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

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(*This Draft: October 23, 2007*)

Abstract

We propose new metrics to describe the complex ownership structure of business groups, and show some evidence that cash flow and voting rights are not the only ownership variables that are important for understanding the structure and the performance of these groups. Our metrics include a precise measure of the degree of indirect (pyramidal) ownership of a group firm (the position of the firm in the group structure), the centrality of a firm for the control of other firms in the group, and whether a firm participates into a cross-shareholding loop involving any arbitrary number of firms. We also propose a new measure of voting rights (the critical control threshold), motivated by the fact that the preferred measure used in previous literature (the weakest link) does not work well in groups with complex ownership structures. We illustrate our measures by describing in detail the ownership structure of Korean chaebols in the period of 1998 to 2004. In addition, we validate the usefulness of our metrics by showing empirically that they are related to the valuation and performance of chaebol firms. Among other results, we show evidence that central firms and firms in cross-shareholding loops have lower valuations than other public Chaebol firms, and that firms owned through pyramids have lower profitability than similar firms placed at the top of the group. These results hold after controlling for variation in ownership concentration and separation between ownership and control.

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

JEL classification: G31

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We wish to thank Utpal Battacharya, Woochan Kim, and participants at the University of Texas at Austin, Indiana University, 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.

In most countries around the world individuals or families control a large number of firms through a complex arrangement of ownership chains. In many cases the family holds 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, which might itself control other firms, and so forth.[1] Another type of inter-company link is through *cross-shareholdings*. In this ownership structure, firms in the group have mutual ownership relations: one firm in the group holds a stake in another, which, in turn, has a stake in the first firm. In general, many large family groups combine the pyramidal form with cross-shareholdings, leading to a complex web of ownership. These so called *business groups* are an important component of several countries' corporate landscape, accounting for a large fraction of their economic activities.[2], [3]

Yet, we still do not understand the causes and consequences of the complex structures of groups. In particular, 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 the ownership structure of business groups. For example, Almeida and Wolfenzon (2006) argue theoretically that pyramids are not equivalent to a direct ownership structure with the same cash flow and voting rights (and thus with the same degree of separation between ownership and control). Their arguments suggest that the ownership structure of groups can be related to group firm performance even controlling for the standard ownership variables considered in the existing literature.

In this paper we make two principal contributions. First, we propose a number of measures that can be used to describe the ownership structure of business groups in greater detail. These measures include the standard measures of cash flow and voting rights that the controlling shareholder holds in group firms, but also a measure of the *position* of any group firm relative to the controlling shareholder (a precise measure of the degree of pyramiding in the ownership structure of that firm), and a measure of the *centrality* of a firm

[1] 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.

[2] The literature sometimes uses the term "business group" to refer to other types of corporate groupings, such as those in which the member firms are tied together by common ethnicity of the owners, interlocking directorates, etc. An example is the Japanese keiretsu, an organization in which individual managers have considerable autonomy in their own firms but coordinate their activities through the president council and a common main bank (Hoshi and Kashyap (2001)). Another example is the horizontal financial-industrial groups in Russia (Perotti and Gelfer (2001), p. 1604). Some of the formulas derived in this paper (such as the algorithm to identify the presence of cross-shareholdings) are also useful to describe this type of corporate grouping.

[3] 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. See also Section 5 for evidence of the importance of Chaebols for the Korean economy.

for the group structure (how important a firm is for the control of other group firms). Our second main contribution is to use a unique dataset of Korean business groups (chaebols) to illustrate the computations of our new measures and to show that they contain important information about the structure of the group, in that they are systematically related to firm characteristics such as size, age, and public status. We show that firms that are owned through pyramids have lower profitability than firms that are owned directly by the family. In addition, we show novel evidence that that central firms have lower profitability, and are valued at a significant discount relative to other group firms. Overall, our results suggest that cash flow and voting rights are not the only ownership variables that are important for understanding the ownership structure and the performance of firms in business groups.

Our paper also contains two additional contributions to the literature on business groups. First, we develop a new measure of the controlling shareholder's voting rights in group firms (the *critical control threshold*). As we argue below, the most common method used in the literature to compute voting rights (the *"weakest link"* measure proposed by Claessens et al. (2000)) is not well defined for groups with complex ownership structures.[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. Nevertheless, to show that our results are robust to the definition of voting rights, we also compute the other main measure of voting rights used in the literature, which we call consistent voting rights (e.g., La Porta et al., 1999). This measure simply represents the sum of direct votes held by the controlling shareholder, with the votes held by other firms controlled by the shareholder.[5] Unlike the minimum link, this alternative measure can be computed for any configuration of the group's ownership structure. Our second additional contribution is to propose a simple way to identify the presence of *cross-shareholdings*, which does not rely on manual inspection of the group's ownership matrix. We argue that previous literature has probably underreported the incidence of cross-shareholdings across the world, because these cross-ownership links typically involve more than two firms, and thus can be hard to identify manually.

We start by describing a simple formula to compute the ultimate cash flow right of the controlling family, which is the same formula previously derived by Brioschi et al. (1989), and Flath (1992). This formula incorporates the effects of cross-shareholdings, and chains of ownership of any degree of complexity.[6] In addition, we show that the same formula can be used to generate measures of the position of a group firm relative to the controlling shareholder, and to determine whether a firm is in a cross-shareholding or even in any general circular ownership pattern. Unlike the basic formula for cash flow rights, these latter measures are new to the literature.

The position of a firm in the group can be thought of as the distance between the firm and the controlling shareholder in terms of the group structure. It is effectively a measure of the

[4] This measure is also used, among others, by Barontini and Caprio, 2004, Claessens et al, 2002, and Faccio and Lang, 2002.

[5] This is also the measure of voting rights used by Korean regulators, who must compute separation between ownership and control in order to determine whether a particular chaebol is subject to certain regulations such as a ceiling on equity investments that can be made on other firms. This measure of voting rights is also used by Aganin and Volpin, 2005, and Lins, 2003, among others.

[6] Most of the previous literature uses a version of this formula that ignores the effect of cross-shareholdings (e.g., Baek, Kang and Lee, 2007).

extent of pyramidal ownership of a group firm. For example, if the controlling shareholder holds only a direct stake in a firm, its position is equal to one. A firm that is controlled entirely through a stake held by another firm (i.e., controlled through a simple pyramid) has a position of 2. Besides these simple cases, our methodology allows us to compute the position of *any* firm, irrespective of the complexity of the group ownership structure.

Cross-shareholdings are relatively easy to compute manually when they consist of two firms (e.g., firm A owns shares in B, which owns shares in A). However, this case (which we call direct cross-shareholdings) is rare in Korean chaebols because of specific regulations (see Section 3). Such restrictions are also common in other countries (see, e.g., Faccio and Lang, 2002), perhaps inducing firms to create cross-shareholding loops that involve more than two firms. Our methodology allows us to identify cross-shareholdings involving any arbitrary number of firms, and to measure how many firms belong to the cross-shareholding loop.

Next, we compute the voting right of the controlling shareholder in each group member. The difficulty here is that it is not clear what fraction of the votes held indirectly through a group firm belongs to the controlling family. The common procedure in the literature has been to use the concept of weakest link (see. e.g., Claessens, Djankov, and Lang (2000), and Faccio and Lang (2002)). For example, if the family holds 20% of the votes of firm A, which holds 50% of the votes of firm B, Claessens et al. would assign 20% of B's votes (the minimum of 20% and 50%) to the family. This definition captures the intuition that the ownership of firm A is the weakest link in the control chain leading up from the family to firm B. For example, an outsider could challenge the control of firm B by acquiring a 20% stake in firm A. Thus, it makes intuitive sense to say that the family owns only a 20% effective voting stake in firm B.

Despite the intuitive appeal of this definition of voting rights, we show that it does not work well for ownership structures that are more complex than simple pyramids. For example, the minimum link is not well defined when there are cross-shareholdings among firms. Because of this, we propose an alternative measure of voting rights, which we call the critical control threshold, CC. This measure captures the same intuition behind the minimum link. Specifically, it represents the weakest link in the control chain leading down to any group firm. We show that CC coincides with the weakest link measure of voting rights for simple pyramids. In addition, it is well defined even in cases in which the weakest link measure cannot be computed. Thus, we can think of CC as a generalization of the weakest link measure of voting rights, for groups with complex ownership structures.

We use the CC measure of voting rights to compute the *centrality* of a firm in the group. The concept that we want to measure is how important a firm is for controlling other group firms. The centrality measure is computed as the average drop in CC (across all group firms) when a firm is hypothetically eliminated from the group. Firms that own substantial stakes in other firms will have high centrality, and specially so if it has an important hierarchical position in the group structure. For example, if firm 1 owns shares in firm 2, firm 1 is likely to be central. But centrality increases if firm 2 also holds shares in firm 3, because dropping firm 1 from the group compromises the control of both firms 2 and 3.

We apply these measures to understand the ownership structure of Korean business groups (*chaebols*). Chaebols are an ideal object for our methodology, given the complexity of their ownership structures. In addition, the political situation surrounding chaebols in Korea allows us to obtain extremely detailed ownership data on chaebol firms. Up until the 1990s, Korean chaebols were credited with being one of the most important factors in Korea's rapid growth. This view appeared to change in the 1990s, as the chaebols began to be seen by some as an obstacle to growth. As a consequence of this political change, and among other regulatory measures discussed below in Section 3, Korean regulators have considerably tightened the disclosure requirements for Chaebol firms. In particular, since the mid 1990s the top Korean chaebols have had to report their complete ownership information to the Korean Fair Trade Commission (KFTC). These reports also include ownership and accounting data on *private* chaebol firms.

A quick look at the summary statistics of these groups reveal that they are highly complex, comprising on average of several dozen firms with many layers and cross-shareholding loops with more than two firms. Consider for example Figure 6, which contains a slice of the ownership structure of the Hyundai Motor group in 2004. Even with the aid of the picture, it is difficult to understand the links between the firms, and to summarize these links in a few firm-specific variables. However, it is straightforward to use our algorithms to compute the basic ownership characteristics of all the firms in this picture. For example, our calculations show that Hyundai Motor is the key firm for the control of the group (highest centrality), and they identify that Hyundai Motor, Kia Motor and INI Steel belong to a cross-shareholding loop with 3 firms in it (Hyundai owns shares in Kia, which owns shares in INI, which owns shares in Hyundai). This example illustrates the usefulness of our algorithm in translating a complex flow chart into a few firm-specific variables that summarize the basic characteristics of the structure.

We compute the ownership variables for all Chaebol firms from 1998 to 2004, and provide a novel characterization of the average ownership structure of a Korean Chaebol (depicted in Figure 7). An average chaebol has 16 firms, with roughly three layers in its ownership structure. On average 3 out of the 16 firms (represented by firms 1 and 2 in the Figure) are owned directly at the very top of the group (layer 1). Nevertheless, the average position of a chaebol firm is 2.11, indicating that the average firm is controlled through a pyramid (which may include cross-shareholdings). We also find that approximately 25% of the firm-years consist of firms that belong to cross-shareholding loops. The typical loop in Korea contains 3 firms, which suggests that previous studies might have been unable to manually identify the presence of such loops. Because of the substantial cross-holdings, these firms are not owned directly by the family. Thus, they comprise what we can think of as layer 2 of a typical chaebol (the middle layer). 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 third and bottom layer (which contain all the other firms), we have firms that are more likely to be private, smaller and younger. They are also less likely to be central and to belong to cross-shareholding loops.

This snapshot of a typical Chaebol in 1998-2004 is consistent with a historical evolution of the chaebol structure. In particular, it seems to be the case that pyramidal business groups are created as the controlling family uses existing and succesful group firms to set up and acquire new firms (Almeida and Wolfenzon, 2006). Firms that own large controlling stakes in other firms (the central firms) are at the top of the group, are older, and more likely to be public and to have grown in size (both measures of their historical success).

Provided with detailed ownership characteristics of all Chaebol firms, we proceed to correlate these variables with measures of profitability and valuation. We were able to obtain accounting data for most chaebol firms (including private firms, which comprise approximately 75% of the sample), and stock market data for all those that have been public in any period between 1998 and 2004 (approximately 25% of the firm-years).

We compute measures of operating assets and profits, which are defined as the asset and profit values that the Chaebol firm would have excluding the adjustments due to equity stakes held in other firms. These asset and profit figures reflect the individual assets and profitability of each Chaebol firm. We regress profitability on ownership variables, controlling for basic firm characteristics such as size, age, industry and public status. Consistent with previous literature, we find that firms in which the controlling shareholder has higher cash flow rights or lower sepration between ownership and control have higher operating performance. However, we also find that central firms show lower operating performance than other similar group firms, even after controlling for the standard ownership variables. In addition, we provide some 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 control of the group (e.g., those at the top layer in Figure 7). These results also hold after controlling for the degree of separation between ownership and control induced by pyramids.

The market valuations of (public) group firms are also related to the new ownership variables that we measure in the paper. Consistent with previous literature, we find that separation between ownership and control is negatively related to Q, if we compute separation using the CC measure of voting rights. In addition, we find that central firms and firms that belong to cross-shareholding loops also carry lower market valuations than other group firms. The negative correlation between loop, centrality and Q holds after controlling for ultimate ownership and/or measures of separation between ownership and control, and also group dummies. Thus, within each group, central firms that belong to cross-shareholding loops are those with the lowest valuations, irrespective of the degree of separation between ownership and control.

We also discuss some possible explanations for these results. In particular, the low valuation of central firms could be due to shareholder's anticipation of future negative NPV pyramidal investments made by these firms, as suggested by Almeida and Wolfenzon (2006). These low valuations can also be a consequence of a lack of marketability of equity stakes held by central firms in other group firms (Longstaff, 1995). The lower profitability of firms owned through pyramids is also consistent with the selection arguments in Almeida and Wolfenzon, whereby the family optimally chooses to control a firm through a pyramid if the firm has low profitability. Overall, these results show that ownership variables other than separation between ownership and control contain interesting information about firm performance and valuation.

Existing literature recognizes that business group's ownership structure is a potentially important determinant of firm performance and valuation.[7] Nevertheless, the focus is mostly

[7] 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).

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 chaebols, 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 flow rights (typically the acquirer) to those in which the family has higher cash flow rights. 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 emerging markets' firms. Joh (2003) finds that separation between ownership and control is negatively related to profitability in Korea.[8] 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 run regressions of performance on 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

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

Enriques (2001) find similar evidence for Italy.

Sections 1 and 2 introduce our methodology to compute ownership variables for group firms. In Sections 3 and 4 we describe the legal and regulatory framework of Korean Chaebols, and the data that we use. In Section 5 we present the results that describe the ownership structure of Korean chaebols, and in Section 6 we relate the ownership variables to performance and valuation.

1 Ultimate cash flow rights: definition and calculation

For brevity, we refer to the controlling shareholder as the "family" in the ensuing discussion. The definition of *ultimate* cash flow rights of the family in a particular firm is the fraction of the dividends paid by that firm that is (eventually) received by the family. 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 proceeds that arise due to the indirect holdings, we propose an algorithm (the *dividend algorithm*) that allows us to *follow* the original dividend through group companies. Importantly, we are able to represent each stage in the dividend algorithm as a simple matrix operation. The matrices needed require information only about the direct stakes in each group firm. This allows us to easily automate the process and to dispense with the need to consider all the potential chains. This method is general enough to accommodate *any* number of firms and *any* possible ownership structures (i.e., any possible configuration of inter-company holdings). To illustrate the use of the formula, we apply it to some examples.

The formula for cash flow rights generated by the dividend algorithm is identical to that generated by the procedures in Brioschi (1989) and Flath (1992).[9] However, in the last part of this section, we provide two applications of our dividend algorithm that have not been previously discussed in the literature.

1.1 The dividend algorithm

The algorithm follows a dollar of dividend paid by a firm. In the first stage, we assume that the firm under consideration pays one dollar in dividends. We then use the *direct* stakes of owners of this firm to compute the amount received by the family and the amounts received by other group firms. In the second stage, we assume that group firms that received a dividend in the first stage pay it out in full as dividends. Then, we again compute the amount received by the family and the amounts received by group firms. We continue with this procedure for an indefinite number of stages. Finally, we add the amounts received by the family in all stages.

[9] While this formula is known, not all the literature uses it to compute cash flow rights. For example, Baek et al. (2007) ignore cross-shareholdings to compute cash flow rights, and incorporate only the effect of two layers of control chains (two-firm pyramids). Claessens et al. (2000) and Faccio and Lang (2002) also use a different procedure to compute cash flow rights.

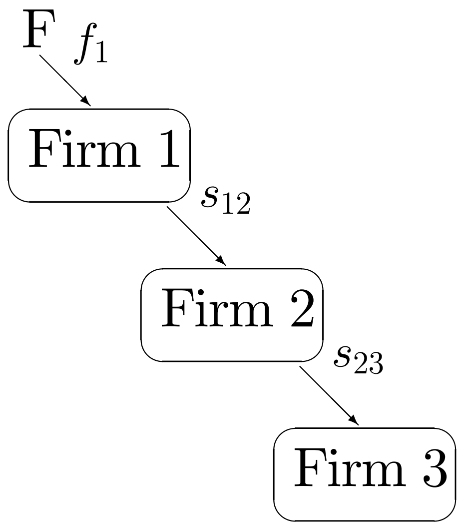

Figure 1: A simple pyramid

Notice that while this procedure assumes that dividends are always paid out, this condition is not really required in practice for the algorithm to work. In other words, cash flow rights can also be computed in this way even for firms that never pay dividends.

Example 1: A simple pyramid

Figure 1 shows a pyramid with no cross-shareholdings. The family owns a fraction f_1 of firm 1, firm 1 owns a fraction s_{12} in firm 2, and firm 2 holds a fraction s_{23} in firm 3. We compute the ultimate cash flow stake of the family in firm 3.

The algorithm calls for following a dollar paid by firm 3. In stage 1, firm 3 pays one dollar in dividends and firm 2 receives s_{23} dollars. The family does not receive anything at this stage. In stage 2, firm 2 pays out the cash it received, s_{23}. Firm 1 receives a fraction s_{12} of the dividend or $s_{12}s_{23}$. In stage 3, firm 1 pays dividends of $s_{12}s_{23}$ and the family receives a fraction f_1 or $f_1s_{12}s_{23}$. At this point, all firms in the group have no part of the original dollar paid by firm 3, and so we can stop. Adding the dividends the family received in all stages, we obtain that its ultimate cash flow stake in firm 3 is

$$u_3 = f_1s_{12}s_{23}.$$

Example 2: Cross-shareholding

Consider the structure in Figure 2. The family has a direct stake of f_1 and f_2 in firms 1 and 2, respectively. Also, firm 1 holds a stake of s_{12} of firm 2, and firm 2, in turn, holds a stake of s_{21} in firm 1. We compute the ultimate cash flow stake of the family in firm 2.

The algorithm proceeds as follows. In stage 1, firm 2 pays one dollar in dividends. The family receives f_2 and firm 1 receives s_{12}. In stage 2, firm 1 pays out the s_{12} dollars it received. Now, the family receives an additional f_1s_{12} and firm 2 receives $s_{21}s_{12}$. In stage 3, firm 2 pays out the $s_{21}s_{12}$ it received. The family receives $f_2(s_{21}s_{12})$ and firm 1 receives $s_{12}(s_{21}s_{12})$. As it is clear, we can continue doing this procedure indefinitely. From the pattern

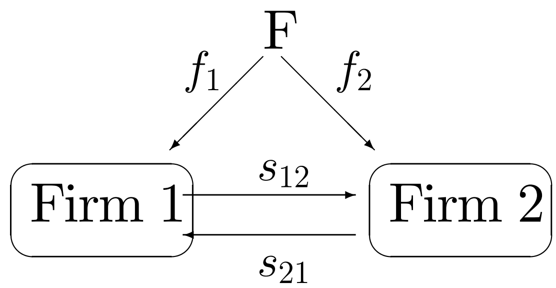

Figure 2: Cross-shareholdings

that emerges, we can compute the total amount received by the family by:

$$u_2 = f_2 + f_1 s_{12} + f_2(s_{21}s_{12}) + f_1 s_{12}(s_{12}s_{21}) + f_2(s_{21}s_{12})^2 + f_1 s_{12}(s_{12}s_{21})^2 + ... \quad (1)$$
$$= \frac{f_2}{1 - s_{21}s_{12}} + \frac{f_1 s_{12}}{1 - s_{21}s_{12}}$$

As can be seen from the above, doing this process manually is tedious, even for a small group with 2 firms. Because business groups have many dozen –and sometimes over a hundred– firms and extensive inter-corporate holdings, the manual procedure we have described –although feasible– is not practical. To automate this algorithm, we turn to the derivation of the general formula in the next section.

1.2 A simple formula

Consider a business groups with N firms. With the *direct* ownership information, we construct a matrix of inter-corporate holdings as follows:

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

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.

We also construct a vector of the direct stakes of the family in each of the N firms

$$\mathbf{f} = \begin{bmatrix} f_1 \\ f_2 \\ \vdots \\ f_N \end{bmatrix}$$

.

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

$$\mathbf{u}' = \mathbf{f}'(I_N - A)^{-1} \tag{2}$$

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

Example 2 (revisited)

Take the group in Figure 2. In this case the matrix of intercompany holdings is:

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

and $f = [f_1\ f_2]'$. Suppose we want to compute the ultimate ownership of the family in firm 2. According to the algorithm we need to follow a dollar of dividend paid by firm 2. We write the dividend that all firms pay in a particular stage in vector form. Thus, the initial dividend is given by:

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

That is, firm 1 pays no dividend and firm 2 pays a dividend of 1. In the rest of the paper, we let $\mathbf{d}_i$ be the vector of zeroes with a 1 in the i^{th} position.

We can now rewrite the computations we followed in the previous section in matrix form. Stage 1 is as follows. The dividends paid are $\mathbf{d}_2$. The family receives $\mathbf{f}'\mathbf{d}_2 = f_2$ and corporate owners receive $A\mathbf{d}_2 = [s_{12}\ 0]'$ (i.e., firm 1 receives s_{12} and firm 2 receives 0). In stage 2, corporate owners pay out the full amount they received in stage 1, i.e., $A\mathbf{d}_2 = [s_{12}\ 0]'$. The family receives $\mathbf{f}'A\mathbf{d}_2 = f_1 s_{12}$ and corporate owners receive $A(A\mathbf{d}_2) = A^2\mathbf{d}_2 = [0\ s_{21}s_{12}]'$. 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 $A^3\mathbf{d}_2$.

A pattern emerges: starting from dividend $\mathbf{d}_2$ and after n rounds of dividends, the fraction of the original dollar held by corporate owners is $A^n\mathbf{d}_2$ and the family receives in this stage $\mathbf{f}'A^{n-1}\mathbf{d}_2$. The same algorithm can be repeated for any firm i in any group with a matrix of direct corporate holdings, A, and a vector of family direct holdings f, to obtain the ultimate ownership, u_i, which is the sum of the dividends that the family receives in all stages:

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

This shows how the formula is derived.

1.3 Applications

We present two different applications of this formula.

1.3.1 Firm's position in a group

A potentially important characteristic of the ownership structure of a business group is the position of a firm in the group (Almeida and Wolfenzon, 2006). The basic concept that we define is the distance between a family and a given firm along a particular path. This distance is simply the number of firms along the path.

We first define the shortest distance (sd) among all possible paths between the family and a particular firm:

Definition 1 *For firms in which the family's ultimate cash flow right is positive, the shortest distance, sd_i, from the family to firm i can be found by using:*

$$sd_i = \min\{n \mid n \geq 1 \text{ and } \mathbf{f}' A^{n-1} \mathbf{d}_i > 0\}.$$

Recall that $\mathbf{f}' A^{n-1} \mathbf{d}_i$ is the dividend that the family gets in stage n from a dollar that originated 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 $n = 1$, which is then the shortest distance as expected. If there are two firms separating the family from firm i (e.g., firm 2 in Figure 1), the first time $\mathbf{f}' A^{n-1} \mathbf{d}_i$ is positive is for $n = 2$, which, as expected, if the shortest distance.

Nevertheless, the shortest distance might not be the most relevant measure of position because there could be several different paths between the firm and the family and there is no particular reason to choose the shortest path. In order to compute a measure of position that takes all paths into account, we define the average distance (ad) of a firm as the weighted average of the distance along all possible paths. The weights we use are the fraction of the ultimate cash flow rights contributed by the particular path. As before, this measure can be easily computed as follows.

Definition 2 *The average distance, ad_i, from the family to firm i can be found by using:*

$$ad_i = \sum_{n=1}^{\infty} n \frac{\mathbf{f}' A^{n-1} \mathbf{d}_i}{u_i}$$

Example 4: Position in a simple pyramid

Consider the group in Figure 1. The position of the firms is straightforward in the case of pure pyramids. The shortest distance between firm i and the family in this example is equal to i ($sd_i = i$). Because there is only one path for each firm, these are also the average distances for the firms ($ad_i = i$).

Example 5: Position in a more complex pyramid

Consider now a slightly more complex example. Specifically, take the group in Figure 2, but assume that $s_{21} = 0$. In this case firm 2 is owned both directly (through the stake f_2), and indirectly, through the stake s_{12}. So we have $sd_2 = 1$, and:

$$ad_2 = 1 \frac{f_2}{f_2 + f_1 s_{12}} + 2 \frac{f_1 s_{12}}{f_2 + f_1 s_{12}},$$

which is simply a weighted average of the direct path, and the indirect one through firm 1. If f_2 is very small, for example, then it is possible that ad_2 is close to 2, despite the fact that the shortest distance is equal to one.

1.3.2 Identifying general cross-shareholdings

We can also use the algorithm and its matrix representation to check whether a given firm is part of a circular ownership pattern and to compute the length of such loop.[10]

Definition 3 *Let*

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

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

Recall that $A^n \mathbf{d}_i$ is a vector of the cash held by each group firm after n stages of the algorithm from a dollar that originated in firm i. Because we are interested in the cash held by firm i itself, we pre-multiply by $\mathbf{d}_i'$ to get the i^{th} element.

The idea is simple. If we start from a dollar paid by firm i and after n stages we see money reappearing in this firm, then it must be that the firm is part of a loop. Also, the number of stages needed for the money to reappear for the first time in firm i measures the number of firms in the shortest loop.

Example 6: Detecting circular ownership patterns

Let's compute the *loop* variable for firm 2 in the group of Figure 2. The first dividend is $\mathbf{d}_2$, corporate owners get $A\mathbf{d}_2 = [s_{12}\ 0]'$, and firm 2 gets $\mathbf{d}_2' A \mathbf{d}_2 = 0$. In the second stage group firms pay dividends of $A\mathbf{d}_2 = [s_{12}\ 0]'$, corporate owners receive $A^2\mathbf{d}_2 = [0\ s_{21}s_{12}]$, and firm 2 gets $\mathbf{d}_2' A^2 \mathbf{d}_2 = s_{21}s_{12} > 0$. Thus, $loop_2 = 2$. This implies, as we were expecting, that firm 2 is in a loop and that the loop has 2 firms in it.

Notice that similarly to the formula for cash flow rights, both of these formulas involve only matrix computations, and do not require the researcher to manually examine the flow chart with cross-ownership links.

2 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 fact not even well defined– in groups with extensive cross-shareholdings. We discuss two alternatives to the minimum link method, including a novel definition of control rights that we call critical control threshold (CC), and a measure that has been used in previous literature (consistent voting rights, VR).

[10] The extensive descriptions of the ownership structure of Asian (Claessens et al., 2000) and European (Faccio and Lang, 2000) firms contain some discussion of the effect of cross-shareholdings on ultimate ownership. However, their results likely understate the effects of cross-shareholdings. For example, Faccio and Lang manually check for the incidence of direct cross-shareholdings (A owns shares in B which owns shares in A), and do not find many cases in their data. However, as the Korean data will show, cross-shareholding loops that include more than two firms are very common. In fact, Faccio and Lang say that most countries impose a 10% cap on direct cross-shareholdings, which effectively limit the extent to which direct cross-shareholdings can occur. As discussed by Claessens et al., the manual computations used in their paper and most of the previous literature have a hard time following all the links that can lead to cross-shareholdings.

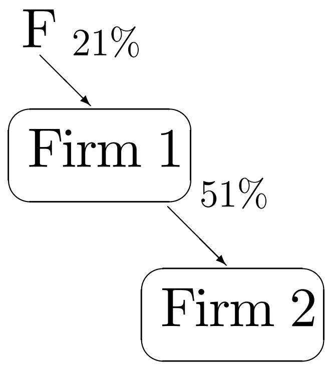

Figure 3: A very simple pyramid

2.1 The weakest link

Consider the following example of a simple pyramid in Figure 3. The family holds a direct stake of 21% in firm 1, and firm 1 holds a 51% stake in firm 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 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. For simple pyramids, this measure is intuitive: Because control of firm 2 is obtained through firm 1, it cannot be the case that the family's degree of control is firm 2 is higher than that in firm 1. Another 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. Thus, it makes intuitive sense to define the family's voting rights in firm 2 as being equal to 21%.

However, the weakest link method does not work well in complex ownership structures. There are three main problems with this measure. 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 4, this procedure would lead to voting rights greater than 100% for firm 3. The problem is that there are two chains of control that go through firm 2 and end up in firm 3, and the minimum link procedure adds up all of them. Would it make sense to say that the family has full control of firm 3 in this case? We believe this is not reasonable, because the family's control of firm 3 depends on the family's 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 same intuition explained above).

XXX ADD EXAMPLE HERE (FIGURE 4). Family holds 40% of firm 1, 50% of firm 2, and 5% of firm 3. firm 1 holds 30% of firm 2, and 60% of firm 3. Firm 2 holds 30% of firm 3XXX

The second and third problems are associated with cross-shareholdings, and can be illustrated using figure 2. What is the weakest control link between the family and firm 2 (for example)? To answer that question, one needs to know what is the degree of control that the family has over firm 1. In other words, one needs to know the weakest control link between the family and firm 1. But to calculate that, given that firm 2 also holds shares in firm 1, one needs to know the weakest control link between the family and firm 2, which is precisely the question we started with! The weakest link formula as discussed in the literature does not tell us how to solve this circularity problem.

Finally, a simple examination of Eq. 1 reveals that there are infinite links between the family and firms that are controlled through cross-shareholdings. If we sum the minimum value in each link we end up with an infinite amount of votes. Again, it is not clear how the standard weakest link calculation can handle this case.

We conclude that we cannot meaningfully apply the weakest link idea to an ownership structure with cross-shareholdings. One possibility is to ignore cross-shareholdings, but even if we do this we still have the first problem, namely that the voting rights can be greater than one if there are multiple pyramidal links going through a group firm and leading down to another group firm.

2.2 An alternative measure: the critical control threshold

We now discuss an alternative measures of voting rights, which is easily implementable in groups with cross-shareholdings and which captures the same intuition of the weakest link formula. The idea behind this measure is again to calculate the weakest link in the control chain leading up from the family to any firm in the group. In fact, we show that this measure is equivalent to the weakest link in situations in which this latter measure is well defined (no cross-shareholdings, no multiple links as explained above). This measure is derived from two simple assumptions about control.

2.2.1 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 hold in a firm are 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 treshold (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 2 *For a given treshold T, the set of firms controlled by the family is given by:*

$$C(T) = \{i \in N : f_i + \sum_{j \in C(T),\ j \neq i} s_{ji} \geq T\}. \tag{3}$$

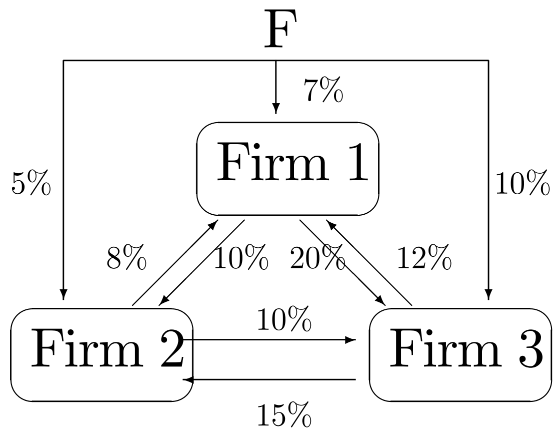

Figure 4: A complex group with many cross-shareholdings

In other words, the set $C(T)$ is the solution to a fixed point problem.[11] A potential problem with this definition is that, for groups with loops, it is impossible to implement this definition sequentially. As in the discussion of the weakest link formula above, there is a potential circularity problem associated with the computation of this set, as the example below illustrates.

Example 7: Firms controlled by the family in a group with cross-shareholdings Consider the group in Figure 5 and assume that $T = 25\%$. Let us try to determine whether firm 3 is controlled by the family. The family holds a direct stake of 10% in this firm. In addition, firms 1 and 2 have stakes of 20% and 10%, respectively. Thus, we would conclude that the family controls firm 3 if it controlled firm 1 (since $10\% + 20\% > 25\%$). However, we have not established yet whether the family controls firm 1. If we try to establish this, we run into a circular argument, since in order to determine whether the family controls firm 1, we need to establish whether it controls firm 3! (without control of firm 3, the most votes the family can control in firm 1 is $7\% + 8\% = 15\%$).

Fortunately, there is a simple algorithm that can be used to find $C(T)$ in any situation. We first provide a formal definition of the algorithm and then we explain how it works.

Definition 4 *(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 of 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 (of course, we only consider indirect stakes

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

of firms that are in $S(1)$). 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 3 *$S(\sharp N)$ satisfies condition 3.*

The proof of this proposition in the Appendix. Proposition 3 is important for two reasons. First, it shows that the outcome of the algorithm generates what we are looking for: the set of firms that the family controls for a given threshold T. Second, because the set $S(\#N)$ can always be computed (after all, $\#N$ is finite), Proposition 3 shows that there always exists a set that satisfies condition 3. In other words, our notion of the set of firms controlled by the family is well defined.

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 algorithm the first time we do not drop a firm.

Example 7 (revisited)

Let us now apply the algorithm to the group of Figure 5. We first assume that the family controls the three firms, $S(0) = \{1, 2, 3\}$. Next we compute the voting rights. The family holds 27% of the votes in firm 1 (7%+8%+12%), 30% of the votes in firm 2 (5%+10%+15%) and 40% of the votes in firm 3 (10% + 20% + 10%). Since all three quantities are larger than 25%, we do not drop any of the firms and hence $S(1) = \{1, 2, 3\}$. Because we did not drop a firm, it is the case that $S(3) = S(1) = \{1, 2, 3\}$. By Proposition 3, $C(25\%) = \{1, 2, 3\}$

Let us now apply the algorithm to compute $C(30\%)$. We let $S(0) = \{1, 2, 3\}$. As before, we get that the family holds 27%, 30%, and 40% in firms 1, 2, and 3, respectively. Because the votes in firm 1 are below the threshold, we drop it and so $S(1) = \{2, 3\}$. We again compute the votes assuming the family controls firms 2 and 3. Under this assumption, we get that the family controls 20% in firm 2 (5% + 15%) and 20% in firm 3 (10% + 10%). We drop both firms because the votes of the family fall below the threshold. As a result, $S(2) = \emptyset$. Because we can no longer drop firms, it must be that $S(3) = \emptyset$. By Proposition 3, $C(30\%) = \emptyset$. That is, the family controls no firm for a control threshold of 30%.

Before defining our new measure of control rights, it is important to note that there might be multiple sets that satisfy condition 3. For example, we showed in Example 7 that $C(25\%) = \{1, 2, 3\}$. However, the null set also satisfies condition 3 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 3 and at the same time has the maximum number of firms. We can prove the following Proposition.

Proposition 4 *Consider all possible sets of firms that satisfy condition 3 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 3. 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.

2.2.2 Critical control threshold

We can now define our new measure of control rights:

Definition 5 *For any firm $i \in N$, the* critical control threshold *is given by*

$$CC_i = \max\{T \mid i \in C(T)\} \tag{4}$$

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.[12]

Several observations are in order. First, notice that in Figure 3 the critical control thresholds are 21% for both firms. We can think of CC as a well defined measure of control rights that coincides with the weakest link measure for simple pyramids, as conjectured above. Second, the CC measure is based on the same algorithm of section 2.2.1. In order to compute CC for any arbitrary set of firms, we simply run the algorithm of section 2.2.1 sequentially with increasingly higher control thresholds, and we keep track of the threshold T at which each firm is dropped from the set $C(T)$. Third, CC is a measure of control rights that is independent of the particular control threshold T. This is convenient because there is no agreement about what is a reasonable value for T. The interpretation of CC is similar to the intuition behind the weakest link. It 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.

In order to illustrate the CC definition, consider again Figure 4. 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, 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 control of firm 3 by purchasing a 40% stake in firm 1.

2.2.3 An application of CC: measuring the centrality of a firm for the control of the group

We can use the CC measure to easily calculate a statistic that summarizes how important a given firm is for the control of the overall group. For example, take the group in Figure 4. In this example, firm 1 is potentially important for the control of the group (because firm 1 holds significant stakes in firms 2 and 3), while firm 3 is not (because it does not hold shares

[12] Kim and Sung (2006) compute a similar variable for Korea, using cash flow rights instead of voting rights. Thus, their variable has a different interpretation than ours. In particular, 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.

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:

Definition 6 *We define the* centrality *of a firm i as:*

$$central_i = \frac{\sum_{j \neq i} CC_j - \sum_{j \neq i} CC_j^{-i}}{\sharp N - 1}, \tag{5}$$

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.

2.3 Consistent voting rights

Besides the weakest link, previous literature has also used an alternative measure of voting rights, namely the sum of direct stakes held by the controlling shareholder, and direct stakes held by firms controlled by this shareholder (LaPorta et al., 1999, Aganin and Volpin, 2003, and Lins, 2003). We use the set of firms controlled by the family to implement this measure of control rights:

Definition 7 *Given a threshold T, the* consistent voting rights *of the family in firm $i \in C(T)$ are defined as:*

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

In words, to find the family's sum of votes in firm i we simply sum 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 4 we would have $\{VR_1(T), VR_2(T), VR_3(T)\} = \{40\%, 80\%, 95\%\}$, for $T \leq 40\%$.

We use the CC measure for the definition of centrality rather than the consistent voting rights because the former measure incorporates to a larger extent the overall group structure whereas the latter measure is mainly affected by firms directly above. For example, in figure 4, firm 2 is not a central firm according to the CC measure, but it would be considered a central firm if we use VR to compute centrality (despite the fact that firm 2 does not appear to be important for the control of firm 3).

3 Korean Chaebols: Definition and Regulatory Framework

A "Chaebol" is a South Korean's business group consisting of many firms in diverse business areas that are owned and controlled by family members. The chaebols exert significant economic influence in Korea. For example, as of 2004 the chaebols 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.

3.1 Regulatory Framework for Chaebols

Chaebols 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.[13] 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 into a small number of large companies. Lacking 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). The government agency to oversee the FTA is the Fair Trade Commission (FTC) that was established in 1981 along with the law.

The legal expression for chaebol is 'Large Business Group,' which is precisely defined in the FTA. The business group is legally designated based on the size, the size being the combined total asset of affiliated companies in the group. From 1987 to 2001, the FTC designated annually the 30 largest chaebols. The firms in the designated 30 chaebols were prohibited from cross shareholdings and also subject to limitations on equity investment in the domestic firms. From 1998, immediately after the outbreak of the financial crisis, these firms were also prohibited from cross debt guarantees among affiliated companies. From 2002, the FTC changed its scheme of designating chaebols. The FTC first designates a group of chaebols that are prohibited from cross shareholding and cross debt guarantees.[14] Legally, these chaebols are termed 'business groups subject to limitation on cross shareholding and cross debt guarantees.' Currently, these are business groups with the combined assets greater than two trillion won.[15] Among these business groups, very large ones are further 'subject to ceiling on total equity investment in other domestic companies.'[16] In this paper, chaebol

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

[14] Non-financial affiliates cannot provide other affiliated companies with financial guarantees for credits supplied by domestic financial institutions. Cross shareholding among chaebol's affiliates is prohibited by the FTA. Financial institutions of chaebols are exempt from this regulation, if they invest other people's money in affiliated company shares. These finance companies of chaebols, however, may not exercise voting rights of shares of domestic companies in the same chaebol.

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

[16] 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.

hereafter refers to those family-controlled business groups subject to legal limitations on cross shareholding and cross debt guarantees.

3.1.1 Who are the legal members of chaebols (Inclusion requirements)

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 rather broadly defined 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 an 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 very broadly interpreted, some companies legally belong to a group even though neither families nor other affiliated companies own shares of those companies.

4 Data Description

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

4.1 Ownership Data

The ownership data of our study are from 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 guarantee of affiliates of the same group from 2002 to 2004, which are designated by KFTC. As explained above, KFTC has assigned and supervised the largest 30 business groups from 1987 to 2001 and the large business groups subject to prohibitions on cross-shareholding and debt guarantee from 2002 to now based on the Monopoly Regulation and Fair Trade Act(hereafter Fair Trade Act) and its enforcement ordinance.

The largest 30 business groups until 2001 and the business groups under cross-shareholding and debt guarantee prohibition after 2002 should report the status of affiliate shareholders and persons with special interest and the main financial status on April 1 to KFTC until the end of April each year, following Fair Trade Act and its enforcement ordinance. Among the ownership data and financial data which KFTC has kept, we obtained the data for the period 1998-2004. However, we study only business groups with the ownership of a natural man (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 firm-years is 4742.

The ownership status of the affiliates and the person with special interest of each firm in the above ownership data of KFTC is recorded relatively in detail. In our ownership data, the shareholders are categorized into 7 types; family owner, the relatives of family owner, nonprofit affiliate, 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 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.

4.2 Financial data

We take advantage of two databases developed by Korea Listed Companies Association (KLCA) and Korea Investors Service (KIS). KLCA and KIS's databases contain information not only of listed companies, but also some private firms which are subject to external audit. As it stands, KLCA turned out to cover 860 firms and 2994 year-firms that are also included in the ownership sample above, and KIS covers 790 firms and 2780 year-firms. In sum, financial data of 3741 firm-years (which amounts to 73.25% of the firm-years in the ownership data) are available. Our sample contains 3,548 firm-years of ownership data from 1998 to 2004. Out of these firm-years, the accounting data is available for 3,445 of them.

5 Ownership Structure of Korean Chaebols

In this section we provide a detailed description of the ownership structure of the major Korean chaebols in the period of 1998 to 2004.

5.1 An example - Hyundai Motor

Figure 6 shows 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. The structure of cross-ownership is quite complex, and difficult to figure out visually. However, our methodology to compute the ownership variables for chaebol firms does not require the researcher to draw the group structure as we have done in Figure 6.[17]

Table 1 shows some variables of interest for the firms depicted in Figure 6. 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

[17] In fact, in order to draw Figure 6, we first looked at the variable that describes the firm's position in the Chaebol structure. This step makes it much easier to figure out the overall structure of the Chaebol, that is, which firms are at the top of the group and which firms are at the bottom.

centrality variable. These firms are also among the largest firms in the Chaebol in terms of the number of employees, and they tend to be older 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. Though it is a bit hard 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, with 3 firms in it (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. Notice, however, that Jung Mong Koo does not own shares in Kia directly. Therefore, Kia's position in the group structure is lower than those of Motor and Mobis.

The Hyundai Motor Chaebol also illustrates the computation of the two different measures of control. The variable VR (consistent voting rights) simply represents the sum of all direct and indirect family votes in all firms controlled by the family.[18] The family controls all the firms in this graph for any $T < 25\%$. Notice that the VR measure is close to 100% for the private firms in the bottom of the group (e.g., Dymos). However, the family itself does not hold large cash flow stakes in these firms. As a consequence, the separation between ownership and control measured using VR is extremely large for these private firms. However, notice that the variable CC (critical control threshold) is equal to 25% for all firms except those that are owned directly at the top. This is because the control of all group firms that are controlled indirectly depends on the family's control of Hyundai Motor. Thus, the critical control threshold is equal to the family's direct and indirect votes in Hyundai Motor ($VR = 25\%$ for Hyundai Motor).

5.2 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 that were present at any point in the sample between 1998 and 2004, and 1085 firms. The controlling family holds 13% of the cash flows of the median firm, but it holds substantial more votes according to the two alternative measures of voting power. Naturally, the VR (consistent voting rights) measure gives 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 variation. Some firms are owned directly (25% of firms show average position lower than 1.40), with few ownership links from 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. The summary statistics also show that 26% of the firm-years involve listed firms, while 74% involve private firms, and that 25% of the firm-years involve firms in cross-shareholding

[18] Note that the calculation of the ownership variables also takes into account cross-ownership with other group firms not depicted in the chart.

loops.

The fraction of firms participating in cross-shareholding loops may seem surprising given the Korean regulation restricting direct cross-shareholdings. However, Panel B shows that the overall majority of cross-shareholding loops has 3 firms in it (72% of all loops). If this pattern is also true for other countries, then it is possible that previous literature has underestimated the incidence of cross-shareholdings because to the best of our knowledge previous papers tend to focus on direct cross-shareholdings (Faccio and Lang, 2002).[19] 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 C 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 to belong to loops.

Regarding the standard ownership variables, notice that ultimate ownership has intuitive correlations with the other ownership variables. For example, it is higher in firms that are placed closes to the family in the group structure (average position), and it is higher in private firms. The family has higher ultimate ownership in central firms (though the correlation is small, 0.11). The two measures of control are correlated between themselves, but the correlation is far from perfect (0.35). They also relate to the other ownership variables in different ways. For example, the family has greater voting power in central firms if one looks at the CC measure of control, but lower voting power in central firms according to VR. In addition, VR is higher for firms at the bottom of the group, while CC is higher for firms at the top of the group.

We have also calculated the ownership variables separately for each one of the 47 groups in our sample. The related tables are omitted for brevity, but are available from the authors. Each group has on average 16 affiliated firms. Out of these firms, an average of 4 firms are public, and an average of 2.93 firms belong to cross-shareholding loops. Also, on average 3 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.

Finally, we measure the correlations between the ownership variables and basic firm characteristics, by running some regressions of the ownership variables on size, age, and public status. These regressions include group and year dummies. The regressions with group dummies provide evidence on the relationship between ownership variables and firm characteristics within groups. The results are similar if we do not use the group dummies.

The results on Table 3 show very clearly that older, larger and public firms tend to be higher up in the group (smaller average positions). Similar results hold for the centrality and loop variables, suggesting that central firms and firms in cross-shareholdings also tend to be larger, older and public. The correlations with the standard ownership variables show that the family holds more cash flows and votes in private firms. The correlations among size, age and the ownership variables depend on the particular ownership variable.

[19] Claessens et al. (2000) report some figures for the incidence of cross-holdings in Korea, but as discussed in Faccio and Lang (2002) their methodology might also include multiple control chains that are not cross-shareholdings.

5.3 Summary: the average structure of a Korean Chaebol

Figure 7 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 (position 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 of 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 10 out of the 16 firms).[20]

Some of the features of the average structure depicted in Figure 7 are consistent with the theoretical arguments in Almeida and Wolfenzon (2006), which predict that pyramidal business groups are created as the controlling family uses existing and succesful group firms to set up and acquire new firms. Clearly, in Korean chaebols firms that own large controlling stakes in other firms (the central firms) are at the top of the group, are older, and more likely to be public and to have grown in size (both measures of their historical success).[21]

6 Profitability and Valuation of Chaebol Firms

This section relates the ownership structure of Chaebol firms to their profitability and valuations.

6.1 Accounting issues - the equity method

In order to provide measures of profitability for Korean Chaebol firms, it is important to understand the effect of equity stakes on reported asset and profit figures. Starting in 1999, the financial statements of Korean chaebol firms became subject to the *equity method* reporting rule. Essentially, if firm A owns shares in firm B, firm B's equity and profits will affect reported asset and net income figures for firm A. The basic idea behind the 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. The specific accounting rule that guides the calculations of the book value of equity stakes and affiliate profits are quite complex, though. For example, if there are cross-shareholdings among firms A, B and C, the accounting rule does not take the looping nature of the ownership relation into account. If

[20] Nevertheless, we again stress that this average picture hides substantial variation. For example, some public 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.

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

the stakes of A on B and of B on C are taken into account, the accountants will generally assume that C does not own shares in A to break the loop and simplify the calculation. In addition, there are specific rules that determine the exact amount of profits from affiliates that will affect the parent company's profit (details available upon request).

Nevertheless, the financial statements contain enough information to allow anyone to back out the exact amount by which accounting figures have been adjusted. 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:

$$\text{Operating Assets} = \text{Total Assets - Equity Method Stock}, \tag{6}$$

and:

$$\text{Operating Profits} = \text{Total Profits - Gains from Equity Method + Losses from Equity Method}, \tag{7}$$

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 7 (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 4 reports the summary statistics for the variables used in this Section and the next. Our benchmark measure of profitability is operating ROA, defined as operating profits (as defined in equation 7) divided by operating assets (as defined in equation 6). The statistics for operating ROA are reported in column (1). For comparison, we also report in column (2) a measure of profitability unadjusted for the equity method items (total profits/total assets). The average unadjusted measure overstates average profitability by a small amount. Columns (3) and (4) report the logs of adjusted assets (log of operating assets), and log of total assets. Naturally, operating assets are lower than total assets because of the equity method adjustment (approximately a 10% decrease).

6.2 Profitability and ownership structure

Tables 5, 6 and 7 displays the regressions that relate profitability to ownership variables. The basic controls that we use are firm age, size measured both by operating assets and number of employees, whether the firm is public or private, leverage, and industry and year dummies. This benchmark model is reported in column (1). Firm age and public status are not related to profitability, but both size variables are positively correlated with operating ROA. The industry classification corresponds roughly to a 2-digit SIC classification in the US, and the industry dummies (there are 45 different industries) are also highly significant. Because our measure of profitability is after interest, leverage has an expected negative correlation with profitability.

The following columns introduce the ownership variables, starting with the standard variables that measure ownership concentration and separation between ownership and control. Previous literature has reported a positive correlation between profitability and ultimate ownership, and a negative correlation between profitability and measures of separation between ownership and control. We replicate these results in columns (2) to (4). Then, we introduce the new ownership variables that we compute in this paper. It turns out that position and loop are not correlated with firm profitability, even when included on their own in the regressions (columns (5) and (6)).

Table 6 shows the profitability regressions that include centrality. Centrality is negative correlated with profitability, even after controlling for ultimate ownership or the measures of separation between ownership and control, or after controlling for group dummies, indicating that within each group central firms have lower profitablity than other firms. The correlation between centrality and profitability also seems to be economically significant. For example, take the specification in column (8), which compares centrality and ultimate ownership. Using these coefficients, the impact of a one-standard-deviation in centrality is equivalent to 20% of the average value of operating ROA. This is equivalent to the impact of half a standard deviation in ultimate ownership.

To sum up, there is some evidence that firms in which the controlling shareholder has high ultimate ownership (or low separation between ownership and control) have high profitability. Controlling for this correlation, firms that are central to group control also have lower profitability than other group firms.

6.2.1 Pyramids and profitability

The lack of correlation between average position and profitability appears inconsistent with the theoretical arguments in Almeida and Wolfenzon (2006), which predict that firms that are set up through pyramids should have lower profitablity than firms which are controlled directly by the family. In Almeida and Wolfenzon's model, this pattern arises from a selection effect - the family optimally chooses to use an existing group firm to set up a new firm (e.g., to create a pyramid) when the new firm has low inherent profitability.

Nevertheless, there is a sense in which the regressions in Table 8 do not represent a direct test of the arguments in the theory. In order to understand this point, consider again Figure 7. Almeida and Wolfenzon's model would predict that firms that are controlled directly (such as firms 1 and 2 in the graph) have lower profitability than firms that are controlled through pyramids (such as firms 6, 7, etc.). The theory makes no prediction regarding the profitability of firms in the "control group", such as firms 3, 4 and 5. Thus, a more powerful test of the theory would be to directly compare firms in the top layer (those owned directly) with firms in the bottom layer (those which are clearly owned through pyramids), not considering the firms in the middle layer (which include firms in the control group).

In order to implement a test of this argument, consider the following experiment. We construct a variable called *pyramid*, which is equal to one if the average position of a group firm is in the 75th percentile or higher (higher than 2.55), and equal to zero if average position is in the 25th percentile or lower. We then relate this variable to profitability, restricting the comparison only to firms that are non-central for the control of the group (centrality equal to zero). Such a regression gets more directly at the theoretical prediction in Almeida and Wolfenzon, since it compares firms that are owned directly (but which are not central) to firms that are owned through pyramids.

The results are reported in Table 7. Naturally, the sample is drastically reduced in comparison to Table 9. Nevertheless, the regressions suggest that consistent with theoretical expectations, it is indeed the case that firms owned through pyramids have lower profitability than firms that are owned directly (column (1)) by the family, but which are not central to the control of the group. The next columns correlate performance to *pyramid* after controlling for variation in the standard ownership variables. As Table 2 shows, the correlation between position and the ownership variables is very high, which makes it difficult to disentangle the impact of each variable on profitability. However, the results in columns (2) to (4) are suggestive of a correlation between pyramids and profitablity that holds irrespective of variation in ownership concentration. For example, the correlation between pyramids and profitability in this sample drives out the correlation between the measures of separation and profitability (which become positive and insignificant). However, while the coefficient is still negative the significance of both ultimate ownership and pyramids decreases.

We conclude that there is some evidence that firms that are owned through pyramids have lower profitability than firms that are controlled directly at the top of the group, and which are not central to group control. There is also suggestive evidence that this correlation holds irrespective of variation in the standard ownership variables.

6.3 Valuation and ownership structure - the parent company discount

We now examine the valuation of group firms, and we show evidence that firms that own substantial stakes in other firms (i.e., central firms) have lower market valuations than other (public) group firms. We call this phenomenon the "parent company discount".[22] Before we go into the regressions, let us describe an example that illustrates the phenomenon.

6.3.1 The SK example

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.[23] The value of these equity stakes alone (i.e., assuming a zero value for the stakes in private firms) was 4.4 billion dollars.[24] 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 (or Tobin's Q) was only 0.68 in December 2003.

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, in December 2004 SK corporation's Q had increased to 0.92.[25]

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). Is the low valuation of central firms a pervasive phenomenon in Korean chaebols?

6.3.2 Calculating Q for business group firms

In order to examine the relative valuation of Chaebol firms in our sample, we construct three alternative measures of Q for public Chaebol firms, which differ with respect to the adjustments that we make to take equity stakes in other firms into account. The simplest way to compute Q is to use the observed market value of the equity, and the total assets from the balance sheet (unadjusted Q, Q_{una}):

$$Q_{una} = \frac{EV + \text{Book Liabilities}}{\text{Book Assets}}.$$

The observed equity value EV should in principle incorporate the value of the equity stakes held in other firms. Also, the firm's total book assets includes an accounting adjustment for

[22] Previous literature has analyzed some examples of parent company discounts in the US. Please see the discussion below in Section 6.4.

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

[24] 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.

[25] 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.

equity held in other firms, as explained above. Thus, this measure is at least theoretically correct.

Nevertheless, one issue with the measure Q_{una} is that the official accounting adjustment made in Korea (the equity method) might understate the firm's total assets because it ignores the looping nature of cash flows when there are cross-shareholdings (as explained above). To correct for that, we construct our own measure of total book assets using the operating assets calculated as in equation 6, and then using the ownership matrix to construct total assets for each group firm (the procedure is similar to that described in Section 1). We call this measure of assets "consolidated assets". The summary statistics in Table 8 show that this measure of assets produces values that are generally higher than the official assets from the balance sheet. We can then use this alternative measure to compute a second measure of Q:

$$Q_{con} = \frac{EV + \text{Book Liabilities}}{\text{Consolidated Assets}}.$$

One problem with this measure is that the ownership data and the accounting data are generally not for the exact same month. The ownership data always refers to April, while the accounting data generally refers to December. Because of this problem we cannot guarantee that Q_{con} is always a more precise measure than $Q_{una,}$ and use both in the regressions below.

The third alternative is to derive implied operating asset values from the market (as we have done in the SK example above), and then to compare that with book operating assets. This Q measure can be interpreted as the Q that a group firm would have if it were valued as a stand-alone entity (Q_{sa}):

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

This measure is attractive, but it also suffers from the problem that in general the accounting and the ownership data refer to different months of the year. In the calculations below, as in the SK example, we use the ownership data as of April in year t together with stock market data from the month in which the accounting numbers are reported. For example, we use April 2003 ownership data together with stock market values of December 2003 for firms that report in December. We believe this practice allows for better comparison of market and book values.

Unlike in the SK example, in the Q_{sa} calculations that we present below we do not assume that the equity value of Chaebol private firms is zero. Rather, we use book equity to value the private firms (if book equity is positive). Thus, we assume a market-to-book ratio of one for the private firms. Naturally, the need to value private firms introduces an additional layer of measurement error for Q_{sa}.

6.3.3 Results

Table 4 (discussed above) presents the summary statistics for the new variables introduced in this Section. Most importantly, notice that the three alternative measures of Q produce very similar values, despite the different assumptions used to compute them.[26] There are a

[26] This is consistent with results in Bohren and Michalsen (1994), who compute distortions due to double counting of value of firms with cross stakes in Norway. Valuation metrics such as price-earnings ratio are

total of 886 firm-years available for public firms between 1998 and 2004.

Table 8 presents the regressions that relate Q to ownership variables, using the unadjusted measure of Q, Q_{una}. Our benchmark model includes size (log of the firm's market value of assets),[27] age, operating ROA, leverage, capital expenditures over assets (a control for growth opportunities) and industry dummies. Larger firms and firms with higher growth opportunities have higher valuations. Age is negatively related to valuation.

As we did in the profitability regressions, we first introduce the standard ownership variables to the valuation regressions. Interestingly, ultimate ownership is negatively related to Q (column (2)). This result is not necessarily inconsistent with previous regressions reported in the literature, which tend to find a non-linear relationship between ultimate ownership and Q depending on the range of ownership concentration that is considered in the regression (e.g., Morck, Shleifer and Vishny, 1988). We have also run regressions in which we include the square of ownership, but we find no evidence for a non-linear relationship in our data. The VR measure of separation between ownership and control and average position is not significantly related to Q (column (3)). However, the regressions using the CC measure of separation (column (4)) show that separation between ownership and control is negatively related to Q (consistent with previous literature). This result is also not surprising, given that the CC measure is closely related to the minimum link measure that has been used in previous literature.

We then introduce the new ownership variables. As in the profitability regressions, average position is not significantly related to valuation (column (5)). The next columns show that, consistent with the conjecture in the SK example, central firms seem to have lower valuations than other group firms (column (6)). Firms that belong to loops are also valued at lower levels, though the effect is not as strong as that estimated for centrality (column (7)).The next regressions show that the negative correlations between loop, centrality and Q hold even after controlling for ultimate ownership and separation between ownership and control (columns (8) and (9)). Finally, in the last regressions we introduce group dummies. The results suggest that centrality is the only variable that is robustly correlated to valuations within groups. The other ownership variables become insiginficant, suggesting that the correlation picked up in the previous regressions is driven by variation across groups. For example, it is not the case that within each group, firms with high separation between ownership and control have lower valuations. Rather, groups with high average separation have lower valuations.

The correlations between Q, centrality and loop are also economically significant. For example, the effect of one standard-deviation in centrality is equivalent to that of a one-standard-deviation in separation between ownership and control. The effect of being in a cross-shareholding loop is also comparable to that of separation between ownership and control. A firm that both has centrality value one standard-deviation above zero (the median value), and is part of a cross-shareholding loop is predicted to have a Q value 9.1% lower than the median value of 0.81.

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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.

[27] In the regressions with Q_{sa} we use a measure of the value of stand-alone assets (not including equity stakes) as opposed to the value of total assets.

To sum up, there is some evidence that between 1998 and 2004 central firms and firms in cross-shareholding loops have lower valuations than other public Chaebol firms. This effect is not explained by separation between ownership and control in central/loop firms.

6.4 Interpreting the Profitability and Valuation Results

The profitability regressions suggest that central firms, and firms that are owned through pyramids have lower profitability than firms that are owned directly at the top of the group, but which are not central to group control. In terms of the typical ownership structure depicted in Figure 7, the most profitable group firms tend to be those that are owned directly by the family such as firms 1 and 2. These firms are least likely to be part of pyramidal structures, either as controlling or controlled firm.

The lower profitability of firms owned through pyramids is consistent with the selection arguments in Almeida and Wolfenzon (2006), whereby the family optimally chooses to control a firm through a pyramid when its profitability is low. However, this correlation is also potentially consistent with a story in which pyramidal ownership reduces firm profitability. For example, the family could have incentives to tunnel cash flows from firms at the bottom of the group, to those in the top (Bertrand et al., 2002). A piece of evidence that does not seem to support the tunnelling story is that the lower profitability of firms owned through pyramids is somewhat independent of variation in ownership concentration. To wit, the tunnelling story predicts that cash flows will be tunnelled from firms in which the family has low ownership, to firms in which the family has higher ownership. However, as we discussed before it is difficult to perfectly disentangle the effects of pyramiding from those of ownership, given the high correlation between position and ownership. Thus, we cannot rule out the tunnelling explanation for this correlation.

While the theoretical literature has offered some reasons why firms controlled through pyramids would have lower profitability, we are not aware of any theory that can explain the lower profitability of central firms relative to other group firms. An additional challenge for future research is to explain the lower profitability of central firms.

The valuation results suggest that group firms that are central to the control of the group, and which belong to cross-shareholding loops have lower valuations than other group firms. In terms of Figure 5, those are firms 3, 4 and 5. The lower valuations of central firms are consistent with the theoretical arguments in Almeida and Wolfenzon (2006). Essentially, central firms are those which are used by the family to set up and control other group firms. In Almeida and Wolfenzon's model, the acquisition of an equity stake on a new firm is a negative NPV investment for minority shareholders of the existing (central) firm. If shareholders of the central firm anticipate that this firm might be used again in the future as a device to set up and acquire other firms, they should anticipate this possibility and discount the shares of the central firms. Thus, this argument predicts low valuation of central firms, provided that shareholders expect firms that are currently central to continue being used by the family to acquire equity stakes in new firms.

However, this is not the only possible explanation for the discount on central firms. One important characteristic of these firms (and also of firms in cross-shareholding loops) is that they hold substantial stakes in other firms. Furthermore, these stakes might be *non-marketable* for the parent company, in the sense analyzed by Longstaff (1995). 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).[28] Thus, the value of the equity stakes held by the parent company could be 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.[29] In particular, some of the explanations developed to explain the closed end fund puzzle bear some resemblance to the agency and marketability stories above. It is possible that shareholders of the closed end fund expect poor portfolio management in the future (agency story), or that the closed end fund might hold shares that have trading restrictions such as privately placed stock (marketability story). Nevertheless, not all arguments regarding the closed end fund puzzle seem equally relevant. For example, the investor sentiment story explained in Shleifer (2000) 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.

6.4.1 Parent company discounts in the US

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 (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.[30] The standard explanation for this phenomenon in the US is that it is due to noise trading bidding up the prices of the subsidiary stocks,[31] and arbitrage costs that make a price correction difficult.

It is possible that this inefficient markets story 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 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

[28] 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.

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

[30] 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.

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

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 815 in which the market value of equity stakes are larger than the market value of the parent company, 11% of the entire sample.[32] 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.[33]

[32] This calculation assumes that private group firms have a market-to-book ratio of one, as in the calculation of Q_{sa} above. The number of cases is even higher is we use the alternative method used by Mitchell et al., which assumes that the operating equity of the parent should be valued at book levels. We can show that this criteria is equivalent to requiring that $Q_{sa} < 1$, which is true of more than 50% of the sample including firms that do not own stakes in other firms.

[33] 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.

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Appendix

Proof of Proposition 3

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

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

$$f_k + \sum_{j \in S(\sharp N),\, j \neq i} s_{jk} \geq T. \tag{8}$$

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

$$T > f_k + \sum_{j \in S(n-1),\, j \neq k} s_{jk} \geq f_k + \sum_{j \in S(\sharp N),\, j \neq k} s_{jk}, \tag{9}$$

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 8 and 9 cannot hold at the same time. Putting together steps 2 and 3 leads to the statement of the Proposition.■

Proof of Proposition 4

We show that $S(\sharp N) = \bigcup_{i=1}^{M} C_i$. The proof is divided into two steps.

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

By Proposition 3, we know that $S(\sharp N)$ satisfy condition 3, 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 3 the following is true:

$$\text{For all } k \in C_m,\ f_k + \sum_{j \in C_m,\ j \neq k} s_{jk} \geq T \tag{10}$$

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

$$T > f_k + \sum_{j \in S(n-1),\ j \neq k} s_{jk} \geq f_k + \sum_{j \in C_m,\ j \neq k} s_{jk}, \tag{11}$$

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 10 and 11 cannot hold at the same time. This proves step 2. Finally, putting together steps 1 and 2 leads to the statement of the Proposition.■

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	3548
VR	0.68	0.28	0.68	0.47	1.00	3548
CC	0.33	0.19	0.30	0.19	0.43	3548
Separation VR	0.47	0.29	0.44	0.23	0.73	3548
Separation CC	0.12	0.11	0.12	0.03	0.19	3548
Average Position	2.11	0.82	2.06	1.40	2.56	3548
Centrality	0.02	0.05	0.00	0.00	0.00	3524
Loop	0.25	0.43	0.00	0.00	1.00	3548
Public	0.26	0.44	0.00	0.00	1.00	3548
					No.Firms	1085
					No.Groups	47

Panel B: Correlation table

	Ult Own	Votes (VR)	Votes (CC)	Av Pos	Public	Centrality
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	
Loop	-0.06	-0.25	-0.09	-0.18	0.42	0.21

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					
	Av pos	Loop	Centrality	Ultimate Ownership	Votes (VR)	Votes (CC)
	(1)	(2)	(3)	(4)	(5)	(6)
Firm age	-12.867***	9.074***	0.824***	1.720***	-0.182	0.695***
	(1.121)	(0.619)	(0.091)	(0.307)	(0.338)	(0.254)
No employees	-0.162***	0.165***	0.016***	-0.003	-0.051***	-0.004
	(0.025)	(0.018)	(0.003)	(0.005)	(0.007)	(0.004)
Public	-0.152***	0.182***	0.024***	-0.098***	-0.356***	-0.063***
	(0.036)	(0.022)	(0.003)	(0.008)	(0.010)	(0.007)
Group FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3548	3548	3524	3548	3548	3548
R-squared	0.31	0.36	0.28	0.34	0.39	0.43

Standard errors in parentheses
* 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	0.02	0.11	0.03	-0.01	0.08	2976
Return on assets	0.02	0.11	-0.01	0.03	0.09	2976
Op assets (million USD)	708	2544	72	16	400	3445
Assets (million USD)	772	2735	75	17	434	3445
Firm age	16.8	14.3	13.0	4.0	26.0	3445
No employees	1203	3769	198	44	845	3445
Quna	0.92	0.32	0.85	0.74	1.00	886
Qcon	0.91	0.34	0.84	0.72	1.00	886
Qsa	0.91	0.36	0.84	0.72	1.01	870
Consolidated assets (million USD)	775	2727	82	18	436	3445
Mkt value of equity (million USD)	2077	5044	737	235	1997	886
Stand alone mkt value of equity (million USD)	1901	4693	694	226	1878	870
Capital expenditures/operating assets	0.06	0.15	0.03	0.01	0.07	2592
Leverage	0.21	0.28	0.15	0.04	0.30	2636

Note: The variables are defined in the text.

Table 5. Operating profitability and ownership variables

	Dependent variable: Operating return on assets					
	(1)	(2)	(3)	(4)	(5)	(6)
Firm age	-0.214 (0.176)	-0.375** (0.179)	-0.257 (0.177)	-0.248 (0.179)	-0.244 (0.178)	-0.176 (0.183)
Ln(assets)	0.004* (0.002)	0.005** (0.002)	0.004* (0.002)	0.004* (0.002)	0.004* (0.002)	0.004* (0.002)
No employees	0.021*** (0.006)	0.020*** (0.006)	0.020*** (0.006)	0.021*** (0.006)	0.020*** (0.006)	0.021*** (0.006)
Public	-0.006 (0.006)	-0.002 (0.006)	-0.010* (0.006)	-0.004 (0.006)	-0.006 (0.006)	-0.005 (0.006)
Leverage	-0.095*** (0.016)	-0.096*** (0.016)	-0.095*** (0.016)	-0.094*** (0.016)	-0.095*** (0.016)	-0.095*** (0.016)
Ult ownership		0.060*** (0.011)				
Separation (K)			-0.019** (0.009)			
Separation (CT)				-0.039** (0.019)		
Av pos					-0.003 (0.003)	
Loop						-0.005 (0.005)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2634	2634	2634	2634	2634	2634
R-squared	0.15	0.16	0.15	0.15	0.15	0.15

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6. Operating profitability and centrality

	Dependent variable: Operating return on assets							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm age	-0.135 (0.181)	-0.274 (0.182)	-0.172 (0.181)	-0.171 (0.183)	0.041 (0.203)	-0.019 (0.203)	0.018 (0.203)	0.014 (0.206)
Ln(assets)	0.004* (0.002)	0.006*** (0.002)	0.004** (0.002)	0.004* (0.002)	0.005** (0.002)	0.005** (0.002)	0.005** (0.002)	0.005** (0.002)
No employees	0.022*** (0.006)	0.022*** (0.006)	0.021*** (0.006)	0.022*** (0.006)	0.019*** (0.006)	0.019*** (0.006)	0.019*** (0.006)	0.019*** (0.006)
Public	-0.005 (0.006)	-0.000 (0.006)	-0.010* (0.006)	-0.004 (0.006)	-0.003 (0.006)	0.002 (0.006)	-0.006 (0.006)	-0.002 (0.006)
Leverage	-0.095*** (0.016)	-0.095*** (0.016)	-0.095*** (0.016)	-0.094*** (0.016)	-0.092*** (0.018)	-0.093*** (0.018)	-0.092*** (0.018)	-0.092*** (0.018)
Centrality	-0.077** (0.031)	-0.131*** (0.032)	-0.085*** (0.031)	-0.074** (0.031)	-0.112*** (0.038)	-0.139*** (0.038)	-0.115*** (0.038)	-0.112*** (0.038)
Ult ownership		0.066*** (0.011)				0.053*** (0.012)		
Separation (K)			-0.021** (0.009)				-0.014 (0.009)	
Separation (CT)				-0.038** (0.019)				-0.030 (0.023)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Group FE	No	No	No	No	Yes	Yes	Yes	Yes
Observations	2611	2611	2611	2611	2611	2611	2611	2611
R-squared	0.15	0.16	0.15	0.15	0.24	0.25	0.24	0.24

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 7. Operating profitability: pyramidal versus direct ownership

	Dependent variable: Operating return on assets			
	(1)	(2)	(3)	(4)
Firm age	-0.778 (0.473)	-0.789* (0.470)	-0.784* (0.472)	-0.810* (0.473)
Ln(assets)	0.004 (0.004)	0.006 (0.004)	0.004 (0.004)	0.004 (0.004)
No employees	0.011 (0.062)	0.019 (0.063)	0.009 (0.061)	0.007 (0.061)
Public	-0.001 (0.014)	0.004 (0.013)	0.005 (0.015)	-0.002 (0.014)
Leverage	-0.106*** (0.014)	-0.106*** (0.014)	-0.106*** (0.014)	-0.107*** (0.014)
Pyramid	-0.050*** (0.010)	-0.024 (0.017)	-0.060*** (0.014)	-0.064*** (0.015)
Ult ownership		0.065** (0.032)		
Separation (K)			0.025 (0.021)	
Separation (CT)				0.066 (0.051)
Industry FE	Yes	Yes	Yes	Yes
Observations	763	763	763	763
R-squared	0.23	0.24	0.23	0.23

Robust std. errors. * signif. at 10%; ** signif. at 5%; *** signif. at 1%

Table 8. Valuation and ownership variables

	Dependent variable: Tobin's Q										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Firm age	-5.007***	-4.908***	-5.029***	-5.010***	-4.977***	-4.406***	-4.914***	-4.302***	-4.287***	-4.464***	-4.420***
	(0.801)	(0.796)	(0.818)	(0.804)	(0.804)	(0.779)	(0.796)	(0.775)	(0.777)	(0.905)	(0.911)
Ln(assets)	0.074***	0.069***	0.074***	0.074***	0.075***	0.082***	0.079***	0.083***	0.088***	0.088***	0.089***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.011)	(0.012)
OROA	0.270	0.289	0.270	0.267	0.267	0.230	0.270	0.246	0.228	0.352*	0.351*
	(0.195)	(0.199)	(0.195)	(0.193)	(0.196)	(0.197)	(0.195)	(0.201)	(0.194)	(0.207)	(0.206)
Capital exp	0.436***	0.445***	0.435***	0.418**	0.439***	0.420**	0.437***	0.432***	0.410**	0.339**	0.337**
	(0.165)	(0.167)	(0.165)	(0.164)	(0.165)	(0.165)	(0.164)	(0.165)	(0.163)	(0.153)	(0.153)
Leverage	0.064	0.067	0.066	0.073	0.073	0.080	0.065	0.079	0.087	0.027	0.028
	(0.120)	(0.118)	(0.121)	(0.118)	(0.121)	(0.119)	(0.119)	(0.116)	(0.116)	(0.108)	(0.108)
Ult ownership		-0.233***						-0.143**		-0.088	
		(0.063)						(0.066)		(0.102)	
Separation (K)			-0.019								
			(0.061)								
Separation (CT)				-0.248***					-0.200**		0.003
				(0.087)					(0.086)		(0.103)
Av pos					0.024						
					(0.015)						
Centrality						-0.500***		-0.441***	-0.508***	-0.358***	-0.385***
						(0.104)		(0.107)	(0.104)	(0.120)	(0.117)
Loop							-0.037*	-0.048**	-0.049**	-0.043	-0.043
							(0.022)	(0.022)	(0.022)	(0.027)	(0.026)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Group FE	No	No	No	No	No	No	No	No	No	Yes	Yes
Observations	815	815	815	815	815	808	815	808	808	808	808
R-squared	0.41	0.42	0.41	0.42	0.41	0.42	0.41	0.43	0.43	0.53	0.53

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Figure 6. Ownership Structure of Hyundai Motor in 2004.

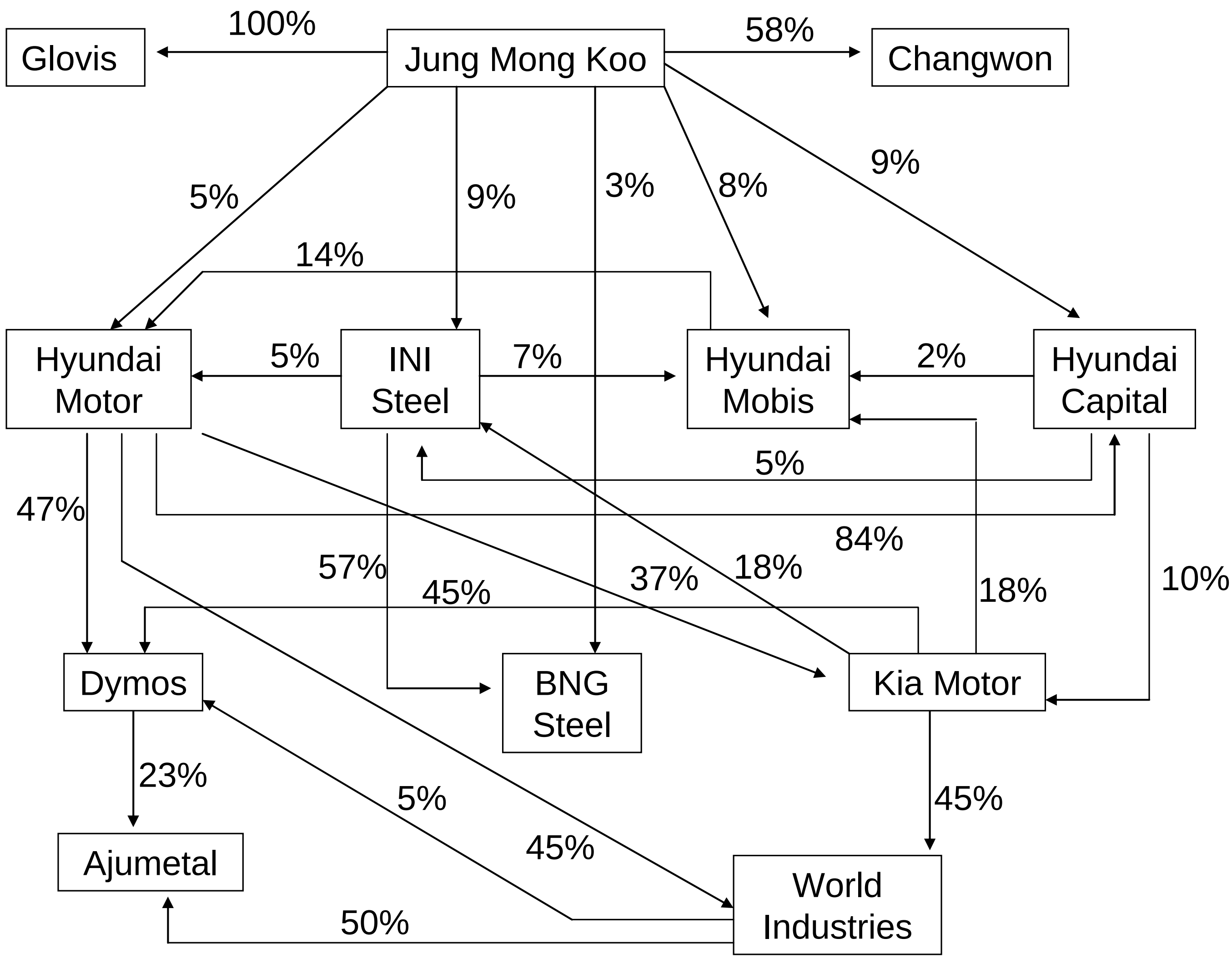
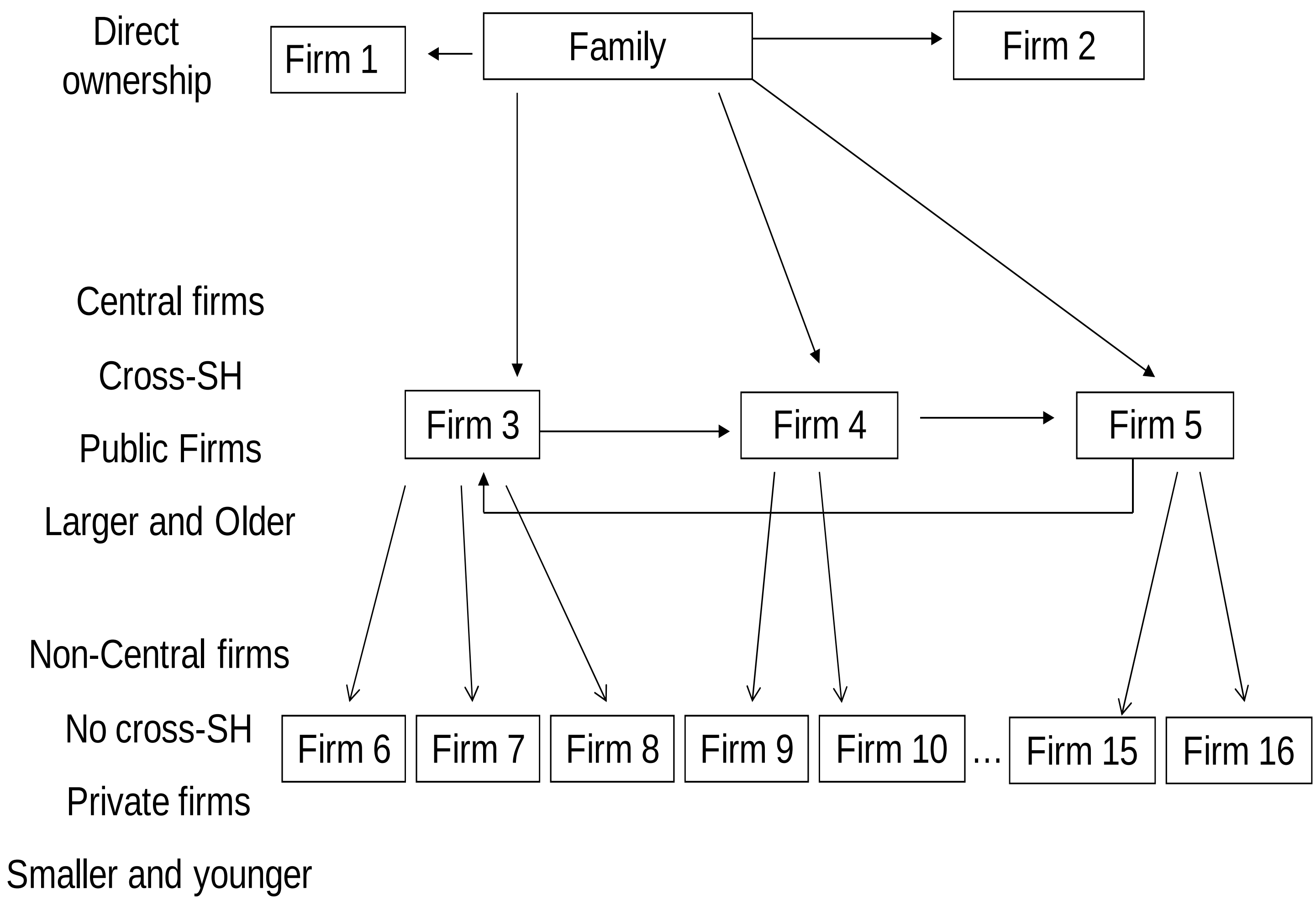


Figure 7. Average Ownership Structure of a Korean Chaebol, 1998-2004



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