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Valuation and performance of firms in complex ownership structures: An application to Korean chaebols*

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Abstract

We propose several new metrics to describe the complex ownership structure of business groups, and provide simple formulas and algorithms to compute these metrics. We use these measures to describe in detail the ownership structure of Korean chaebols in the period of 2003 to 2004. In addition, we validate the usefulness of our new metrics by showing empirically that they are important for understanding the valuation and performance of group firms. In particular, we show evidence that firms that are central to the control structure of the chaebol (central firms), firms in cross-shareholdings, and firms that are placed at the bottom of the group (i.e., with lower ultimate ownership) have lower profitability than other group firms. The valuation results suggest that central firms and firms in cross-shareholding loops have lower valuations than other public Chaebol firms. The lower valuation of these firms is not explained by variation in measures of ownership concentration and separation between ownership and control.

Key words: business groups, family firms, firm performance, pyramids, cross-shareholdings, parent company discount
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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, the literature has only used rough measures to describe groups, mostly relying on variables such as whether a firm is directly or indirectly owned, or the ownership stake of the controlling shareholder.[4] The reasons for this are that alternative measures do not exist, and that data on ownership is usually difficult to obtain, specially for privately held firms in a group.

In this paper we make two contributions. First, inspired by recent theoretical work on business groups (e.g., Almeida and Wolfenzon (2006)), we provide a number of measures that can be used to describe their complex structure. In addition to being well-defined for any group structure, these measures are easy to compute using algorithms that we develop. Second, we use a unique dataset of Korean business groups (chaebols) to illustrate the computations of these new measures and, more importantly, to show that they contain important economic information as they are shown to be strongly correlated to valuation and profitability.

We start by providing a simple formula to compute the *ultimate cash flow right* of the controlling family. Although the special case of this formula for simple pyramids is well known ("the product of the cash flow stakes along the ownership chain"), the computation

[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). In this paper, we focus on "*family* business groups", those in which member firms are controlled by the same family. As we will show later, Korean Chaebols are largely family controlled.

[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 6 for evidence of the importance of Chaebols for the Korean economy.

[4]See the literature review in the next Section.

of ultimate cash flows rights in the presence of cross-shareholdings and loops is considerably more difficult because the number of ownership chains is infinite.

The method we develop involves "following" a dividend through all these ownership chains. We show that this can be easily done using simple matrix operations. The final formula requires only information about the direct stakes of the member firms as well as the direct stakes of the controlling family. This methodology can be applied to compute the *position* of a group in the firm and to determine whether a firm is in a *cross-shareholding* or even in any general circular ownership pattern.

The position of a firm in the group can be thought of as the distance between the firm and the controlling family in terms of the group structure. For example, if a family 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 how complex its ownership structure is. Cross-shareholdings are 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 is relatively rare in Korean chaebols because of specific regulations (see Section 4). Importantly, our methodology allows us to identify cross-shareholdings of any arbitrary number of firms, and to measure how many firms belong to a given cross-shareholding loop.

Next, we tackle the issue of computing the voting right of the controlling family in each group member. The difficulty here is what fraction of the votes held indirectly through a group firm to assign 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)). Although this concept makes intuitive sense for simple pyramids, it is less intuitive –and not even well defined—for groups with extensive cross-shareholdings.

We propose two alternative measures that are based on two simple –albeit not uncontroversial– assumptions. First, we assume that a family obtains control of a firm when it holds more than a threshold, say T, of votes. Second, we assume that, if a family controls a firm, it owns the votes that this firm holds in other firms. With these two simple assumptions, we can determine, for a given control threshold T, the set of firms that a family controls. Even though applying this definition is sometimes circular (to determine whether you control firm A, you need to know whether you control B and its votes in A, but to know whether you control B, it is possible that you need to know whether you control A and its votes in B!), we can show that it is well defined for any group structure. Moreover, we provide a simple algorithm that can be used to find such a set.

Our two alternative measures are the *consistent voting rights (VR)* and the *control threshold (CC)*. The first one depends on the threshold considered. After determining the set of firms controlled by the family for the given threshold, the VR measure is simply the direct votes of the family plus the indirect votes held by firms the family control (for a threshold T).[5] The CC measure is the maximum threshold consistent with family control of the firm. It has various advantages. First it is not dependent on any particular threshold. Second, it coincides with the weakest link measure in simple pyramids. This is appealing because for these structures, the weakest link measure is intuitive. Finally, it only requires computation

[5] This measure is similar to that used by LaPorta, Lopez-de-Silanes and Shleifer (1999).

of the set of firms controlled by the family for various controlled thresholds. This can be easily done with the algorithm we propose.

As an application of our control measures, we 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.[6]

Importantly, *none* of the formulas that we compute require visualization of the group structure. In other words, the researcher does not need to first draw the group structure to compute the ownership variables. All the computations can be entirely automatized, and thus are easily implementable irrespective of the complexity of the group structure.

We apply these new 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 (more on this below). In addition, the political situtation surrouding chaebols in Korea allowed us to obtain extremely detailed ownership data on chaebol firms.[7] 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. Too much political power (as evidenced by a number of corruption scandals), almost total control of product and financial markets, and excessive debt levels are some of the reasons why the chaebols were believed to be hampering growth. As a consequence of this political change, from the late 1990s the Korean government has been exerting pressure on the chaebols to slim their empires. Among other regulatory measures discussed below in Section 4, Korean regulators have considerably tightened the disclosure requirements for Chaebol firms. In particular, since 1998 the top Korean chaebols have to report their complete ownership information to the Korean Fair Trade Commission (KFTC). These reports 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 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. Of course, the task is even harder without the picture. However, it is straightforward to use our algorithms to compute the 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).

We compute the ownership variables for all Chaebol firms in 2003 and 2004, and provide

[6]Because this hierarchical aspect of centrality can only be captured with the variable *CC*, we use that variable to compute centrality instead of *VR*.

[7]In Korea, there is an official (though not legally binding) definition of what constitutes a Chaebol firm. See the discussion in Section 4.

a novel characterization of the average ownership structure of a Koreal Chaebol (depicted in Figure 7). There are roughly three layers in the Chaebol ownership structure. Some firms (firms 1 and 2 in the Figure) are owned directly at the very top of the group, without ownership links to the other firms. The middle layer contains firms that belong to cross-shareholding loops, which typically contain three firms (firms 3, 4 and 5 in this example). 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 the bottom layer (firms 6, 7 and 8), we have firms that are more likely to be private, smaller and younger. They are also less likely to own substantial stakes in other firms (less central, less cross-shareholdings).

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), and stock market data for all those that are public.

In order to provide measures of profitability for Korean Chaebol firms, it is important to understand the effect that equity stakes held in other firms have on reported asset and profit figures. 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. Luckily, the financial statements after 2003 contain enough information to allow anyone to back out the exact amount by which accounting figures have been adjusted.[8] 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 can then compute a measure of firm profitability by dividing operating profits by operating assets (we call this "operating ROA").[9]

We regress operating ROA on ownership variables, controlling for basic firm characteristics such as size, age, industry and public status. The profitability regressions show that firms that are central to the control structure of the group, and firms with lower ultimate ownership (those placed at the bottom of the group) have lower profitability than other group firms. There is also some evidence that firms in cross-shareholdings are less profitable, though this evidence is weaker. These correlations are also economically significant. Our benchmark calculations show that a one standard deviation increase in centrality reduces operating ROA by 0.01 (27% of the mean), while a one standard deviation increase in ultimate ownership increases operating ROA by 0.016 (39% of the mean).

The market valuations of (public) group firms is also related to the complex ownership variables that we measure in the paper. We compute three alternative measures of Tobin's Q (market-to-book ratios) using different definitions of market and book values of assets. These alternative definitions correspond to different levels of consolidation of the accounting statements and of market values of equity. Irrespective of the definition of Q, we find that firms at the bottom of the group (higher average position and lower ultimate ownership) tend

[8] Before 2003 the data is only available from footnotes to the financial statements. This is the main reason why we focus the current draft on the 2003 and 2004 data only.

[9] We believe we are the first ones in the business group literature to provide profitability measures that are clean of equity stake-related adjustments.

to have *higher* valuations than other group firms (despite being on average less profitable). In addition, central firms and firms that belong to cross-shareholding loops carry lower market valuations than other group firms. Importantly, the negative correlation between loop, centrality and Q becomes even stronger after controlling for ultimate ownership and/or measures of separation between ownership and control. Thus, these valuation results are not explained by simple variations in ownership concentration. The correlation between centrality/loop and Q is also economically significant. A firm that is both central and is in a cross-shareholding loop such as Hyundai Motor in Figure 6 has on average a Q that is 14% lower than the median Q in the sample of group firms.

We also discuss some possible explanations for the negative relation between centrality/loop and market valuations.[10] In particular, we argue that 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). In addition, 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 next section presents a short review of the literature. Sections 2 and 3 introduce our methodology to compute ownership variables for group firms. In Sections 4 and 5 we describe the legal and regulatory framework of Korean Chaebols, and the data that we use. In Section 6 we present the results that describe the ownership structure of Korean chaebols, and in Section 7 we relate the ownership variables to performance and valuation.

1 Related Literature

Existing literature on the effects of group ownership structure has focused on simple ownership variables such as whether firms are indirectly owned, and on separation between ownership and control. Claessens et al. (2002) and Volpin (2002) provide evidence that firms in business groups organized as pyramids have lower Tobin's Q than stand-alone firms and firms organized in horizontal groups. Holmen and Hogfeldt (2004) suggest that this undervaluation is greater if the controlling shareholder has lower ultimate ownership. Claessens et al. (2002), Lemmon and Lins (2003), Lins (2003), Mitton (2002), and Joh (2003) report evidence that the separation of ownership and control is detrimental to performance. 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 the firms lower down in the pyramid to firms at the top. In a similar vein, Bae et al (2002) show in the context of Korea that the controlling families use acquisitions to benefit themselves at the expense of the minority shareholders.

The literature also examines the relationship between valuation and firm membership in business groups, without distinguishing between pyramids and other types of groups. See 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.

[10] This result is linked to the closed end fund puzzle, and to a literature that examines parent company discounts in the US. See the discussion in Section 7.4.

Besides valuation and performance, the literature has studied other characteristics of business group 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 owned through pyramids) are younger than those with less separation. Pyramidal firms also seem to be associated with larger scales of capital investment. Attig, Fischer, and Gadhoum (2003) find evidence consistent with this implication, using Canadian data. Claessens, Fan, and Lang (2002) also find that in East Asia, group firms tend to be larger than unaffiliated firms. Bianchi, Bianco, and Enriques (2001) find similar evidence for Italy.

To sum up, previous empirical literature provides some evidence that firms owned through pyramids have lower valuations and profitability than other firms, and that these patterns might be due to the tunneling of resources out of firms in which the family holds low cash flow stakes to other firms at the top of the group. However, the average effects of group membership on firm performance seem to be more ambiguous. There is also 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).

The relation between pyramidal ownership and performance is consistent with the traditional view of pyramids, which suggests that pyramids allow the controlling family to achieve control of the firms in the group with a relatively small cash flow stake, thereby distorting incentives away from value maximization (see, e.g., Bebchuk (1999)).[11] In contrast, Almeida and Wolfenzon (2006) argue that the negative correlation between pyramiding and performance might be due to a selection effect, namely that the *types* of firms that the family controls through pyramids might have inherently lower profitability than firms that are controlled directly by the family. Under this interpretation, the pyramidal structure itself is not the cause of the under-performance.[12]

Whether pyramids decrease performance or performance predicts pyramidal ownership is also likely to be important from a policy point of view. Although widely regarded as the engine of economic growth in earlier decades, business groups have more recently been blamed by politicians and commentators for the economic problems (slow growth, financial crises, etc.) affecting some regions of the world, in particular East Asia.[13] Those against the busting up of business groups contend that these organizations substitute for missing

[11] Other benefits of groups may include the ability to prop up (inject money into) failing firms (Morck and Nakamura (1999) and Friedman, Johnson, and Mitton (2003)) and the use of a group's deep pockets as a strategic tool in product market competition (Cestone and Fumagalli (2005)). None of these arguments considers the ownership structure of the business group. Regulatory or tax considerations might also help explain the creation of pyramids. For example, Morck (2003) provides evidence that taxes on intercompany dividends reduce the incidence of pyramidal structures.

[12] Consistent with this alternative story, Attig, Fischer, and Gadhoum (2003) show that low Tobin's Q predicts membership in a pyramidal group.

[13] In particular, those in favor of dismantling business groups have argued, among other things, that business groups inhibit the growth of small independent firms by depriving these firms of finance. Almeida and Wolfenzon (2006-b) present a model which shows that this possibility might arise as an equilibrium outcome in a poor investor protection country.

markets (Leff, 1978, Khanna and Palepu, 1997, 1999).[14]

2 Ultimate cash flow rights: definition and calculation

The definition of *ultimate* cash flow rights of the controlling family in a particular firm is the fraction of the dividends paid by that firm that is (eventually) received by the family. 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. Our 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.

In the last part of this section, we provide three additional applications of our dividend algorithm. First, we propose a formula to find the position of a firm in a group. Second, we propose a way of identifying whether a particular firm is part of a cross-shareholding loop. This method can identify not only direct cross-shareholdings (i.e., A owns shares in B which owns shares in A), but also any form of circular holdings (i.e. A owns B which owns C which owns A), irrespective of the number of firms in the loop. Finally, we propose a formula that relates the stand-alone value of all group firms (the value the firms would have without their stakes in other firms) to their observed market values.

2.1 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.

Example 1: A simple pyramid

[14] Other benefits of groups may include the more active operation of an internal capital market ((Hoshi, Kashyap, and Scharfstein, 1991; Perotti and Gelfer, 2001), the ability to prop up (inject money into) failing firms (Morck and Nakamura (1999) and Friedman, Johnson, and Mitton (2003)) and the use of a group's deep pockets as a strategic tool in product market competition (Cestone and Fumagalli (2005)). Regulatory or tax considerations might also help explain the creation of pyramids. For example, Morck (2003) provides evidence that taxes on intercompany dividends reduce the incidence of pyramidal structures.

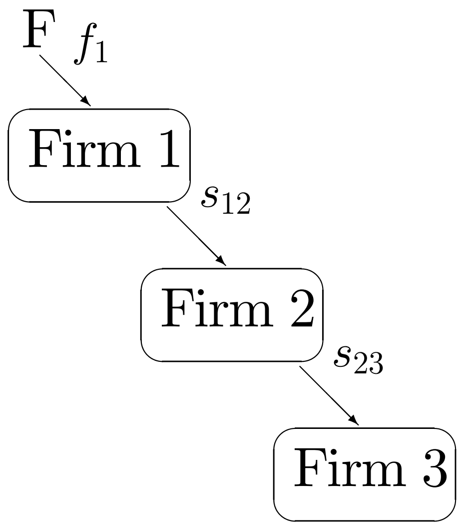

Figure 1: A simple pyramid

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

$$u_3 = f_1 s_{12} s_{23}$$

(as expected!).

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

$$\begin{aligned} u_2 &= f_2 + f_1s_{12} + f_2(s_{21}s_{12}) + f_1s_{12}(s_{12}s_{21}) + f_2(s_{21}s_{12})^2 + f_1s_{12}(s_{12}s_{21})^2 + ... \qquad (1) \\ &= \frac{f_2}{1 - s_{21}s_{12}} + \frac{f_1s_{12}}{1 - s_{21}s_{12}} \end{aligned}$$

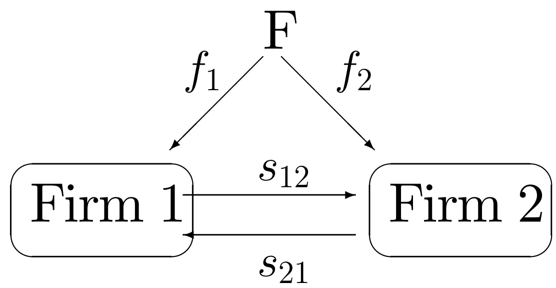

Figure 2: Cross-shareholdings

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.

2.2 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.

We use example 2 to illustrate how the formula is derived. Brioschi, Buzzacchi, and Colombo (1989) derive a similar formula using a different approach. To the best of our knowledge, our derivation of this formula (i.e., using the dividend algorithm), is new. Importantly, all the applications in the following section are based on the dividend algorithm.

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.

2.3 Applications

We present three different applications of the methodology developed.

2.3.1 Firm's position in a group

An important characteristic of the ownership structure of a business group is the position of a firm in the group. The basic concept 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.

An important feature of these formulas is that they only involve matrix computations and there is no need to actually construct all possible links among firms in the group. Thus, we can automate the position of a firm in a group.

2.3.2 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.

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.

2.3.3 The relation between stand-alone value and market value

The market value of firms in a group can be decomposed into the stand-alone value and the value of the stakes in other firms. Let e_i^T be the total market value of the equity of firm i in a group and let e_i^S be the value of the equity as if the firm held no stakes in other firms (the "stand-alone" value of equity). The following equation follows:

$$e_i^T = e_i^S + \sum_j s_{ij} e_j^T$$

Expressing this equation in matrix form for all the firms in the group leads to

$$\mathbf{e}^T = \mathbf{e}^S + A\mathbf{e}^T$$

or

$$\mathbf{e}^S = (I_N - A)\mathbf{e}^T$$

where e^T and e^S are the vectors of total market value of equity and stand alone value of equity.[15]

[15]The derivation of this formula implicitly assumes that the value of the stakes is fully reflected in the equity value of firm i. If part of the value of the stakes is supporting the debt (e.g., leverage of firm i is quite high) then this formula has to be modified.

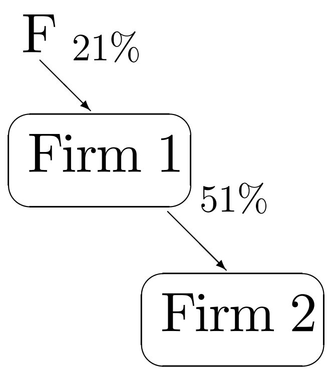

Figure 3: A very simple pyramid

3 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 –and sometimes 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).

3.1 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.

However, the intuition is less clear for more complex structures. For example, 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. Why should this be the right way to do it? Because there is no theory behind this rule, it is difficult to say. Moreover, in groups with cross-shareholding and loops, there might be an infinite number of chains leading to a particular firm.

3.2 Two alternative measures

We now discuss two alternative measures of voting rights, which are easily implementable in groups with cross-shareholdings and are derived from two simple assumptions about control. Both measures require that we first determine the set of firms that the family control for a given control threshold T.

3.2.1 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.

A potential problem with this definition is that, for groups with loops, it is impossible to implement this definition sequentially. Consider, for example, the group in figure 2. To figure out whether the family controls firm 2, we need to compute whether the family has more than T votes in this firm. The family holds some votes directly and might also hold indirect votes through firm 1. However, we can only assign the votes of firm 1 to the family if the family controls firm 1. Therefore, we need to determine whether the family controls firm 1. As it is clear, in order to determine this we need to know whether the family controls firm 2. But this was the question we started with!

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:*

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

In other words, the set $C(T)$ is the solution to a fixed point problem.[16] Finding such a fixed point might not be easy, specially for complex groups.

Example 7: Firms controlled by the family in a group with cross-shareholdings

Consider the group in Figure 4 and assume that $T = 25\%$. Let's 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

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

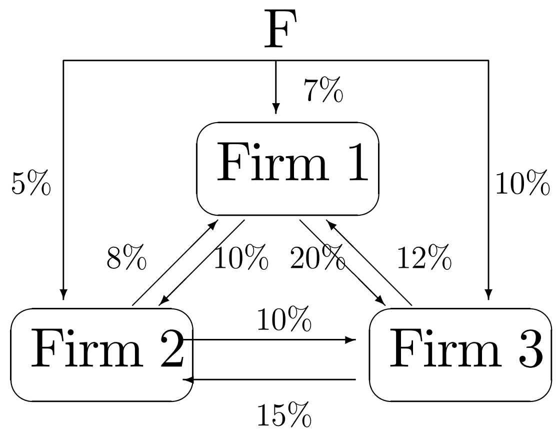

Figure 4: A complex group with many cross-shareholdings

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 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's now apply the algorithm to the group of Figure 4. 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's 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 two measures 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. Fortunately, 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.

3.2.2 Consistent voting rights

We use the set of firms controlled by the family to suggest a simple measure of control rights

Definition 5 *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 $\{VR_1(T), VR_2(T), VR_3(T)\} = \{27\%, 30\%, 40\%\}$, for $T \leq 27\%$.

3.2.3 Critical control threshold

Our second measure of control rights is as follows.

Definition 6 *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.

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. This is important because the CC measure respects an intuitive idea about control: If a family controls firm 2 through firm 1, its control of firm 2 cannot be higher than that for firm 1. The consistent voting rights measure does not satisfy this simple property as it is evidenced in the example above.

Second, the advantage of the CC measure is that it is based on the same algorithm of section 1. In order to compute CC for any arbitrary set of firms, we simply run the algorithm of section 1 sequentially with increasingly higher control thresholds, and we keep track of the threshold T at which each firm is dropped from the set $C(T)$. The routine can be entirely automated, and thus dispenses with the need for the researcher to draw the group structure and examine all (possibly infinite) links.

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.

In order to further illustrate the CC definition, we consider an additional example.

Example 8: CC for a pyramid with multiple chains

Consider the group in Figure 5. The family holds a 25% stake in firm 1, which holds a 40% stake in firm 2. The family also holds a 10% direct stake in firm 2. Thus, there is both a direct chain of control leading to firm 2, and an indirect one going through firm 1.

In this example, our methodology would produce the following numbers:

$$\{VR_1(T), VR_2(T)\} = \{25\%, 50\%\}, \text{for } T \leq 25\%$$
$$\{CC_1, CC_2\} = \{25\%, 25\%\}$$

The family controls neither firm if $T > 25\%$. In comparison, the weakest link methodology would call for separately considering all the links between the family and firm 2. There

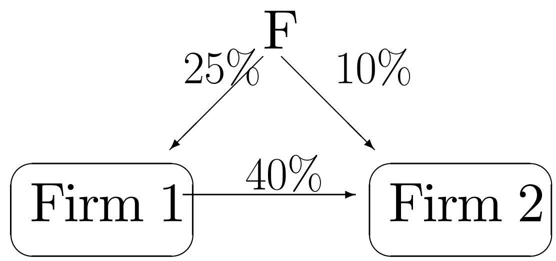

Figure 5

is an indirect link through firm 1, with minimum link equal to 25%, and a direct link of 10%, yielding a voting stake of 35% in firm 2.

3.2.4 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 5. In this example, firm 1 is important for the control of the group (because firm 1 holds a significant stake in firm 2), while firm 2 is not (because it does not hold shares in firm 1). An easy way to capture this difference is to drop both 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 2 is dropped from Figure 5, CC_1 is unchanged. In contrast, if firm 1 is dropped, CC_2 goes down from 25% to 10%. These calculations suggest the following definition for a firm's centrality in the group control structure:

Definition 7 *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.

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.

4 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.

4.1 Regulatory Framework for Chaebols

Chaebols are mainly regulated by laws pertaining, though strange, to competition policies. This contrasts with legal regimes addressing regulation of corporate groups in other countries: laws relating to holding companies in the US, a specialized law of corporate groups, Konzernecht, in Germany, and special provisions addressing group-related issues in European company laws.[17] Although the main purpose of regulating business groups in other countries is to protect creditors and minority shareholders against the opportunism of controlling shareholders, its main purpose in Korea is to deter excessive concentration of economic power 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.[18] From 1987 to 2001, the FTC designated annually the 30 largest chaebols.[19] 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. 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.[20] Among these business groups, very large ones are further 'subject to ceiling on total equity investment in other domestic companies.'[21] In our empirical study, chaebol hereafter refers to those family-controlled business groups subject to legal limitations on cross shareholding and cross debt guarantees.

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

[18] For financial and insurance companies of a group, equities replace assets in calculating the total asset of a group. The equity in the FTA refers to paid-in capital or owners' equity, whichever is larger.

[19] Thus, the identity of 30 chaebols changed slightly every year.

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

[21] 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.

4.1.1 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.

4.1.2 Legal restrictions on chaebols

With the exception of a few business groups with a holding company structure, a business group or chaebol itself is not a legal entity.[22] Once designated by the FTC as a large business group, however, the component firms in the group are subject to a host of legal restrictions that are intended to prevent concentration of economic power. The five major regulations for this purpose are as follows.

Limitations on cross debt guarantees Non-financial affiliates cannot provide other affiliated companies with financial guarantees for credits supplied by domestic financial institutions. The credits include loans, financial guarantees and underwriting of liabilities such as corporate bonds. Cross debt guarantees were allowed until1997. Witnessing a series of collapses of chaebols, the government introduced this regulation in 1998, immediately after the financial crisis of 1997.

Prohibition of cross shareholding The Company Law in Korea disallows cross shareholding if a parent company holds more than 50% of a subsidiary company. Even without a parent-subsidiary relationship, voting rights are restricted for those cross shareholdings exceeding a ten per cent level. The FTA applies a much more strict rule to chaebol companies. Cross shareholding among chaebol's affiliates is prohibited. 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, are subject to the following regulation intended to prevent moral hazard.

[22] The holding company structure was legally prohibited until 2000. This prohibition was meant to prevent an excessive expansion of chaebols. Starting in 2001, chaebols have to meet three major legal hurdles in order to adopt a holding company structure: a pure holding company's debt to equity ratio should be less than 100% and its ownership of listed subsidiary and private subsidiary must be over 30% and 50%, respectively. Among the very large chaebols, the LG Group was the first one to adopt the holding company structure in 2003.

Restriction of voting rights of shares held by financial institutions Financial institutions may not exercise voting rights of shares of domestic companies in the same chaebol. There is an important exception which has been subject to recurring debates. For a listed affiliate, financial institutions can exercise voting rights in events such as election of directors, amendment of corporate charters, and M&As, but even for these issues the voting rights exercisable by an 'identical person' including financial institutions cannot exceed 30 per cent.

Ceiling on the total equity investment in domestic companies A member company of chaebol subject to this particular regulation (currently, chaebols with assets grater than six trillion won) cannot invest more than 25 per cent of its equity in other domestic companies. This regulation, unique and very controversial in Korea, was introduced in 1987 when the Korean government formally started to introduce 'chaebol regulations.' As such, it is viewed by the Korean FTC as a very critical tool for controlling excessive expansion of chaebols through pyramid ownership structures.[23] This regulation was repealed in February 1998, immediately after the outbreak of the financial crisis, to facilitate corporate restructuring of chaebol companies. Witnessing a reoccurrence of rampant expansions of chaebol and facing a growing public criticism against it, the government reintroduced this regulation in April 2001.[24]

This regulation has been one of the most controversial chaebol-related regulations in Korea. Chaebols argue that this regulation hinders active corporate real investments. The Korean FTC reacts that it does hinder a reckless expansion of chaebol families' empire, but not valuable investment projects given a variety of exemptions and exceptions.[25] Facing strong objections from the chaebol community while corporate investments had been sluggish, the government introduced in the FTA the so called 'graduation standards' of the said regulation. If a chaebol meets one of the graduation standards that hinge upon good governance practice and desirable ownership structure, the chaebol becomes exempt from the regulation.

Disclosure requirements Intra-group transactions are also regulated by the FTA. There are two elements in this regard. When a chaebol affiliate that is subject to limitations on cross debt guarantees and cross shareholdings engages with another member firm in a transaction of an amount greater than either ten percent of the paid-in capital or ten billion won, it has to be approved by the board and thereafter disclosed. In addition, even a private company in a chaebol has to disclose all the major transactions that have potential impact on ownership, governance, financial conditions, and the long term future of the business.

[23] The Korean company law disallows non-voting common stocks or dual class stocks.

[24] Thus, there was a window of three year period during which chaebol was not subject to this particular restriction on equity investment in affiliated companies.

[25] The regulation does not apply to certain categories of investments; for example, investments in a firm belonging to the same industry or a troubled firm needing restructuring.

5 Data Description

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

5.1 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. At the time of statement of the shareholder status to KFTC each year, the business group under cross-shareholding and debt guarantee prohibition must have access to KFTC online and report that. 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, let us look into the ownership information of Samsung Corporation in Samsung group. In 2004, family owner held 1.42%, relatives of family owner 0.01%, two nonprofit corporations 0.23%, four affiliates 9.64%, thirty seven group officers 0.15%, Samsung Corporation itself 2.20%, and others 86.52% of its common stock.

5.2 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.

As explained below, this draft of the paper uses only 2003-2004 data. The reason is that the accounting data available in KLCA and KIS databases has been subject since 1999 to an "equity method" rule that adjusts assets and profits of group firms to take into account profits and equity owned in other group firms. Starting in 2003, the data contain enough information to allow us to back out the assets and profits of each individual Chaebol firm in isolation. However, before 2003 the data can only be obtained in the footnotes of the financial statements.

Our sample contains 1500 firm-years of ownership data in 2003 and 2004. Out of these firm-years, the accounting data is available for 1229 of them.

6 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 2003 and 2004. Before we do that, we present some basic statistics that show the importance of chaebols for the Korean economy, and we present an example of the ownership structure of one of the largest chaebols (Hyundai Motor).

6.1 The Chaebols' Influence in the Korean Economy

As of April in 2004, there were 41 large business groups designated by the Korean FTC. Among these 41 business groups, 36 groups are controlled by families. As noted already, these 36 family controlled groups or chaebols are the subjects of our analysis.

Table 1 shows that these 36 chaebols have 778 affiliated companies, among which 168 companies are listed. The total assets and the total sales of these groups are 622 trillion won and 469 trillion won, respectively.[26] To assess the economic influence of these chaebols, we examine the value added, the employment and the market capitalization. For value added, we examine only 559 manufacturing companies of chaebols. The chaebols account for 14% of the value added of the entire manufacturing sector. The chaebols' 778 companies account for 2.95% of the nation's employment. The chaebol companies, however, account for more than half (52.3%) of the total market value of all listed companies.

Although there are 36 chaebols in 2004, it is the four largest ones that exert a significant influence.[27] Samsung, LG, Hyundai Motor, and SK together account for 8.74% of the value added (of the manufacturing sector), 1.6% of the nation's employment, and 43% of the stock market value.

[26] Since the GDP in 2003 was 721 trillion won, the aggregate assets and sales of the 36 chaebols amount to 86.3% and 65.0%, respectively.

[27] Although five chaebols used to be the largest and thus most prominent, there are now four such chaebols after the Daewoo Group collapsed in 1999.

6.2 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. Perhaps because of this complexity, the existing literature on business groups focused on measuring only a few characteristics of the ownership of firms, such as whether they belong to a group or not, and whether they show indirect (e.g., pyramidal) ownership.

However, these are not the only variables of interest to describe the Chaebol structure. As we discussed in Section 2, we can also compute the specific position of a firm in the Chaebol structure, whether the firm is a part of a cross-ownership loop, and the centrality of a firm for the control of other firms. Importantly, our methodology to compute these variables does not require the researcher to draw the group structure as we have done in Figure 6.[28] Table 2 shows some variables of interest for the firms depicted in Figure 6.

The Table shows that Hyundai Motor, Hyundai Mobis and Kia Motors are the most important firms for the control of the Hyundai Motor Chaebol, given that these are the firms with the highest values for the *centrality* variable. These firms are also among the largest firms in the Chaebol in terms of 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. Notice that this 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 (variable Cash flow). As a consequence, the separation between ownership and control measured using VR is extremely large for these 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). In either case, the two measures indicate substantial separation between ownership and control in all but a few firms in the Hyundai

[28] 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.

Motor group.

6.3 Summary statistics

Table 3 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 35 groups in the sample in 2003 and 2004, and 840 firms. Because some firms only appear in one of the years, there are a total of 1481 firm-years.[29] The controlling family holds 17% 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 75% of the votes of the median firm in the sample. In contrast, the critical control threshold of the median firm is 34%. Thus, the separation between ownership and control is substantially larger if one uses VR to measure voting power. The data also indicate a substantial degree of pyramiding in Korean chaebol firms (the median position of a firm is 2.13), but with substantial variation. Some firms are owned directly (25% of firms show average position lower than 1.54), 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 holds substantial equity stakes in other firms.

Table 4 reports separate statistics for public (21%) and private (79%) firm-years. Clearly, the family owns larger cash flow stakes in private firms. The variable VR shows that most of the shares not owned by the family in private firms are owned by affiliate firms.[30] As a result, the data show greater separation between ownership and control in private than in public firms, if one uses VR to measure voting power. However, separation is similar for private and public firms if one uses CC to measure voting power. This result is easily understood when one recognizes the public firms are much more likely to be central (average centrality = 0.06 versus 0.01 for private firms). As the Hyundai Motor example shows, the variable CC tends to be equal to the VR in the most central firms. Thus, there is less variation in voting power across public and private firms when one uses CC to measure voting power. Finally, notice that as in the Hyundai Motor example public firms are much more likely to be at the top of group (average position = 1.89), while private firms are on average at the bottom (average position = 2.34).

Next, Table 5 (Panels A and B) reports summary statistics separately for firms in cross-shareholding loops, and firms outside them. The first thing to notice is that only 25% of the firm-years participate in cross-shareholding loops. This might be due to Korean regulation, which restricts direct cross-shareholdings. In fact, Panel C shows that the overall majority of cross-shareholding loops has 3 firms in it (75% of all loops). Also, notice that cross-shareholdings are more common among firms that are the top of the group. In addition, notice that cross-shareholdings do not seem to increase separation between ownership and

[29] Our initial sample has 1500 firm-years, but we dropped 19 firm-years in which the family's ultimate ownership in a group firm was equal to zero.

[30] Notice that the high values for the variable CVR does not mean that the family owns 100% of the private Chaebol firms, as is commonly assumed in the empirical literature on business groups. In fact, most of the shares are owned by other group affiliates. Thus, a complete characterization of the group structure requires data on private firms as well as in the public ones.

control, regardless of the measure that we use. Finally, firms in cross-shareholding loops are much more likely to be public. Only 10% of private Chaebol firms participate in cross-shareholding loops, versus approximately 50% of public firms.

In order to dig deeper into the correlations among the ownership variables, we also present some regressions of the ownership concentration variables on position, centrality and cross-shareholdings. These regressions allow us to measure the correlation between two variables, while controlling for a third one. For example, the basic statistics in Table 5 suggest that cross-shareholdings do not increase the measures of separation between ownership and control. However, because cross-shareholding loops are more common at the top of the group (where there is less separation), it is important to control for the firm's position in order to measure the relation between loops and separation.

The regressions are presented in Table 6. Panels A and B suggest that loops do contribute to lower ownership concentration and higher separation if one uses the CC measure of voting power. However, there continues to be no relation between loops and separation if one uses the VR measure. Similarly, the relation between centrality and separation between ownership and control depends on the particular separation measure that we use. Clearly, the strongest correlation is between the ownership variables and the average position of the firm. Almost by construction, a firm that is owned through a longer pyramidal chain (higher average position) shows lower ultimate ownership and more separation between ownership and control.

6.3.1 Group-by-group statistics

We have also calculated the ownership variables separately for each one of the 35 groups in our sample. The related tables are omitted for brevity, but are available from the authors. Each group has on average 22 affiliated firms. Out of these firms, an average of 4.5 firms are public, and an average of 4.5 firms belong to cross-shareholding loops. Also, on average 4.4 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 3.5 firms are owned directly by the family.

These average statistics also hide substantial variation across groups. For example, a regression of ultimate ownership on group and year dummies produces an R^2 of 42%, suggesting that a substantial fraction of the variation in ownership variables is explained by the group to which the firm belongs to.

6.4 Relating ownership to basic firm characteristics

It is also interesting to measure the correlations between the ownership variables and basic firm characteristics such as size (number of employees), and age (number of years since foundation). To do that, we run some regressions of the ownership variables on size and age, and include group and year dummies in some specifications.

The results on Table 7 show very clearly that both older and larger firms tend to be higher up in the group (smaller average positions). This result holds even after controlling for group dummies, suggesting that this correlation holds within groups as well. Similar results hold for the centrality and loop variables, suggesting that central firms and firms in cross-shareholdings also tend to be larger and older. Regarding the ownership concentration variables, the results are again mixed. In these regressions we also control for the average position of the firm, given the somewhat mechanical link between ownership concentration and position. We find that larger and older firms have lower ultimate ownership, but whether they have larger or smaller separation between ownership and control depends on the measure used. Separation is higher for larger/older firms when we use CC to measure voting power, but lower when we use VR. These results hold irrespective of whether we control for average position or not. Thus, the negative correlation between size/age and VR separation is not due to the fact that larger and older firms tend to be at the top of the group where separation between ownership and control is lower.

6.5 Summary: the average structure of a Korean Chaebol

Figure 7 summarizes the analysis above by charting the ownership structure of the average Korean Chaebol. Out of the average of 22 firms, the Figure plots 8. There are roughly three layers in the Chaebol ownership structure. Some firms (firms 1 and 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 (median position lower than 2). 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 3 to 1). Regarding ownership concentration, ultimate ownership and separation between ownership and control are naturally higher for the firms at the top of the group.

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.

7 Profitability and Valuation of Chaebol Firms

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

7.1 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 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 after 2003 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. 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:

$$\text{Operating Assets} = \text{Total Assets - KLCA\#123560}, \tag{6}$$

and:

$$\text{Operating Profits} = \text{Total Profits - KLCA\#242100} + \text{KLCA\#252600}, \tag{7}$$

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.

Out of the 1481 firm-years for which we have ownership data, the accounting data is available for 1219 of them. Out of these 1219 firm-years, we eliminate 96 of them because of the consistency requirements explained above. Our final matched sample contains 1123 firm-years.

7.2 Profitability and ownership structure

Table 8 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 unadjusted measure overstates average profitability by approximately 10%. 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.

Table 9 displays the regressions that relate profitability to ownership variables and controls. 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, 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.

The following columns introduce the ownership variables. We first introduce them on their own in the profitability regressions. Ultimate ownership is positively correlated with profitability, while the measures of separation (specially the CC measure) and average position correlate negatively with operating ROA. Centrality and the presence of cross-shareholdings are also negatively related to profits.

Because the correlation between ultimate ownership, average position and the separation measures is so high, it is difficult to measure their correlations with profitability while controlling for the other variables. If we do include these variables together in the same regression, however, ultimate ownership seems to have the strongest relation to profitability (columns VIII-X). In addition, the results in column XI show that centrality and cross-shareholdings continue to be negatively related to profits after controlling for ultimate ownership.

In unreported regression results we include group dummies to ask whether the correlations are due to variation across groups, or within groups (i.e., across firms that belong to the same group). It turns out that both centrality and ultimate ownership continue to be related to profitability even after controlling for group dummies, indicating that central firms and firms with lower ownership are less profitable than other firms that belong to the same group. The correlation between profitability and loop goes away, though. We also run the regressions (unreported) for each of the two years in our sample, 2003 and 2004. Centrality and ultimate ownership are related to profits in both years, though their effect is stronger in 2004.

To sum up, these profitability regressions show that firms that are central to the control structure of the group, and firms with lower ultimate ownership (those placed at the bottom of the group) have lower profitability than other group firms. There is also some evidence that firms in cross-shareholdings are less profitable, though this evidence is weaker. These correlations are also economically significant. Calculations using the coefficients in column (XI), the specification using industry dummies but no group dummies show that a one standard deviation increase in centrality reduces operating ROA by 0.01 (27% of the mean), while a one standard deviation increase in ultimate ownership increases operating ROA by 0.016 (39% of the mean).

7.3 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".[31] Before we go into the regressions, let us describe an example that illustrates the phenomenon.

7.3.1 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.[32] The value of these equity stakes alone (i.e., assuming a zero value for the stakes in private firms) was 4.4 billion dollars.[33] 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 corp'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 Corp's equity value. As a result, in December 2004 SK corporation's Q had increased to 0.92.[34]

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

[31] Previous literature has analyzed some examples of parent company discounts in the US. Please see the discussion below in Section 7.4.

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

[33] 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.

[34] 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.

of central firms a pervasive phenomenon in Korean chaebols?

7.3.2 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 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 2). 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}.

7.3.3 Results

Table 8 (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. There are a total of 269 firm-years available for public firms in 2003 and 2004.

Table 9 presents the regressions that relate Q to ownership variables. In Panel A, we look at the unadjusted measure of Q, Q_{una}. Our benchmark model includes size (log of the firm's market value of assets),[35] age, operating ROA and industry dummies as controls in some specifications (columns (1) and (2)). Larger firms and firms with greater operating ROA have higher valuations. The negative effect of age is only marginally significant after controlling for industry.

We then introduce the ownership variables. Interestingly, ultimate ownership is *negatively* related to Q, and significantly so even after controlling for industry. These results hold even after controlling for profitability (given that more profitable firms have higher Q and higher ownership). We have also run regressions in which we include the square of ownership, but we find no evidence for a non-linear relationship. The measures of separation between ownership and control are generally not significant, while average position has an effect on valuation that is consistent with the ultimate ownership result. Firms at the bottom of the group (higher average position and lower ultimate ownership) have higher valuations. Because these variables are highly correlated, it is difficult to disentangle the effect of position from the effect of ownership. The next column shows that consistent with the conjecture in the SK example, central firms seem to have lower valuations than other group firms. Firms that belong to loops are also valued at lower levels, though the effect is not as strong as that estimated for centrality.

We then consider the joint effect of ownership variables. Because average position and ultimate ownership are highly correlated, we include only one of them in these regressions (ultimate ownership). The results are similar if we include average position. Essentially, the next columns show that the negative correlation between centrality and Q is stronger than the negative correlation between ownership and Q, which is not significant after controlling for industry dummies. The negative correlation between loop and Q also becomes stronger after controlling for ultimate ownership.

The correlation between centrality/loop and Q is also economically significant. A one-standard deviation in centrality increases Q by an amount equal to 4% of its median value. Being in a cross-shareholding loop reduces Q by 10% if its median value. Thus, a firm that

[35] 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.

is both central and in a cross-shareholding loop such as SK corporation has on average a Q that is 14% lower than the median Q in the sample of group firms.

The results are essentially similar if we use the two other alternative measures of Q. Using Q_{con} increases the (negative) effect of loop and ultimate ownership on valuations, while the significance of the centrality effect is lower when we use Q_{sa} (though still significant).

To sum up, there is some evidence that in 2003 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. In fact, the correlation between valuations and ultimate ownership is if anything negative.

7.4 Interpreting the Profitability and Valuation Results

The negative correlation between profitability and ultimate ownership has also been reported by the related literature summarized in Section 1. As explained above, it is difficult to empirically disentagle the effect of ultimate ownership from the effect of the position of the firm in the group, given that the two measures are highly correlated. Our detailed measure of position thus confirms previous findings that firms that are owned through pyramids (those at the bottom of the group) tend to have lower profitability than other firms.

However, the negative correlation between centrality and profitability is a novel result. In particular, this result coupled with the result above suggests that the most profitable group firms are those that are placed at the top of the group (such that ultimate ownership is high), but which are not central to the control of the group. 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.

The big challenge in interpreting these results is to disentagle the direction of causality. Does pyramidal ownership decrease profitability, or does profitability predict the position of the firm in the group? As we discussed in the literature review of Section 1, both possibilities have been contemplated by existing literature. The results that we have obtained so far do not allow us to provide evidence for the direction of causality.

The valuation results suggest that the group firms with the lowest valuations are those that are central to the control of the group, and which belong to cross-shareholding loops. In terms of Figure 5, those are firms 3, 4 and 5. Interestingly, the firms at the bottom of the group (6, 7 and 8) have valuations that are, if anything, higher than the average group firm. Thus, the evidence in this paper does not support previous findings that pyramidal ownership is negative related to valuation measures. In particular, the valuation results do not support the standard version of the tunneling argument (i.e., Bertrand et al. (2002)), which predicts that the controlling shareholder has incentives divert cash from firms in which ultimate ownership is low, to those in which ultimate ownership is high. If anything, firms with low ultimate ownership (at the bottom of the group) have higher valuations than other group firms with higher ultimate ownership.

Nevertheless, 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 family is more likely to use an existing group firm to set up and control a new firm if the new firm has lower profitability. In contrast, firms with higher profitability tend to be owned directly by the family.[36] Because of this selection effect, the acquisition of an equity stake on a new firm tends to be 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 alternative agency-based 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).[37] 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. 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.

7.4.1 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

[36] Notice that Chaebol firms that are owned by other firms have in fact lower profitability than firms which are controlled directly, as explained above.

[37] 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.

shares of the subsidiary at a fixed rate in a future date creates an apparently clear arbitrage opprtunity.[38] 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,[39] 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 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 30 firm-years out of a total of 266 in which the market value of equity stakes are larger than the market value of the parent company, 11% of the entire sample.[40] 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.[41]

[38] 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.

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

[40] 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.

[41] 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. Summary statistics of Chaebols in 2004

	Group name	# of affiliate [1]	Key Financial Statistics (billion wons)				Value added/GDP 2			Employees			Market Capitalization		
			Assets	Liabilit.	Sales	Net Profits	Firms under cons.	(%)	Σ [3]	persons	(%)	Σ [3]	billion wons	(%)	Σ [3]
1	SAMSUNG	63(14)	191,072	128,416	120,998	7,418	46	3.65	3.65	139,993	0.6	0.6	110,301.1	25.95	25.95
2	LG	46(13)	65,915	38,292	70,940	3,557	31	1.81	5.46	88,826	0.38	0.98	23,346.7	5.49	31.44
3	HYUNDAI MOTOR	27(7)	62,219	37,004	56,602	2,804	22	1.63	7.09	105,699	0.45	1.43	21,919.2	5.16	36.59
4	SK	59(11)	50,696	34,807	49,847	3,838	45	1.65	8.74	29,489	0.13	1.56	27,044.4	6.36	42.96
7	HANWHA	31(5)	42,474	36,850	19,511	1,211	15	0.85	9.59	31,901	0.14	1.69	3,342.6	0.79	43.74
5	HANJIN	23(7)	27,594	20,904	16,770	121	34	0.77	10.36	40,616	0.17	1.87	3,533.1	0.83	44.57
6	LOTTE	36(5)	26,453	11,697	17,417	1,219	18	0.27	10.63	22,688	0.1	1.97	1,538.4	0.36	44.93
8	HYUNDAI HI	6(2)	14,267	10,049	10,611	217	3	0.36	10.99	33,875	0.15	2.11	2,743.6	0.65	45.58
9	KUMHO ASIANA	15(5)	13,915	11,062	8,341	52	14	0.32	11.31	18,174	0.08	2.19	889.9	0.21	45.79
16	TONGYANG	16(4)	13,438	12,399	3,784	-81	14	0.21	11.52	14,360	0.06	2.25	1,221.3	0.29	46.08
11	DONGBU	22(8)	12,143	9,020	7,846	-108	12	0.13	11.65	11,568	0.05	2.3	1,355.5	0.32	46.40
10	DOOSAN	22(6)	9,192	5,975	6,621	54	5	0.17	11.82	7,170	0.03	2.33	1,969.3	0.46	46.86
12	HYUNDAI	7(3)	8,459	6,270	5,483	-111	10	0.19	12.01	14,569	0.06	2.39	4,507.9	1.06	47.92
29	TAEKWANG	37(3)	6,775	4,769	3,359	-30	16	0.19	12.2	8,356	0.04	2.43	1,343.6	0.32	48.24
13	SHINSEGAE	12(5)	5,220	3,026	7,191	373	32	0.16	12.36	14,892	0.06	2.49	2,192.0	0.52	48.75
15	CJ	41(4)	5,174	2,839	5,634	225	6	0.06	12.42	5,566	0.02	2.52	264.8	0.06	48.81
14	LG CABLE	12(5)	5,052	2,862	7,343	126	10	0.2	12.62	6,241	0.03	2.54	1,553.0	0.37	49.18
18	HYOSUNG	16(1)	5,027	3,048	4,926	60	13	0.13	12.75	9,963	0.04	2.59	326.9	0.08	49.26
17	DAELIM	12(3)	4,807	2,354	5,682	299	6	0.17	12.92	3,898	0.02	2.6	1,106.1	0.26	49.52
19	DONGKUK STEEL	8(2)	4,736	2,758	3,580	156	21	0.05	12.97	8,522	0.04	2.64	362.6	0.09	49.60

Table 1. Summary statistics of Chaebols in 2004 (cont.)

	Group name	# of affiliate [1]	Key Financial Statistics (billion wons)				Value added/GDP 2			Employees			Market Capitalization		
			Assets	Liabilit.	Sales	Net Profits	Firms under cons.	(%)	Σ [3]	persons	(%)	Σ [3]	billion wons	(%)	Σ [3]
20	KOLON	31(6)	4,668	2,939	4,194	-137	15	0.1	13.07	8,919	0.04	2.68	813.5	0.19	49.79
24	DONGWON	17(5)	4,634	2,071	1,747	123	7	0.11	13.18	6,112	0.03	2.7	1,184.6	0.28	50.07
21	HYUNDAI DEPT. STORE	17(3)	3,647	1,860	2,674	198	10	0.06	13.24	3,712	0.02	2.72	739.8	0.17	50.24
23	HANSOL	11(5)	3,474	2,249	2,515	-132	8	0.03	13.27	6,944	0.03	2.75	544.3	0.13	50.37
22	KCC	10(2)	3,419	1,384	2,452	240	8	0.03	13.3	2,197	0.01	2.76	354.3	0.08	50.46
25	TAIHAN ELECTRIC WIRE	11(3)	3,036	1,828	1,568	73	21	0.1	13.4	4,071	0.02	2.77	394.4	0.09	50.55
26	SEAH	36(3)	2,975	1,183	2,267	158	14	0.08	13.48	3,466	0.02	2.79	524.8	0.12	50.67
27	YOUNG POONG	20(3)	2,885	1,282	2,850	31	8	0.08	13.56	4,092	0.02	2.81	1,002.6	0.24	50.91
28	HYUNDAI DEVELOPMENT	12(1)	2,784	1,385	3,080	219	23	0.03	13.59	5,111	0.02	2.83	282.4	0.07	50.97
30	BOOYOUNG	4(0)	2,452	2,130	595	11	5	0.01	13.6	973	0	2.83	na	0.00	50.97
31	NONGSHIM	12(3)	2,369	1,024	2,669	233	11	0.08	13.68	8,257	0.04	2.87	1,613.8	0.38	51.35
32	HITE	12(1)	2,329	1,339	995	100	7	0.06	13.74	2,004	0.01	2.88	1,595.3	0.38	51.73
33	DAESUNG	40(4)	2,322	1,303	2,371	80	21	0.05	13.79	3,964	0.02	2.89	242.4	0.06	51.79
34	DCC	19(4)	2,287	1,170	2,270	79	13	0.06	13.85	4,387	0.02	2.91	332.6	0.08	51.86
35	HANKOOK TIRE	7(2)	2,095	916	2,008	104	7	0.09	13.94	5,419	0.02	2.94	1,577.0	0.37	52.24
36	SAMYANG	8(3)	2,033	761	2,140	96	8	0.06	14	2,200	0.01	2.95	297.2	0.07	52.31
	Total	778(161)	622,037	409,224	468,880	22,876	559	14		688,194	2.95		222,361.1	52.31	

Footnotes 1 The number in each parenthesis refers to listed affiliates.
2 Manufactuing firms and GDP of the manufacturing sector.
3 Σ refers to cumulative proportions.

Sources: Value added : KIS-Line Service
GDP(manufacturing) : Bank of Korea
Employees : KFTC
Working populations : Korean Statistical Information System
Market Capitalization : Korea Exchange

Table 2. 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 3. Summary statistics, ownership structure

Panel A. Basic statistics

All firms	Mean	StDev	Median	25%	75%	Firm-years
Ultimate ownership	0.26	0.25	0.17	0.07	0.35	1481
VR	0.72	0.27	0.75	0.50	1.00	1481
CC	0.39	0.21	0.34	0.24	0.50	1481
Separation VR	0.46	0.28	0.44	0.24	0.70	1481
Separation CC	0.13	0.12	0.14	0.03	0.21	1481
Average Position	2.24	0.90	2.17	1.54	2.74	1481
Centrality	0.02	0.05	0.00	0.00	0.00	1473
					No.Firms	840
					No.Groups	35

Panel B: Correlation table

	Ult. Own	Separ CC	Separ VR	Av Pos	Public	Centrality
Separation CC	-0.59					
Separation VR	-0.51	0.32				
Avg. Position	-0.55	0.52	0.60			
Public	-0.15	0.12	-0.36	-0.20		
Centrality	0.09	0.04	-0.25	-0.27	0.41	
Loop	-0.09	0.03	-0.11	-0.14	0.38	0.25

Table 4. Summary statistics for ownership variables: Public versus private firms.

Panel A: Public firms

Public Firms	Mean	StDev	Median	25%	75%	Firm-years
Ult. ownership	0.18	0.16	0.13	0.07	0.26	312
VR	0.44	0.18	0.43	0.31	0.56	312
CC	0.34	0.15	0.32	0.21	0.46	312
Separation VR	0.26	0.16	0.24	0.15	0.35	312
Separation CC	0.16	0.10	0.16	0.09	0.21	312
Average Position	1.89	0.77	1.87	1.23	2.34	312
Centrality	0.06	0.10	0.01	0.00	0.08	309
					No. firms	165

Panel B: Private firms

Private Firms	Mean	StDev	Median	25%	75%	Firm-years
Ult. ownership	0.28	0.27	0.18	0.08	0.40	1169
VR	0.79	0.24	0.90	0.59	1.00	1169
CC	0.40	0.22	0.34	0.24	0.50	1169
Separation VR	0.50	0.29	0.50	0.31	0.77	1169
Separation CC	0.12	0.12	0.13	0.02	0.20	1169
Average Position	2.34	0.91	2.28	1.75	2.91	1169
Centrality	0.01	0.02	0.00	0.00	0.00	1164
					No. firms	675

Table 5. Summary statistics for ownership variables: Firms in loops

Panel A: Firms in loops

	Mean	StDev	Median	25%	75%	Firm-years
Ult. ownership	0.21	0.20	0.15	0.08	0.29	318
VR	0.61	0.29	0.57	0.35	0.94	318
CC	0.35	0.17	0.33	0.21	0.46	318
Separation VR	0.40	0.26	0.31	0.20	0.58	318
Separation CC	0.13	0.11	0.14	0.06	0.20	318
Average Position	2.01	0.84	1.97	1.29	2.50	318
Centrality	0.04	0.07	0.01	0.00	0.06	314

Panel B: Firms not in loops

	Mean	StDev	Median	25%	75%	Firm-years
Ult. ownership	0.27	0.25	0.18	0.07	0.36	1163
VR	0.75	0.25	0.80	0.51	1.00	1163
CC	0.40	0.21	0.34	0.24	0.50	1163
Separation VR	0.48	0.29	0.47	0.26	0.73	1163
Separation CC	0.13	0.12	0.14	0.02	0.21	1163
Average Position	2.31	0.90	2.23	1.72	2.88	1163
Centrality	0.01	0.05	0.00	0.00	0.00	1159

Panel C. Number of firms in loop

	Frequency	Percent
2 Firms	21	6.6%
3 Firms	239	75.2%
4 Firms	43	13.5%
5 Firms	12	3.8%
6 Firms	3	0.9%
Total	318	

Table 6. Relations among ownership characteristics

Panel A: Ultimate ownership				
Average Position	-0.161 ***	-0.161 ***		-0.164 ***
	(0.006)	(0.006)		(0.006)
Loop	-0.103 ***		-0.074 ***	-0.098 ***
	(0.013)		(0.016)	(0.014)
Centrality		-0.281 ***	0.593 ***	-0.104
		(0.106)	(0.126)	(0.107)
Observations	1481	1473	1473	1473
R-squared	0.33	0.31	0.02	0.34
Panel B: Separation (CC)				
Average Position	0.070 ***	0.075 ***		0.076 ***
	(0.003)	(0.003)		(0.003)
Loop	0.028 ***		0.006	0.018 ***
	(0.006)		(0.008)	(0.006)
Centrality		0.421 ***	0.068	0.389 ***
		(0.049)	(0.059)	(0.051)
Observations	1481	1473	1473	1473
R-squared	0.28	0.31	0	0.31
Panel C: Separation (VR)				
Average Position	0.189 ***	0.182 ***		0.182 ***
	(0.007)	(0.007)		(0.007)
Loop	-0.023		-0.039 **	-0.012
	(0.015)		(0.018)	(0.015)
Centrality		-0.485 ***	-1.237 ***	-0.464 ***
		(0.114)	(0.138)	(0.117)
Observations	1481	1473	1473	1473
R-squared	0.36	0.37	0.06	0.37

Table 7. Ownership variables and firm characteristics

	Dependent Variable						
	Average Position	Loop	Centrality	Ultimate Ownership	Ultimate Ownership	Separation (VR)	Separation (CC)
Firm Age	-0.0030 **	0.0019 **	0.0001	0.0000	-0.0005 **	-0.0003	0.0002 ***
	(0.0012)	(0.0009)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)
No Employees	-0.0000 ***	0.0000 ***	0.0000 ***	-0.0000 ***	-0.0000 ***	-0.0000 ***	0.0000 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Average position					-0.1525 ***	0.1830 ***	0.0686 ***
					(0.0067)	(0.0074)	(0.0028)
Group fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1481	1481	1473	1481	1481	1481	1481
R-squared	0.24	0.23	0.17	0.42	0.65	0.51	0.58

Table 8. Summary statistics of accounting and financial variables

	Mean	StDev	Median	25%	75%	Firm-years
oproa	0.040	0.208	0.041	0.002	0.102	1029
Roa	0.043	0.196	0.044	0.003	0.104	1029
opassets	677.66	2972.08	68.73	16.62	313.17	1123
assets	749.52	3172.59	73.38	18.30	343.33	1123
firm age	19	42	14	4	26	1123
employees	1014	3536	160	42	729	1123
Quna	0.973	0.404	0.891	0.733	1.087	269
Qcon	0.995	0.459	0.889	0.722	1.100	269
Qsa	0.981	0.468	0.890	0.713	1.105	266
con assets	738.04	3147.75	77.58	19.78	344.95	1123
mkt value	2220.60	6177.07	616.60	159.39	1901.93	269
mkt value sa	2038.38	5794.46	613.60	143.89	1753.40	266

Note: Data for assets, opassets, con assets, mkt value and mkt value sa are in millions of US dollars. We used an exchange rate of 1200 Won per dollar for the conversion.

Table 9. Operating profitability and ownership variables

	Dependent Variable: Operating return on assets										
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	(X)	(XI)
Firm Age	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
Ln(Assets)	0.0078 * (0.004)	0.0090 ** (0.004)	0.0080 ** (0.004)	0.0080 ** (0.004)	0.0074 * (0.004)	0.0085 ** (0.0041)	0.0090 ** (0.0042)	0.0090 ** (0.0041)	0.0088 ** (0.0041)	0.0090 ** (0.004)	0.0115 ** (0.0045)
No. employees	0.0000 ** (0.0000)	0.0000 * (0.0000)	0.0000 * (0.0000)	0.0000 ** (0.0000)	0.0000 * (0.0000)	0.0000 *** (0.0000)	0.0000 ** (0.0000)	0.0000 * (0.0000)	0.0000 * (0.0000)	0.0000 * (0.0000)	0.0000 *** (0.0000)
Public firm	0.0004 (0.0091)	0.0023 (0.0091)	-0.0063 (0.0098)	0.0028 (0.0093)	-0.0014 (0.0089)	0.0016 (0.009)	0.0031 (0.0092)	0.0024 (0.0089)	0.0031 (0.0093)	0.003 (0.0105)	0.0081 (0.0092)
Ultimate ownership		0.0533 *** (0.0151)						0.0536 *** (0.019)	0.0396 ** (0.02)	0.0549 *** (0.0197)	0.0660 *** (0.0165)
Separation (VR)			-0.0269 (0.0185)							0.0023 (0.0235)	
Separation (CC)				-0.0918 *** (0.0326)					-0.0485 (0.0424)		
Average position					-0.0089 * (0.005)			0.0001 (0.0062)			
Centrality						-0.1388 ** (0.0646)					-0.1974 *** (0.068)
Loop							-0.0180 * (0.0099)				-0.0171 * (0.0088)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1008	1008	1008	1008	1008	1001	1008	1008	1008	1008	1001
R-squared	0.16	0.17	0.16	0.17	0.16	0.17	0.16	0.17	0.17	0.17	0.19

Table 10. Valuation and ownership variables

	Dependent variable: Unadjusted Q								
Firm age	-0.0002	-0.0002 *	-0.0002 *	-0.0001	-0.0002 *	-0.0002 *	-0.0002	-0.0002 *	-0.0002 *
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Firm size	0.0963 ***	0.0902 ***	0.0985 ***	0.0963 ***	0.1022 ***	0.1139 ***	0.1053 ***	0.1208 ***	0.1259 ***
	(0.0153)	(0.0161)	(0.0154)	(0.0151)	(0.0157)	(0.0175)	(0.0161)	(0.0206)	(0.0182)
ROA	1.3496 ***	1.3275 ***	1.3259 ***	1.3468 ***	1.3390 ***	1.2637 ***	1.2981 ***	1.1928 ***	1.1948 ***
	(0.4352)	(0.451)	(0.4374)	(0.4288)	(0.4447)	(0.4299)	(0.4288)	(0.4348)	(0.4336)
Ultimate ownership		-0.2682 **						-0.0973	
		(0.1247)						(0.1345)	
Separation (VR)			0.1414						
			(0.107)						
Separation (CC)				-0.1538					
				(0.187)					
Average position					0.0540 **				0.0302
					(0.0255)				(0.0271)
Centrality						-0.7190 ***		-0.6938 ***	-0.6825 ***
						(0.2099)		(0.226)	(0.217)
Loop							-0.0783 *	-0.0870 *	-0.0877 **
							(0.0457)	(0.0451)	(0.0444)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	269	269	269	269	269	266	269	266	266
R-squared	0.52	0.53	0.53	0.53	0.53	0.55	0.53	0.56	0.56

Figure 6. Ownership Structure of Hyundai Motor in 2004.

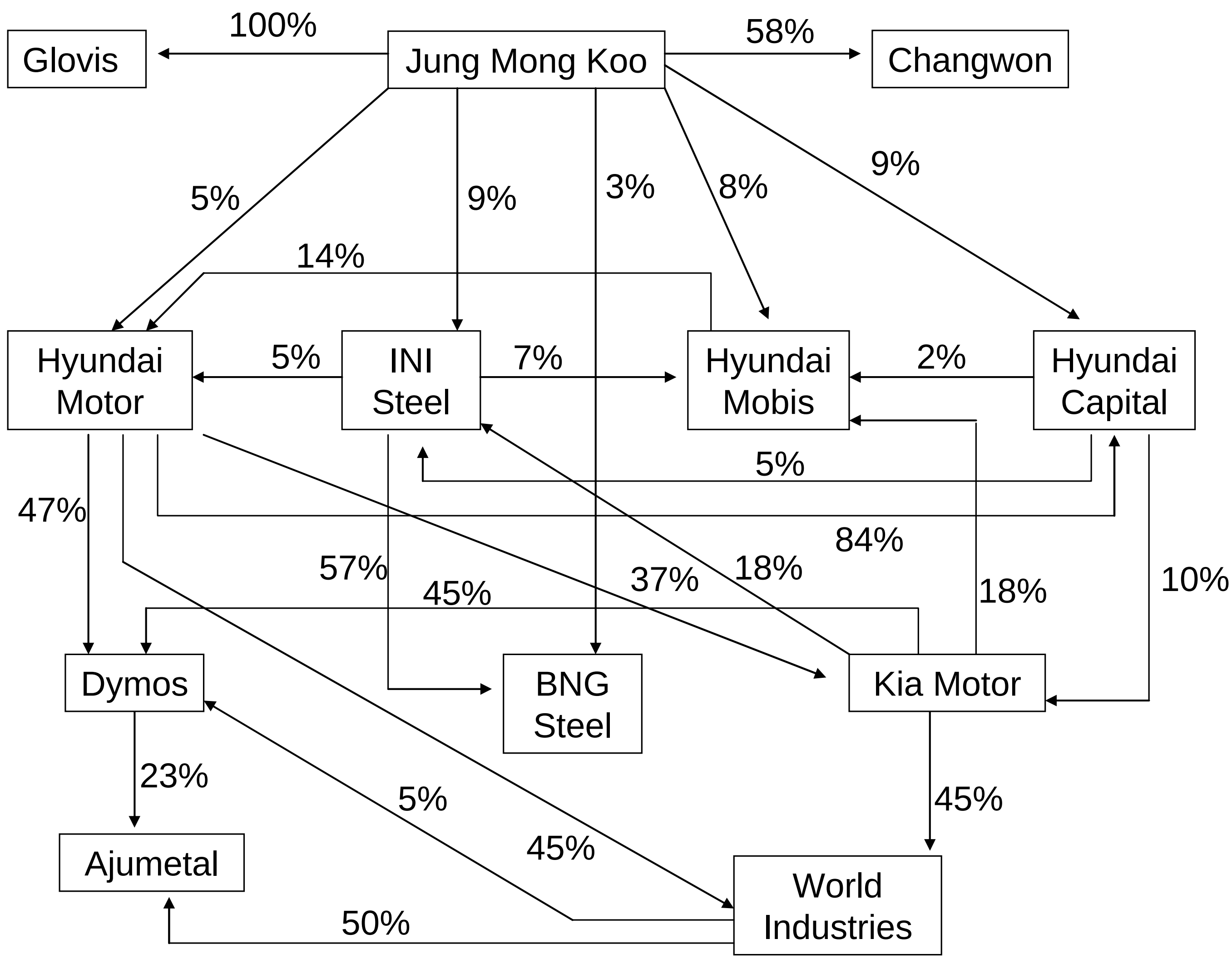
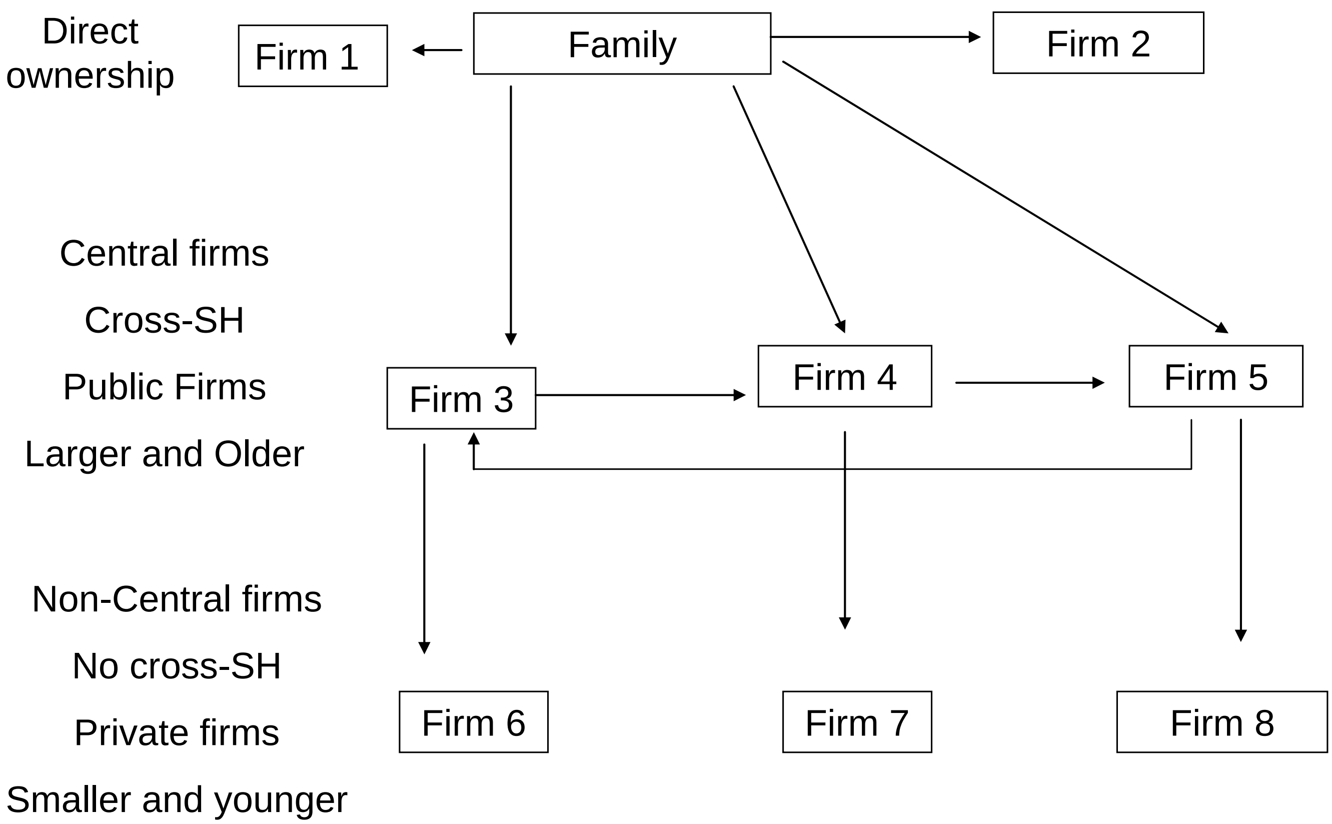


Figure 7. Average Ownership Structure of a Korean Chaebol, 2003-2004.



Average group: 22 firms, 4.4 central firms, 3.5 firms with direct ownership, 4.5 public firms, 4.5 firms in loops