly traded. In addition, the subsidiaries of central Korean firms are not concentrated in any particular industry. Second, the alternative explanations discussed above (agency and control-related marketability issues) are more likely to hold in Korea than in the US, given the particular governance and ownership characteristics of Korean corporate finance.[36]

8 Conclusions

We propose new measures to describe the ownership structure of family business groups that go beyond the standard measures of cash flow and voting rights. Our measures are motivated by recent theoretical work that suggests that cash flow and voting rights are not the only ownership variables that are potentially associated with the performance and valuation of group firms. The variables of interest also include the degree of pyramiding in the ownership structure of a group firm, and the centrality of a firm for the group structure (e.g., whether a given firm is used by the family to control other group firms).

Our empirical results show that these new variables are, in fact, related to the performance and valuation of firms that belong to Korean *chaebol*s. In particular, we show evidence that firms with high investment requirements and/or low profitability are more likely to be set up in pyramids rather than owned directly by the family (a selection effect). In addition, we show evidence that central firms have lower market valuations than other public group firms. These results do not support the standard view that pyramidal ownership matters mostly because of its effect on separation between ownership and control. They support

[34] The spin-off fixed a ratio of shares of Palm that each 3Com shareholder would receive (1.5) in one year, subject to SEC approval. However, 3Com traded at a price that was substantially lower than 1.5 times the price of Palm.

[35] A large fraction of the firms analyzed in these studies are in the internet sector.

[36] Cornell and Liu (2001) discuss agency and liquidity explanations of US parent company discounts, and reject both possibilities in favor of the market inefficiency story above.

the argument that the family selects pyramidal ownership to take advantage of the cash retained in the central firms of the group, and that pyramidal investments are not beneficial for the minority shareholders of the central firms (who discount the value of their shares accordingly).

The ownership variables that we propose can also be useful for other researchers who are interested in the analysis of business groups. To facilitate the implementation of our procedure, we provide algorithms that can be used to calculate these variables for groups of any complexity. In particular, it would be interesting to see if our findings about group structure are particular to Korean *chaebol*s or if they extend to groups in other countries as well.

References

Aganin, Alexander, and Paolo Volpin, 2005, History of Corporate Ownership in Italy, in Randall Morck, ed.: *The History of Corporate Governance around the World: Family Business Groups to Professional Managers* (University of Chicago Press, Chicago, IL).

Almeida, Heitor, and Daniel Wolfenzon, 2006, "A Theory of Pyramidal Ownership and Family Business Groups", *Journal of Finance* 61, p. 2637-2681.

Attig, Najah, Klaus Fischer, and Yoser Gadhoum, 2003, On the determinants of pyramidal ownership: Evidence on expropriation of minority interests, Working paper, Laval University.

Bae, Kee-Hong H, Jun-Koo Kang, and Jin-Mo Kim, 2002, Tunneling or value added? Evidence from mergers by Korean business groups, *Journal of Finance* 57, 2695-2740.

Baek, Jae-Sung, Kang, Jun-Koo, and Inmoo Lee, 2007, Business Groups and Tunneling: Evidence from Private Securities Offerings by Korean Chaebols, forthcoming, *Journal of Finance*.

Barca, Fabrizio, and Marco Becht, 2001, *The Control of Corporate Europe* (Oxford University Press, Oxford).

Barontini, Roberto and Lorenzo Caprio, 2004, The effect of ownership structure and family control on firm value and performance: Evidence from Continental Europe, working paper, Università Cattolica del Sacro Cuore.

Bebchuk, Lucien, Kraakman, Reinier and George Triantis, 2000, Stock Pyramids, Cross-Ownership, and Dual Class Equity: The Creation and Agency Costs of Separating Control From Cash-Flow Rights, in *Concentrated Corporate Ownership* (R. Morck, ed.), pp. 445-460.

Bennedsen, M. and K. Nielsen, 2007, The Principle of Proportional Ownership, Investor Protection and Firm Value in Western Europe, working paper, Copenhagen Business School and CEBR.

Bertrand, Marianne, Paras Mehta, and Sendhil Mullainathan, 2002, Ferreting out tunneling: An application to Indian business groups, *Quarterly Journal of Economics* 117, 121-148.

Bertrand, M., Johnson, S., Samphantarak, K. and Schoar, A., 2004, Mixing Family with Business: A Study of Thai Business Groups and the Families behind Them, working paper, University of Chicago.

Bianchi, Marcello, Magda Bianco, and Luca Enriques, 2001, Pyramidal groups and the separation between ownership and control in Italy, Working paper, Bank of Italy.

Bohren, Oyvind and Dag Michalsen, 1994, Corporate cross-ownership and market aggregates: Oslo Stock Exchange 1980-1990, *Journal of Banking and Finance* 18, 687-704.

Brioschi, Francesco, Luigi Buzzacchi, and Massimo G. Colombo, 1989, Risk capital financing and the separation of ownership and control in business groups, *Journal of Banking and Finance* 13, 747-772.

Chang, Sea Jin and Unghwan Choi, 1988, Strategy, Structure and Performance of Korean Business Groups: A Transactions Cost Approach, *Journal of Industrial Economics*, 37, pp. 141-158.

Cheung, Y.L., R. Rau and A. Stouraitis, 2006, Tunneling, propping, and expropriation: evidence from connected party transactions in Hong Kong, *Journal of Financial Economics* 82, p. 343–386.

Claessens, Stijn, Simeon Djankov, Joseph P.H. Fan, and Larry H.P. Lang, 2002, Disentangling the incentive and entrenchment effects of large shareholdings, *Journal of Finance* 57, 2741-2771.

Claessens, Stijn, Simeon Djankov, and Larry H.P. Lang, 2000, The separation of ownership and control in East Asian Corporations, *Journal of Financial Economics* 58, 81-112.

Claessens, Stijn, Joseph P.H. Fan, and Larry H.P. Lang, 2002, The benefits of group affiliation: Evidence from East Asia, Working paper, University of Amsterdam.

Cornell, Bradford, and Liu, Qiao, 2001, "The Parent Company Puzzle: When Is the Whole Worth Less than One of the Parts?" *J. Corp. Finance* 7: 341–66.

Faccio, Mara, and Larry H.P. Lang, 2002, The ultimate ownership of Western European corporations, *Journal of Financial Economics* 65, 365-395.

Fisman, Raymond, and Tarun Khanna, 2000, Facilitating development: The role of business groups, Working paper, Columbia University and Harvard University.

Flath, David, 1992, Indirect Shareholdings within Japan's Business Groups, *Economics Letters* 38: 223-227.

Holmen, Martin, and Peter Hogfeldt, 2004, Pyramidal power, Working paper, Uppsala University and Stockholm School of Economics.

Hoshi, Takeo, and Anil Kashyap, 2001, *Corporate Financing and Governance in Japan* (MIT Press, Cambridge, MA).

Joh, Sung Wook, 2003, Corporate governance and profitability: Evidence from Korea before the economic crisis, *Journal of Financial Economics* 68, 287-322.

Khanna, Tarun, 2000, Business groups and social welfare in emerging markets: Existing evidence and unanswered questions, *European Economic Review* 44, 748-61.

Khanna, Tarun, and Krishna G. Palepu, 2000, Is group affiliation profitable in emerging markets? An analysis of diversified Indian business groups, *Journal of Finance* 55, 867-891.

Khanna, Tarun, and Jan W. Rivkin, 2001, Estimating the performance effects of business groups in emerging markets, *Strategic Management Journal* 22, 45-74.

Khanna, Tarun and Caterine Thomas, 2005, Relationships and Stock Price Comovements: Evidence from an Emerging Market. Working paper, HBS.

Khanna, Tarun and Yishay Yafeh, 2005, Business Groups in Emerging Markets: Paragons or Parasites? Forthcoming, *Journal of Economic Literature*.

Kim, W. and T. Sung, 2006, What Makes Group-Affiliated Firms Go Public? working paper, KDI School of Public Policy and Management.

La Porta, Rafael, Florencio Lopez-de-Silanes, and Andrei Shleifer, 1999, Corporate ownership around the world, *Journal of Finance* 54, 471-517.

Lamont, Owen, and Richard Thaler, 2003, Can the Market Add and Subtract? Mispricing in Tech Stock Carve-outs, *Journal of Political Economy,* p. 227-268.

Lemmon, Michael L., and Karl V. Lins, 2003, Ownership structure, corporate governance and firm value: Evidence from the East Asian financial crisis, *Journal of Finance* 58, 1445-1468.

Lins, Karl V., 2003, Equity ownership and firm value in emerging markets, *Journal of Financial and Quantitative Analysis* 38, 159-184.

Longstaff, F., 1995, How Much Can Marketability Affect Security Values?, *Journal of Finance* 50: 1767-1774.

Mitchell, Mark, Pulvino, Todd; and Stafford, Erik, 2002, "Limited Arbitrage in Equity Markets." *J. Finance* 57: 551–84.

Morck, Randall, David Stangeland, and Bernard Yeung, 2000, Inherited wealth, corporate control and economic growth: The Canadian disease, in Randall Morck, ed.: *Concentrated Corporate Ownership* (University of Chicago Press, Chicago, IL).

Morck, Randall, Daniel Wolfenzon, and Bernard Yeung, 2005, Corporate governance, economic entrenchment and growth, *Journal of Economic Literature* 43, 657-722.

Perotti, Enrico, and S. Gelfer, 2001, Red barons or robber barons? Governance and investment in Russian financial-industrial groups, *European Economic Review* 45, 1601-1617.

Shleifer, A., 2000. *Inefficient Markets: an introduction to behavioral finance.* Oxford University Press.

Silber, W., 1991, "Discounts on Restricted Stock: The Impact of Illiquidity on Stock Prices," *Financial Analysts Journal*, July/August.

Volpin, Paolo, 2002, Governance with poor investor protection: Evidence from top executive turnover in Italy, *Journal of Financial Economics 64, 61-90.*

A Computing the set $C(T)$ in section 3.4.2

We first provide a formal definition of the algorithm to compute $C(T)$ and then we explain how it works.

Definition 7 *(Algorithm) Let the sequence of sets* $S(0) \supseteq S(1) \supseteq S(2)...$ *be defined by* $S(0) = N$, *and* $S(n+1) = \{i \in S(n) : f_i + \sum_{j \in S(n),\, j \neq i} s_{ji} \geq T\}$.

The idea behind this algorithm is to start with all the firms, $S(0) = N$. In the first stage, we assume that the family controls all the firms and we drop the firms in which the direct and indirect stake of the family is below T. This procedure generates $S(1)$. Next, we assume that the family controls only the firms in $S(1)$ and again drop from $S(1)$ the firms in which the direct and indirect stake of the family is below T. This generates $S(2)$. We can repeat this algorithm a number $\sharp N$ of times to arrive at $S(\sharp N)$. This last set is important in light of the following Proposition.

Proposition 4 $S(\sharp N)$ *satisfies condition (22):*

$$C(T) = \{i \in N : f_i + \sum_{j \in C(T),\, j \neq i} s_{ji} \geq T\}. \tag{22}$$

A property that simplifies the algorithm is that if $S(n) = S(n+1)$ for $n < \sharp N$ then $S(\sharp N) = S(n)$. This means that we can stop the computation of the algorithm the first time we do not drop a firm.

To prove this proposition, we need to show $S(\sharp N) = \{i \in N : f_i + \sum_{j \in S(\sharp N),\, j \neq i} s_{ji} \geq T\}$. The proof is divided into a number of steps.

Step 1: $S(\sharp N) = S(\sharp N + 1)$.

Consider two cases: 1) $S(\sharp N) = \varnothing$ and 2) $S(\sharp N) \neq \varnothing$. In case 1), the lemma follows directly from the definition of $S(\sharp N + 1)$. In case 2), we have that, after $\sharp N$ stages, there are firms that are not yet eliminated. Because we started with $\sharp N$ firms, this means that there was a stage $n \leq \sharp N$ such that no firm was dropped. In other words, we have that $S(n) = S(n-1)$. We can now compute $S(n+1) = \{i \in S(n) : f_i + \sum_{j \in S(n),\, j \neq i} s_{ji} \geq T\} = \{i \in S(n-1) : f_i + \sum_{j \in S(n-1),\, j \neq i} s_{ji} \geq T\} = S(n)$, where the first equality follows from $S(n) = S(n-1)$ and the second from the definition of $S(n)$. Analogously, we can show that $S(n) = S(n+1) = S(n+2) = \ldots = S(\sharp N) = S(\sharp N + 1)$. The last equality proves step 1.

Step 2: $S(\sharp N) \subseteq \{i \in N : f_i + \sum_{j \in S(\sharp N),\, j \neq i} s_{ji} \geq T\}$

Note that $S(\sharp N) = S(\sharp N + 1) = \{i \in S(\sharp N) : f_i + \sum_{j \in S(\sharp N),\, j \neq i} s_{ji} \geq T\}$, where the first equality follows from step 1 and the second is simply the definition of $S(\sharp N + 1)$. Because $S(\sharp N) \subseteq N$, it is clear that $i \in S(\sharp N) \Rightarrow i \in \{i \in N : f_i + \sum_{j \in S(\sharp N),\, j \neq i} s_{ji} \geq T\}$.

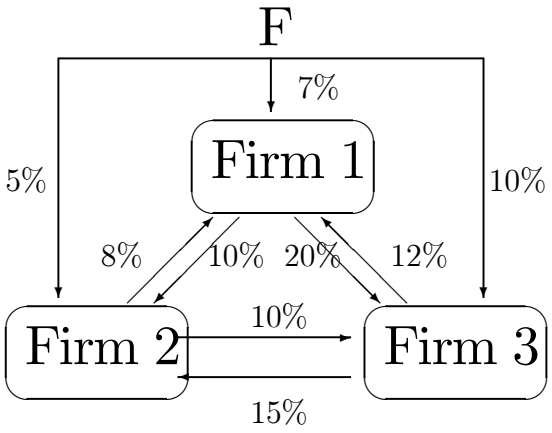


Figure A1: A complex group with many cross-shareholdings

Step 3: $S(\sharp N) \supseteq \{i \in N : f_i + \sum_{j \in S(\sharp N),\, j \neq i} s_{ji} \geq T\}$

Towards a contradiction, we suppose that $k \in \{\, i \in N : f_i + \sum_{j \in S(\sharp N),\, j \neq i} s_{ji} \geq T\}$ and $k \notin S(\sharp N)$. The first condition implies that

$$f_k + \sum_{j \in S(\sharp N),\, j \neq i} s_{jk} \geq T. \tag{23}$$

The last condition implies that firm k was eliminated in some earlier stage in the algorithm, say stage n. Thus $k \in S(n-1)$ but $k \notin S(n)$. We now have

$$T > f_k + \sum_{j \in S(n-1),\, j \neq k} s_{jk} \geq f_k + \sum_{j \in S(\sharp N),\, j \neq k} s_{jk}, \tag{24}$$

where the first inequality follows from the fact that firm k was eliminated in round n and the second inequality follows from $S(n-1) \supseteq S(\sharp N)$ and the fact that $s_{ij} \geq 0$. This is a contradiction because Equations 23 and 24 cannot hold at the same time. Putting together steps 2 and 3 leads to the statement of the Proposition.■

One problem that we need to address is the existence of multiple sets that satisfy condition 4. Consider the example in Figure A1, and assume that $T = 25\%$. Clearly, we have that $C(25\%) = \{1, 2, 3\}$ because the set $\{1, 2, 3\}$ satisfies condition 4. However, the null set also satisfies condition 4 for the same control threshold. To see this, suppose that the family controls no firms, then its voting rights in firms 1, 2 and 3 are 5%, 7%, and 10%, respectively. Note that all of them are below the threshold of 25%, confirming that the family does not control any of these firms.

Because in the case of Korea the firms with which we start (the set N) have already been pre-classified as members of the *chaebol*, we would like to choose the set that satisfies condition 22 and at the same time has the maximum number of firms. We can prove the following Proposition.

Proposition 5 *Consider all possible sets of firms that satisfy condition 22 for a given control threshold T: $C_1, C_2, \ldots, C_M$. The following holds: $S(\sharp N) = \bigcup_{i=1}^{M} C_i$.*

This Proposition of important for two reasons. First, it tells us that there is a unique set that has the maximum number of firms over all the sets that satisfy condition 22. This is important since it removes the arbitrariness of picking a set among many. Second, the proposition tells us that the outcome of the algorithm is precisely the set we are looking for.

The proof of this result is divided into two steps.

Step 1: $S(\sharp N) \subseteq \bigcup_{i=1}^{M} C_i$

By Proposition 4, we know that $S(\sharp N)$ satisfy condition 22, thus there is a m such that $S(\sharp N) = C_m$. The result follows.

Step 2: $S(\sharp N) \supseteq \bigcup_{i=1}^{M} C_i$

We show that $C_m \subseteq S(\sharp N)$ for all $m = 1 \ldots M$. Step 2 follows directly from this. Take a set C_m. Because C_m satisfies condition 22 the following is true:

$$\text{For all } k \in C_m, \ f_k + \sum_{j \in C_m,\, j \neq k} s_{jk} \geq T \tag{25}$$

Towards a contradiction, suppose that some of the firms in C_m are not in $S(\sharp N)$. That is, there must be a stage in the algorithm in which the first firm of C_m is eliminated. Let that stage be n. We then have that $C_m \subseteq S(n-1)$ but there is at least one $k \in C_m$ such that $k \notin S(n)$. We now have that

$$T > f_k + \sum_{j \in S(n-1),\, j \neq k} s_{jk} \geq f_k + \sum_{j \in C_m,\, j \neq k} s_{jk}, \tag{26}$$

where the first inequality follows from the fact that k is eliminated in round n and the second follows from $C_m \subseteq S(n-1)$ and the fact that $s_{jk} \geq 0$. This is a contradiction because Equations 25 and 26 cannot hold at the same time. This proves step 2. Finally, putting together steps 1 and 2 leads to the statement of the Proposition.■

B Accounting measures of operating assets and operating profits

After January 1st, 2003, the item 'stocks accounted in equity method' (code number KLCA 123560) reports the aggregate book value of the shares subject to the equity method. Before 2003, however, 'stocks accounted in equity method' was not separately recorded but pooled into all investment securities. The data are available from the footnotes to financial statements, which we examined to calculate this item for the remaining years. Regarding profits, the profits coming from affiliate companies (call it "equity method profits") are

recorded in two items in the non-operating portion of the income statement of parent companies. If equity method profits are positive, they are called "Gain on valuation of Equity Method" (KLCA # 242100). If they are negative, they are called "Loss on valuation of Equity Method" (KLCA # 252600).

With this knowledge, it is easy to adjust the financial statements to back out the values of the accounting figures that refer to each individual *chaebol* firm. Specifically, we have:

$$\text{Operating Assets} = \text{Total Assets - Equity Method Stock}, \tag{27}$$

and:

$$\text{Operating Profits} = \text{Total Profits - Gains from Equity Method + Losses from Equity Method}, \tag{28}$$

where we define Operating Assets/Profits as the asset/profit values that the *chaebol* firm would have in the absence of the equity method adjustment. These asset/profit figures reflect the individual assets and profitability of each *chaebol* firm.

One issue with the calculation of operating profits is that one cannot easily back out the tax implications of the equity method adjustments. For example, if affiliate companies provide profits to a parent, the parent's taxes will be higher. However, we do not know exactly how much higher. Thus, in the calculations below, we use a pre-tax measure of profitability to measure each firm's Total Profits that we input in equation 28 (specifically, we use *ordinary income* to measure total profits).

We also check the data for basic consistency requirements. In particular, if the balance sheet shows a number for the equity method stock (i.e., if item KLCA#123560 is non-missing), then there should also be an item in the income statement for gains and losses from equity method (i.e., KLCA#242100 and KLCA#252600 cannot both be missing). The reverse should also hold. In addition, it should not be the case that *both* items KLCA#242100 and KLCA#252600 are positive, since affiliates will either generate a profit or a loss. We eliminate all firm-years that do not satisfy this consistency requirement.

Table 1. Hyundai Motor's ownership structure.

Firm	Ult. Own	VR	CC	Position	Loop	Steps
Glovis	100.0%	100.0%	100.0%	1.0	0	0
Changwon	58.2%	67.6%	57.0%	1.0	0	0
INI Steel	10.4%	32.6%	25.0%	1.3	1	3
Hyundai Mobis	9.8%	35.2%	25.0%	1.3	1	3
Hyundai Motor	7.1%	25.0%	25.0%	1.4	1	3
Hyundai Capital	14.9%	93.1%	25.0%	1.6	1	3
BNG Steel	9.1%	60.7%	25.0%	1.9	0	0
Kia Motors	4.2%	47.6%	25.0%	2.4	1	3
World Industries	5.1%	90.5%	25.0%	2.8	0	0
Dymos	5.5%	97.8%	25.0%	2.8	0	0
Ajumetal	3.8%	72.7%	25.0%	3.8	0	0

Firm	Centrality	Type	Employ	Age	Industry
Glovis	4	private	196	3	Other Transport
Changwon	0	private	195	30	Fabr. Metals
INI Steel	4	listed	4329	50	Basic metals
Hyundai Mobis	12	listed	3924	27	Motor Vehicles
Hyundai Motor	13	listed	52542	37	Motor Vehicles
Hyundai Capital	0	private	1059	11	Fin. Institution
BNG Steel	0	listed	544	38	Basic metals
Kia Motors	9	listed	31432	60	Motor Vehicles
World Industries	0	private	1624	28	Motor Vehicles
Dymos	0	private	875	5	Motor Vehicles
Ajumetal	0	private	204	31	Basic metals

Table 2. Summary statistics, ownership structure

Panel A. Basic statistics

All firms	Mean	StDev	Median	25%	75%	Firm-years
Ultimate ownership	0.21	0.22	0.13	0.05	0.28	3545
VR	0.68	0.28	0.68	0.47	1.00	3545
CC	0.33	0.19	0.30	0.19	0.43	3545
Separation VR	0.47	0.29	0.44	0.23	0.73	3545
Separation CC	0.12	0.11	0.12	0.03	0.19	3545
Average Position	2.11	0.82	2.06	1.40	2.56	3545
Centrality	0.02	0.05	0.00	0.00	0.00	3521
Stake	0.08	0.34	0.00	0.00	0.04	3545
Loop	0.25	0.43	0.00	0.00	1.00	3545
Public	0.26	0.44	0.00	0.00	1.00	3545
					No.Firms	1085
					No.Groups	47

Panel B: Correlation table

	Ult Own	Votes (VR)	Votes (CC)	Av Pos	Public	Centrality	Stake
Votes (VR)	0.36						
Votes (CC)	0.86	0.35					
Av Pos	-0.52	0.20	-0.28				
Public	-0.16	-0.57	-0.15	-0.23			
Centrality	0.11	-0.17	0.16	-0.26	0.37		
Stake	0.12	-0.04	0.06	-0.16	0.05	0.13	
Loop	-0.06	-0.25	-0.09	-0.18	0.42	0.21	0.25

Panel C. Number of firms in loop

Firms in loop	Frequency	Percent
2	87	9.74
3	641	71.78
4	118	13.21
5	34	3.81
6	11	1.23
7	1	0.11
8	1	0.11
Total	893	

Table 3. Ownership variables and firm characteristics

	Dependent variable					
	Loop	Centrality	Stake	Av pos	Av pos	Av pos
	(1)	(2)	(3)	(4)	(5)	(6)
Firm age	9.079***	0.824***	3.417***	-12.867***	-8.076***	-7.833***
	(8.41)	(5.21)	(2.69)	(-6.00)	(-5.43)	(-5.02)
No employees	0.165***	0.016***	-0.011	-0.162***	-0.121***	-0.162***
	(5.49)	(3.21)	(-0.75)	(-3.23)	(-3.38)	(-4.35)
Public	0.182***	0.024***	-0.014	-0.152***	-0.083	-0.388***
	(4.91)	(4.66)	(-0.47)	(-2.20)	(-1.47)	(-7.16)
Ult. Own					-1.750***	-1.627***
					(-16.84)	(-15.36)
Separ VR					0.932***	
					(13.08)	
Separ CC						2.182***
						(12.66)
Group FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3545	3521	3545	3545	3545	3545
R-squared	0.36	0.28	0.09	0.31	0.63	0.62

Robust standard errors in parentheses, clustered at the firm level
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4. Summary statistics of accounting and financial variables

	Mean	StDev	Median	25%	75%	Firm-years
Op return on assets	0.022	0.124	0.027	-0.010	0.085	3002
Return on assets	0.023	0.125	0.028	-0.008	0.086	3002
Op assets (million USD)	705	2535	73	16	398	3470
Assets (million USD)	768	2725	75	17	429	3470
Firm age	16.8	14.3	13.0	4.0	26.0	3470
No employees	1198	3757	196	45	843	3470
Quna	0.92	0.32	0.85	0.74	1.00	889
Qsa	0.91	0.36	0.84	0.72	1.01	873
Mkt value of equity (million USD)	2071	5037	730	235	1992	889
Stand alone mkt value of equity (million USD)	1896	4686	691	227	1874	873
Capital expenditures/operating assets	0.06	0.15	0.03	0.01	0.07	2616
Leverage	0.21	0.30	0.14	0.04	0.30	2660

Table 5. Determinants of pyramidal versus direct ownership

	Dependent variable: Pyramids					
	(1)	(2)	(3)	(4)	(5)	(6)
Capital Exp.	0.094*	0.080*	0.045	0.085	0.089*	0.016
	(1.8)	(1.7)	(1.1)	(1.6)	(1.8)	(0.4)
Op. Roa	-0.349***	-0.255***	-0.264***	-0.366***	-0.278***	-0.312***
	(-3.3)	(-2.8)	(-3.2)	(-3.3)	(-2.86)	(-4.05)
Firm age	-8.193***	-6.560***	-6.501***	-8.259***	-6.877***	-6.039***
	(-3.83)	(-3.63)	(-3.99)	(-3.77)	(-3.82)	(-3.66)
Ln Assets	0.012	-.003	0.006	0.001	0.003	0.004
	(0.96)	(0.25)	(0.66)	(0.06)	(0.24)	(0.45)
Public	0.010	0.225***	-0.020	0.017	0.234***	-0.045
	(0.16)	(4.16)	(0.46)	(0.31)	(4.64)	(1.14)
Separation (VR)		0.805***			0.842***	
		(15.95)			(16.04)	
Separation (CC)			2.155***			2.406***
			(17.21)			(16.42)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Group FE	No	No	No	Yes	Yes	Yes
Observations	1788	1788	1788	1788	1788	1788
R-squared	0.18	0.39	0.47	0.29	0.48	0.56

Std. errors clustered at firm level. * signif. at 10%; ** signif. at 5%; *** signif. at 1%

Table 6. Determinants of pyramidal versus direct ownership: new firms

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable =	Pyramids	Pyramids	Op Roa next year	Pyramids	Pyramids	Op Roa next year
Op. Roa	-0.566***			-0.532***		
	(-3.57)			(-3.78)		
Op. Roa last year		-0.526**			-0.409**	
		(-2.5)			(-2.25)	
Pyramids			-0.043			-0.088
			(0.91)			(1.34)
Firm age	1.943	0.744	1.107	0.732	0.300	1.177
	(0.48)	(0.17)	(0.60)	(0.21)	(0.07)	(0.64)
Ln Assets	0.022	0.021	-0.006	0.016	0.007	-0.007
	(1.34)	(1.08)	(0.59)	(1.14)	(0.38)	(0.67)
Public	-0.084	-0.086	-0.005	-0.033	-0.030	-0.001
	(0.67)	(0.65)	(0.10)	(0.30)	(0.26)	(0.01)
Separation (CC)				1.551***	1.253***	0.323
				(5.35)	(3.38)	(1.39)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	195	147	147	195	147	147
R-squared	0.30	0.38	0.22	0.47	0.47	0.24

Std. errors clustered at firm level. * signif. at 10%; ** signif. at 5%; *** signif. at 1%

Table 7. Valuation and centrality

	Dependent variable: Tobin's Q					
	(1)	(2)	(3)	(4)	(5)	(6)
Centrality	-0.548***	-0.568***	-0.517***			
	(-3.68)	(-3.77)	(-3.40)			
Stake				-0.205**	-0.216**	-0.214**
				(-2.33)	(-2.37)	(-2.35)
Loop	-0.048	-0.050	-0.048	-0.017	-0.016	-0.015
	(-1.51)	(-1.52)	(-1.47)	(-0.47)	(-0.46)	(-0.45)
Firm age	-4.463***	-4.515***	-4.518***	-4.984***	-5.04***	-4.983***
	(-3.73)	(-3.70)	(-3.75)	(-4.06)	(-4.01)	(-4.03)
Ln assets	0.088***	0.089***	0.088***	0.076***	0.075***	0.076***
	(6.29)	(6.32)	(6.29)	(5.37)	(5.34)	(5.43)
op roa	-0.022	-0.021	-0.023	0.025	0.028	0.022
	(0.09)	(0.09)	(0.10)	(0.10)	(0.12)	(0.09)
Capex	0.440*	0.434*	0.425*	0.439*	0.435*	0.416*
	(1.95)	(1.93)	(1.90)	(1.94)	(1.92)	(1.85)
Leverage	0.061	0.067	0.067	0.053	0.058	0.063
	(0.45)	(0.50)	(0.50)	(0.39)	(0.43)	(0.47)
Separation (VR)		-0.077			-0.061	
		(-0.90)			(0.70)	
Separation (CC)			-0.222*			-0.282**
			(-1.94)			(2.47)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	811	811	811	818	818	818
R-squared	0.41	0.42	0.42	0.41	0.41	0.41

Standard errors clustered at firm level. * significant at 10%; ** significant at 5%; *** significant at 1%

Figure 4. Ownership Structure of Hyundai Motor in 2004

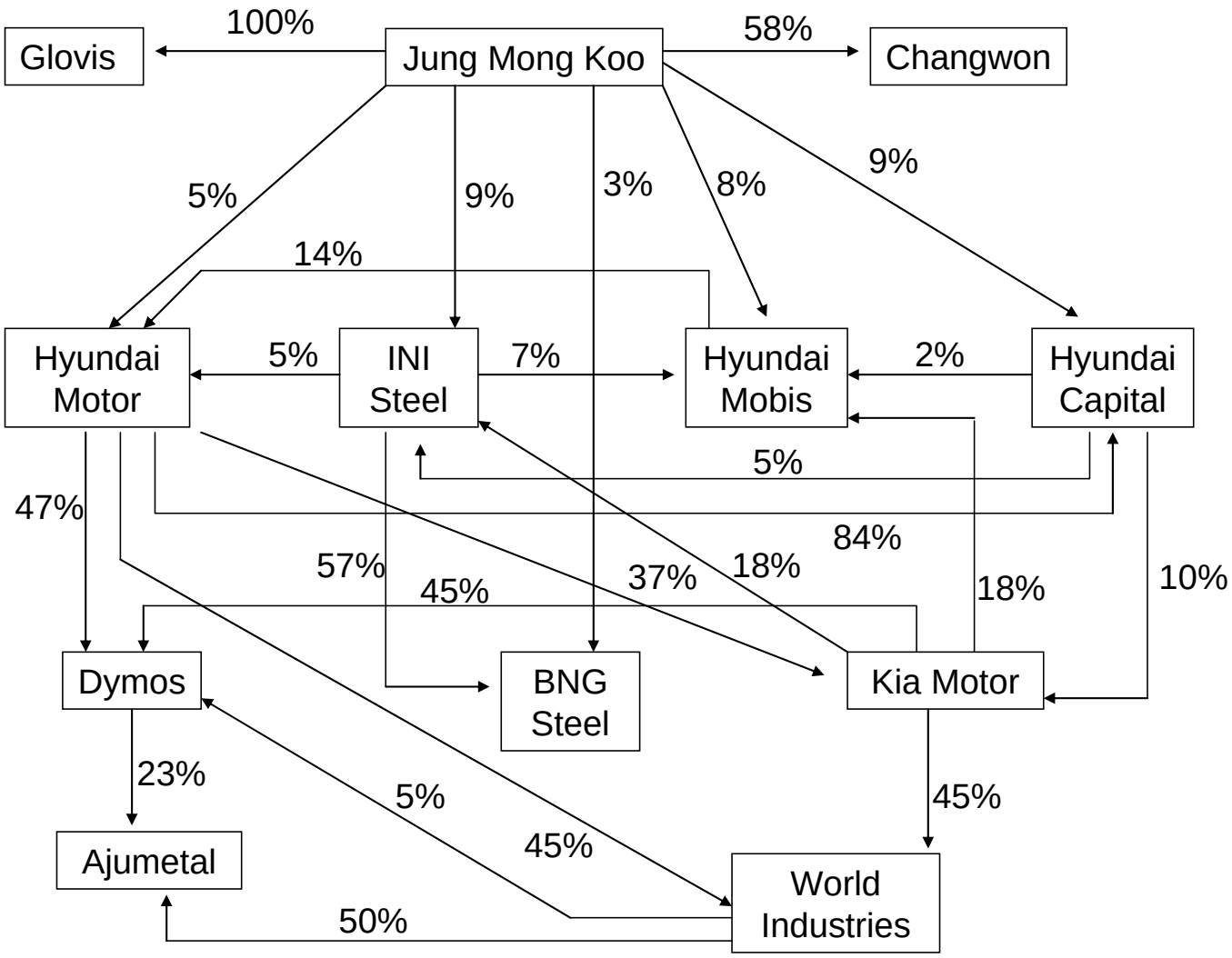
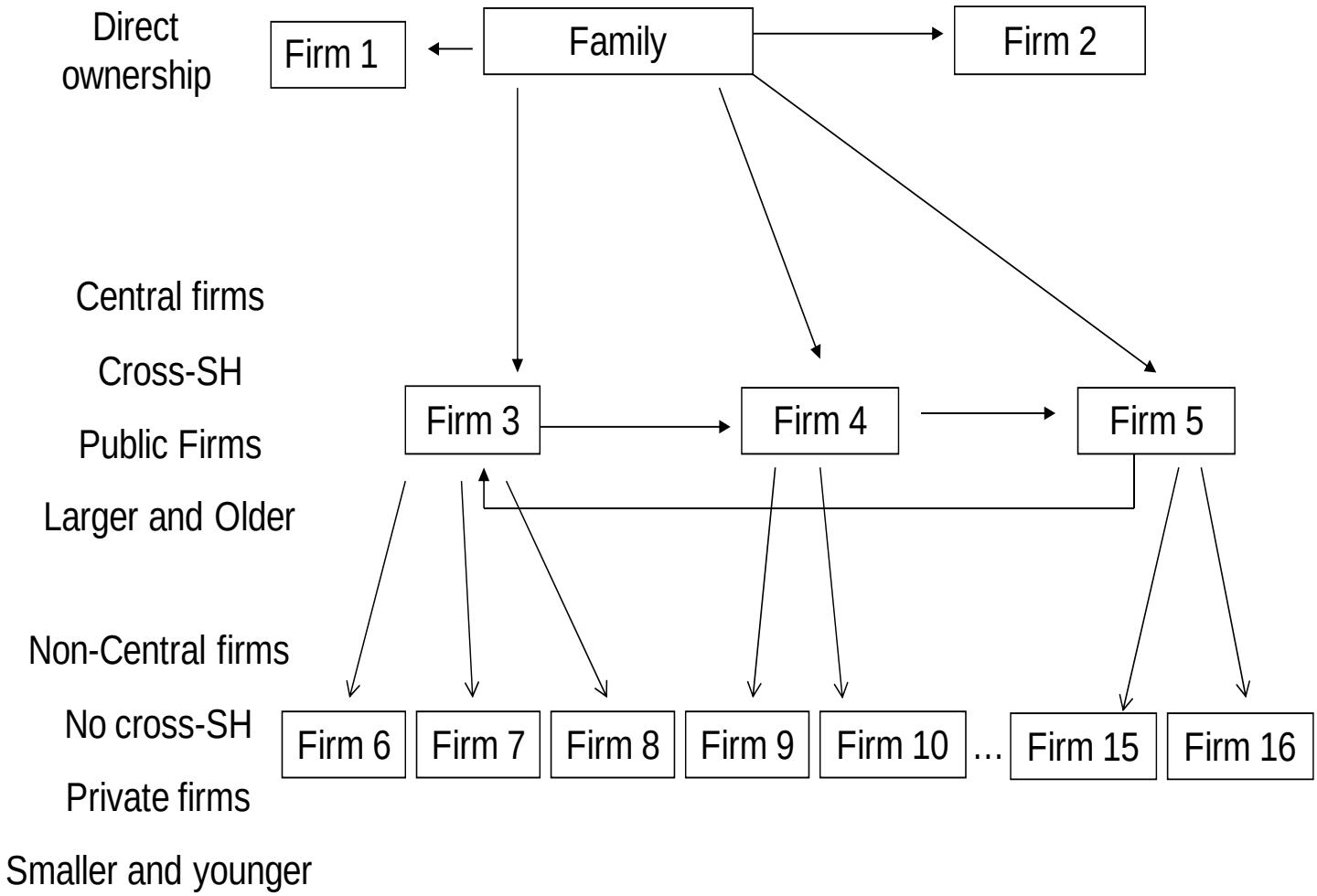


Figure 5. Average Ownership Structure of a Korean Chaebol, 1998-2004



Average group: 16 firms, 3 central firms, 3 firms with direct ownership, 4 public firms, 3 firms in loops