The structure and formation of business groups: Evidence from Korean Chaebols*

Heitor Almeida
Sang Yong Park
Marti Subrahmanyam
Daniel Wolfenzon

(*This Draft: October, 2008*)

Abstract

In this paper we study the determinants of business groups' ownership structure using a unique dataset of Korean *chaebols*, and a set of new metrics of group ownership structure. We find that *chaebols* grow vertically (that is, pyramidally) as the family uses well-established group firms ("central firms") to set up and acquire firms that have low profitability and high capital requirements. *Chaebols* grow horizontally (that is, using direct family ownership) when the family acquires firms that are highly profitable and require less capital. We also provide direct evidence that the low profitability of firms owned through pyramids is partly due to a selection effect: the profitability of new group firms in the year before they are added to the group predicts whether they are added to pyramids or controlled directly by the family. The relationships between pyramids, profitability, and capital intensity that we uncover do not appear to be due to the separation between ownership and control induced by pyramids. Finally, we find that the selection of low-profitability firms into pyramids causes the group's central firms to trade at a discount relative to other public group firms. Taken together, these results suggest that controlling families optimally design the ownership structure of the group in a manner that is consistent with theory.

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

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

Groups of firms under common ownership are prevalent around the world. These so-called business groups account for a large fraction of the economic activity of many countries.[1] Most of these groups are controlled by families that hold equity stakes of group firms either directly or indirectly through other firms in the group. For example, one typical ownership structure is referred to as a pyramid. In this structure, the family achieves control of the constituent firms by a chain of ownership relations: the family directly controls a firm, which in turn controls another firm.[2]

The previous empirical literature has taken group structure as given, and studied the consequences induced by its ownership structure. In particular, recent papers have analyzed the relationship between the controlling family's cash flow and voting rights and measures of accounting performance and valuation (see, e.g., Claessens, Djankov and Lang 2000, Bertrand, Mehta and Mullanaithan, 2002, and Faccio and Lang, 2002). Yet, it is unlikely that group structure is exogenously given; rather, the controlling family can have influence on its design. However, whether or not this is the case and, if it is, the reasons that determine a group's ownership structure remain largely unexplored. We try to fill this gap in this paper.

We review the theory on group formation and establish several empirical implications. In particular, Almeida and Wolfenzon's (2006) theory of pyramidal ownership relates the characteristics of new firms that are added to a group to their position in the group structure. One implication is that the higher the expected profitability of the new firm, the more likely it is that the firm will be set up as a stand-alone firm controlled directly by the family. In other words, high profitability should be associated with direct, rather than pyramidal ownership. Direct ownership allows the family to capture the value of the firm entirely, instead of having to share it with shareholders of an already existing group firm, which would have been the case had the family chosen to control the new firm using a pyramid. In contrast, the pyramidal structure allows the family to use the financial resources of existing group firms to invest in new firms. Thus, an additional prediction of this theory is that firms that require larger capital expenditures are more likely to display pyramidal ownership. Finally, this theory predicts that pyramidal ownership should be associated with firm age: firms owned through pyramids should be younger than other group firms.[3] Importantly, in Almeida and Wolfenzon's theory, the trade-offs between direct and pyramidal ownership are independent of the separation between ownership and control that pyramids create.

We also examine the implications of the traditional informal argument for pyramidal ownership. This argument states that pyramids are a device to separate cash flow and voting rights, and therefore, they allow families to achieve control of firms using only a small cash flow stake.[4] According to this argument, pyramids should be particularly valuable

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

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

[3] As we discuss in Section 2, this implication is not trivial because the family can also have incentives to set up firms with direct ownership, and use them to acquire equity stakes in other (possibly older) group firms.

[4] This argument goes back at least to the beginning of the 20th century: Berle and Means (1932) and

when benefits of control are high. This argument generates implications that resemble some implications of Almeida and Wolfenzon's theory. For example, because profitability can be correlated with the extraction of private benefits by the family, the traditional argument is also consistent with a negative relationship between firm profitability and pyramidal ownership. In addition, this argument suggests that firm characteristics that predict pyramidal ownership should also be closely associated with separation between ownership and control (since, according to the traditional argument, this is the only reason for creating a pyramid in the first place). To distinguish between the two arguments, we examine whether profitability and capital intensity also predict the degree of separation between cash flow and voting rights in the ownership structure of group firms.

Both theories also suggest that pyramidal investments are bad news for minority shareholders of the *central firms*, firms that are used by the family to set up and acquire other firms. If minority shareholders anticipate additional pyramidal investments in the future, they should discount the current valuation of the central firms. Previous empirical literature on business groups has not examined this implication.

The theoretical arguments motivate new metrics of group ownership that go beyond the standard measures of cash flow and voting rights. First, we provide a measure of the *position* of any group firm relative to the controlling shareholder. This metric allows us to distinguish pyramidal from direct ownership. In addition, to identify firms that the family uses to set up new firms, we compute the *centrality* of a firm for the group structure (e.g., whether a given firm is used by the family to control other group firms).[5] We also introduce a new metric to compute voting rights that we call *critical control threshold*. As we argue in the paper, the *weakest link,* the most common measure to compute voting rights, does not work well for groups with complex ownership structures. Our new measure can be seen as a generalization of the concept of weakest link, that is both well defined and easy to compute, for any possible group structure. We provide algorithms that can generate these ownership measures for group structures of any degree of complexity. In our data, this is necessary because the complex ownership structures of Korean business groups (*chaebol*s) with dozens of firms and several ownership links among them makes it difficult for the researcher to directly compute them.[6]

We use a unique dataset of Korean business groups to test the theory's implications. The political and regulatory context of *chaebols* allows us to obtain extremely detailed ownership data on *chaebol* firms. Since the mid-1990s, the top Korean *chaebol*s have had to report their complete ownership information to the Korean Fair Trade Commission (KFTC). These reports include ownership and accounting data on all firms (public or private) in each *chaebol*. Another feature that distinguishes our data from is its dynamic nature. We have a panel from 1998 to 2004, for a relatively comprehensive sample of chaebol firms. In most countries, these type of data are not generally available.[7]

Graham and Dodd (1934) use this argument to explain the creation of pyramids in the U.S. in the early 20th century. See Bebchuk, Krakman and Triantis (2000) for a more recent discussion.

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

[6] Our algorithms can also be useful in other countries with complex ownership structures, such as India.

[7] Franks et al. (2008) assemble a dataset that contains ownership information on private firms in France, Germany, Italy and the UK. They focus on the trade-off between family and dispersed ownership, rather

We find that both pyramids and cross-shareholdings are common in Korean *chaebol*s. Nevertheless, pyramids in Korean *chaebols* are not "deep". A large majority of *chaebol* firms belong to pyramids with a total of two or three firms. Only a few group firms in each group are classified as being central, and they tend to be the older, larger and publicly traded firms. These findings suggest that in a typical Korean *chaebol,* a small number of central firms hold stakes in a large number of firms controlled through a pyramid involving the central firms. We also observe a substantial number of firms that are controlled directly by the family, with no ownership links to other *chaebol* firms. This cross-sectional variation in *chaebol* firm ownership structures allows us to test the predictions described above.

The empirical evidence on the characteristics of group firms is largely consistent with the theoretical implications derived above. First, we find that firms owned through pyramids are younger than firms that are at the top of the group.

Second, we provide evidence that lagged profitability and capital intensity help predict a *chaebol* firm's ownership structure. In particular, low profitability and high capital intensity firms are more likely to be placed in pyramids, rather than controlled directly by the family. These results also hold after controlling for the degree of separation between ownership and control induced by pyramids, suggesting that pyramidal ownership is not equivalent to separation between cash flow and voting rights.

Third, to further distinguish between a firm's position in the *chaebol* and the degree of separation, we also examine whether profitability and capital intensity help predict the extent of separation between cash flow and voting rights in *chaebol* firms. We find that lagged capital intensity is unrelated to the degree of separation between ownership and control. In addition, the correlation between lagged profitability and the measures of separation is weak. These results suggest that the links between capital intensity, profitability and pyramidal ownership are not explained by a desire of the controlling family to separate ownership and control in low profitability and high capital intensity firms.

Fourth, we test the causal relation between a firm's position (being in a pyramid) and its profitability. Prior empirical literature suggests that the correlation between firm profitability and its position in the group is due to the agency costs arising from the separation of ownership and control that pyramids typically create. That is, in this argument it is a firm's position in a pyramid that causes its low profitability. Conversely, Almeida and Wolfenzon (2006) argue theoretically that reverse causality can explain this correlation as, in their model it is optimal for the controlling family to place low profitability firms in pyramids. We show that the negative correlation between profitability and pyramidal ownership also holds when we measure firms' profitability the year *before* they become *chaebol* firms, suggesting that controlling families place low profitability firms in pyramids. In addition, and consistent with the results above, pre-*chaebol* profitability does not predict the degree of separation between ownership and control in the first year in which a firm appears in the *chaebol*. Thus, these results seem to be most consistent with the prediction that firms with low profitability are selected into pyramids, for reasons that are unrelated to separation between ownership and control.

Finally, we examine the relative valuation of central firms. We find a robust negative correlation between *centrality* and market-to-book ratios (Tobin's Q) that holds even after

than in the ownership structure of groups.

controlling for standard variables and across several robustness checks. This valuation discount is consistent with the prediction that minority shareholders of the central firms "price in" the expected effect of value-destroying pyramidal investments.

Overall, the evidence in this paper suggests that the ownership structure of business groups is optimally designed by the controlling family, and thus, cannot be taken as exogenous. Our evidence can be summarized as follows. *Chaebol*s grow vertically (that is, pyramidally) as the family uses central group firms to set up and acquire new group firms that have low profitability and high capital requirements. *Chaebols* grow horizontally (that is, using direct family ownership) when the family acquires new firms that are highly profitable and require less capital. These patterns do not seem to be due to the separation between ownership and control induced by pyramids. Finally, the selection of low profitability firms into pyramids apparently causes the group central firms to trade at a discount relative to other public group firms that do not hold large stakes in other firms.

The outline of the paper is as follows. Section 1 provides a brief review of the literature on the financial performance of family groups. Section 2 develops the empirical implications that we test in this paper. Section 3 introduces our methodology to compute ownership variables for group firms. In Section 4 we describe our dataset. Section 5 presents our main empirical tests, and Section 6 concludes.

1 Literature review

There is a vast literature on family business groups.[8] In this section, we discuss briefly the part of the literature that links ownership structure to financial performance.

The existing literature points out that the ownership structure of business groups is a potential determinant of group firm performance and valuation.[9] Most papers use cash flows and voting rights as the main metrics to describe group structure. For example, Bertrand et al. (2002) use a sample of Indian business groups to show that the value of group firms is affected by the controlling families' tunnelling of resources from firms in which they have low cash flow rights to firms in which their ultimate stake is high.[10] In the context of Korean *chaebol*s, Baek, Kang and Lee (2006) argue that discounted equity issues are more likely when the controlling shareholder has higher ultimate ownership in the acquirer than in the issuer. Bae, Kang and Kim (2002) argue that intra-*chaebol* acquisitions transfer wealth from firms in which the family has low cash flow rights (typically the acquirer) to those in which the family has higher cash flow rights.[11] Claessens et al. (2002) show that firm value is

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

[9] This does not mean that ownership is the only dimension of group structure that is interesting. Khanna and Thomas (2005), for example, show that stock price comovement in Chilean firms is greater when directors overlap than when firms belong to the same pyramid. Bertrand et al. (2004) link group structure to the history of the familes of controlling shareholders. Marisetty and Subrahmanyam (2008) study IPO underpricing of stand-alone and group firms. See also Khanna (2000), and the survey by Khanna and Yafeh (2007).

[10] In contrast, Gopalan, Nanda and Seru (2006) examine intra-group loans in Indian business groups, and find little evidence of tunneling. They suggest that loans are used to support financially weaker firms in the group.

[11] In a related fashion, Cheung, Rau and Stouraitis (2006) find that connected transactions between Hong

negatively related to the separation between ownership and control in East Asia, while Lins (2003) finds similar results for a sample of firms from the emerging markets. Joh (2003) finds that the separation between ownership and control is negatively related to profitability in Korea.[12]

Instead of focusing on measures of cash flow and voting rights, other papers examine variables that indicate whether a firm has some indirect (e.g., pyramidal) ownership. In particular, Claessens et al. (2002) and Volpin (2002) provide evidence that firms with indirect ownership have lower Tobin's Q than other firms. In contrast, Masulis, Pham, and Zein (2008) find that Tobin's Q is higher in pyramidal firms than in firms at the top of the group.

The literature has also examined whether group membership affect valuation (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. Baek, Kang and Park (2004) focus on the effects of Asian crisis on Korean firms, and show evidence for a stronger impact of the crisis on *chaebol* firms. In a cross-country study, Masulis et al. (2008) find that, after controlling for group membership choice, groups help improve firm value.

Finally, the literature provides some evidence on the correlation between ownership variables and firm characteristics. In particular, there is evidence that firms that are owned through pyramids are smaller and younger than firms at the top of the group (those that own shares in other firms). Aganin and Volpin (2005) describe the evolution of the Pesenti group in Italy, and show that it was created by adding new subsidiaries to the firms the Pesenti family already owned, through carve-outs of existing group firms. One of their conclusions is that, in Italy, business groups expand through acquisitions when they are large and have significant cash resources. Claessens, Fan and Lang (2002) find that firms with the highest separation of votes and ownership (i.e., those most likely to be owned through pyramids) are younger than those with less separation. Pyramidal firms also seem to be associated with larger scales of capital investment. Attig, Fischer, and Gadhoum (2003) find evidence consistent with this implication in Canada. 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.[13]

2 Hypotheses regarding family groups

The traditional informal explanation for pyramidal structures is based on the idea that families try to control as many firms as possible to enjoy private benefits of control. Pyramidal structures lead to a separation of cash flow from voting rights that allow these families to

Kong listed companies and their controlling shareholders (such as transfer of assets across firms under the shareholder's control) result in value losses for minority shareholders. Their sample includes both group and non-group firms.

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

[13]Kang, Park and Jang (2006a) also analyze the family's choice of ownership structure in *chaebols*. However, they focus on average ownership characteristics of the entire group rather than on characteristics of individual *chaebol* firms.

minimize their ultimate cash flow stake in the firms they control (see, e.g., Bebchuk, Kraakman and Triantis, 2000). In this argument, pyramidal structures are only a device to achieve the desired separation of cash flow from control rights.[14]

This argument predicts that pyramids should be used to control firms with substantial private benefits. Therefore, firm characteristics that proxy for private benefits of control should be correlated with the use of pyramids. Moreover, because in this argument pyramids are only a device to separate ownership and control, any firm characteristic that predicts pyramidal ownership should also predict the extent of separation between cash flow and voting rights.

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

This argument generates specific predictions about the relationship between the characteristics of firm B and the ownership structure that is chosen by the family. In particular, firms with low investment requirements and/or high profitability are less likely to be set up in pyramids. External financing is less important for such firms, and thus, the ability to use the cash retained in firm A is less valuable for the family. In addition, high profitability firms generate higher cash benefits for minority shareholders, and hence, the family is more likely to choose a direct ownership structure for firm B to avoid sharing these benefits with the minority shareholders of firm A. Conversely, the family is more likely to select pyramidal ownership when firm B has low profitability and high investment requirements. For such firms, using the cash retained in firm A through an equity investment in firm B is beneficial for the family.[15]

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

[14] As discussed by Almeida and Wolfenzon (2006), while pyramids are generally associated with large deviations from "one share-one vote", this pattern is not universal. See, for example, Franks and Mayer (2001).

[15] Gopalan, Nanda and Seru (2007) develop a theory of dividends in business groups that uses arguments that resemble those in Almeida and Wolfenzon (2006). In particular, they show how families can use dividends as a way of transferring cash across group firms to finance group investments. Their focus is on explaining group dividend policy rather than ownership structure.

independent of the deviation between cash flow and voting rights in firm B.[16]

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

Finally, the model generates implications about the timing of pyramid creation. In the model, a pyramidal structure allows the family to use firm A's financial capacity to reduce the financing costs of setting up firm B. This argument implies that pyramids are created over time. As existing family firms build internal resources, it becomes more likely that they will be used to acquire new firms through pyramidal stakes. In other words, we expect firms that hold large equity stakes in other group firms (those that are like firm A in the model) to be older than the firms at the bottom of the pyramid (those that are like firm B).

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

Implication 1 Group firms that are used by the family to set up and acquire new group firms are older than firms at the bottom of the group.

Implication 2 When adding a new firm to the group, the controlling family places firms with low expected profitability in pyramids and directly controls firms with high expected profitability.

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

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

Implication 1 might seem trivial, but one can imagine situations in which it does not hold. The family can set up a firm with direct family ownership, and place it at the top of a pyramid. In particular, the traditional argument does not necessarily predict that firms owned through pyramids should be younger. For example, the family might decide to increase separation between ownership and control of an older firm that it already owns, and use equity investments by younger firms to achieve that goal. Also, controlling families sometimes set up shell companies to acquire stakes in other group firms in a tax-efficient manner. In all these cases we would see younger firms at the top of pyramids.

[16] In fact, Almeida and Wolfenzon (2006) show that this financing advantage exists even when the family can issue unlimited dual-class shares to set up firm B. Under this assumption, the separation between ownership and control that is achieved through the pyramid plays no role. In particular, the traditional argument for pyramids does not apply.

Implication 2 is consistent with a negative correlation between pyramidal ownership and profitability. In fact, previous papers find strong evidence on this correlation (see Section 1). However, the interpretation so far has been that this association is evidence that pyramids reduce profitability. In contrast, in our argument the correlation is driven by the opposite direction of causality: lower profitability firms are *selected* into pyramids. Our empirical tests explore the dynamics of group structure to provide evidence on the direction of causality.

Under some assumptions, Implications 2 and 3 can also be consistent with the traditional argument for pyramids. If low profitability and high capital requirements proxy for high private benefits of control, then the traditional argument would predict that families will use pyramids to control firms with these characteristics. Moreover, the traditional argument would predict that the degree of separation between ownership and control is also high for low profitability, high capital requirement firms. To distinguish between the two theories, in the empirical section, we examine whether profitability and capital intensity predict the degree of separation between cash flow and voting rights in group firms.

Regarding Implication 4, previous empirical studies focus on the relation between a given group firm's valuation and its own ownership structure. In contrast, Implication 4 focuses on the role the firm plays in the group. This implication is new to the literature on groups and it is common to both Almeida and Wolfenzon (2006) and the traditional theory. This implication also bears some resemblance to other empirical findings in the finance literature including the "closed-end fund puzzle" (see, e.g., Shleifer, 2000) and the "parent company discount" (see, e.g., Cornell and Liu, 2001). We discuss the relationship between our findings and these previous findings after we present the empirical results (in Section 5.3.1).

3 Metrics of group ownership structures

In order to test the empirical implications described in Section 2, we develop some new metrics of group structure. Specifically, the theory models the family's choice of whether to set up a new firm as a partial subsidiary of an established firm, or to hold stakes directly. To capture this notion, we define the variable *position*. We also define the variable *centrality* to identify firms that the controlling family uses to set up and acquire new firms. In addition, we argue that the standard measure of voting rights (the weakest link) is difficult to apply to groups with complex ownership structures such as the Korean *chaebol*s. We propose an alternative measure of control in a group, the *critical control threshold*, and provide an algorithm to compute it.

We provide formulae and simple algorithms to compute all the metrics we propose. This is crucial for the case of Korea, where the web of ownership relations among group firms can be quite complex. As an illustration of this complexity, in Figure 1, we have selected only 11 of the 27 firms that form part of the Hyundai Motor group and drawn its ownership structure as of 2004. Needless to say, computing ownership metrics in this group can be a daunting task. Importantly, the formulae we propose can easily deal with any type of ownership structure.

In Appendix A, we show a numerical example that illustrates the computation of several of the ownership variables described here, including *position*, the *critical control threshold*, and *centrality*.

3.1 Ultimate cash flow rights, position and loops

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

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

where s_{ij} is the stake of firm i in firm j. We also define a vector with the direct stakes of the family in each of the N firms:[17]

$$\mathbf{f}' = \left[\begin{array}{cccc} f_1 & f_2 & \cdots & f_N \end{array} \right]. \tag{2}$$

The key insight to derive all formulae in this section is to follow one dollar of dividends paid by firm i. We write this dividend as a vector of zeroes with a 1 in the ith position:

$$\mathbf{d}_i' = \left[\begin{array}{ccccc} 0 & \cdots & 1 & \cdots & 0 \end{array} \right]. \tag{3}$$

The family receives $\mathbf{f}'\mathbf{d}_i$ when the dividend is paid and group firms receive $A\mathbf{d}_i$. Now suppose group firms pay out to shareholders what they themselves receive as dividends from other companies, i.e., the new dividend is now $A\mathbf{d}_i$. The family receives an additional $\mathbf{f}'(A\mathbf{d}_i)$ and the cash in group firms out of the original dollar paid is $A(A\mathbf{d}_i) = A^2\mathbf{d}_i$. A simple pattern emerges: After n rounds of dividends, the cash position of group firms is $A^n\mathbf{d}_i$.[18]

3.1.1 Ultimate cash flow rights

We can now compute the family's ultimate cash flow right in firm i, u_i. The ultimate cash flow right in firm i is defined as the fraction of the dividend originally paid by firm i that is (eventually) received by the family. That is, $u_i = \sum_{n=0}^{\infty} \mathbf{f}'A^n\mathbf{d}_i$. Simplifying this expression leads to the following result.

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

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

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

This formula is easy to use and can accommodate any group structure, regardless of its complexity.[19] Brioschi, Buzzacchi, and Colombo (1989) use a different method to derive this formula. Essentially the formula works through the matrix of cross-shareholdings to arrive at the ultimate ownership. This is very much in the same spirit as input-output analysis (Leontieff, 1986) where the share of an industry or sector in the aggregate economy is being computed.

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

[18] This argument does not presume that dividends are actually paid. If the dollar is retained in firm i, the formulas will tell us the fraction of the dollar that is owned by the family and the other group firms (e.g., the cash flow rights of the family and group firms).

[19] Most papers in the literature compute cash flow right by multiplying the stakes along the ownership chain. This is correct under the assumption that no cross-shareholdings exist. Under this assumption, the chain multiplication formula is a special case of equation 4.

3.1.2 Position

Using the same idea, we can now compute the *position* of a firm in a group. We define *position* as the distance between the family and a firm in the group. For example, in the case of a simple pyramid with two firms, the firm at the top of the pyramid is in *position* 1 and the one at the bottom is in *position* 2. Since there might be multiple chains from a particular firm to the family, we weigh each chain by its importance in terms of the cash flows the family receives. Note that the family receives $\mathbf{f}'\mathbf{d}_i$ from firm i directly (*position* 1). It also receives $\mathbf{f}'A\mathbf{d}_i$ from firm i through chains that contain one intermediate firm (*position* 2) and so on. Therefore, the *position* of firm i is defined by

$$pos_i = \frac{\mathbf{f}'\mathbf{d}_i}{u_i} \cdot 1 + \frac{\mathbf{f}'A\mathbf{d}_i}{u_i} \cdot 2 + \frac{\mathbf{f}'A^2\mathbf{d}_i}{u_i} \cdot 3 \cdots = \sum_{n=1}^{\infty} \frac{\mathbf{f}'A^{n-1}\mathbf{d}_i}{u_i} \cdot n. \tag{5}$$

Simplifying this expression leads to:

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

$$pos_i = \frac{1}{u_i}\mathbf{f}'(I_N - A)^{-2}\mathbf{d}_i \tag{6}$$

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

The above proposition yields a relationship for the *position* of a particular firm taking into account all possible ownership chains.[20]

3.1.3 Loops

While it is not the main focus of the empirical tests, we can also use these calculations to check whether a firm is part of a cross-ownership pattern and to compute the number of firms involved in this loop. Recall that after n rounds of dividends starting with one dollar paid by firm i, the cash position of group firms is given by the vector $A^n\mathbf{d}_i$. If cash reappears in firm i, that is, if $d_i' A^n \mathbf{d}_i > 0$ for some n, then firm i is part of a loop. Also, the n for which funds reappear for the first time in firm i measures the number of firms in the shortest loop, which we define as *loop*.

Definition 1 *Let*

$$loop_i = \min\{n | n \geq 1 \text{ and } \mathbf{d}_i' A^n \mathbf{d}_i > 0\}, \tag{7}$$

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

The above definition provides a rule to determine whether a firm is in a loop and to determine the number of firms in involved in the shortest loop.

[20] Kang, Park and Jang (2006b) derive an alternative measure of a firm's position in a group based on whether a firm owns significant equity in other group firms, or whether other firms own a large fraction of the firm's equity. The first component of the definition creates a mechanical correlation with our centrality variable (defined below), and so we believe our definition is more appropriate to the general case of complex ownership structures.

3.2 Control rights and centrality

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 ultimately controlled by the family. The most frequently used measure in the literature is the weakest link, which is defined as the minimum stake along the chain of control. This measure is intuitive for simple pyramids: the controlling family must have a better grip on the control of a firm that is higher up in the pyramid than over a firm lower down that is controlled via the initial one. Yet, this measure has some drawbacks. First, when there are multiple chains used to control a firm, the definition calls for adding up the minimums over all chains. The intuition for this is not as clear. Second, in groups where there are multiple chains leading to one firm, this definition can generate numbers above 100%.[21] Finally, the weakest link is not well defined for firms that are part of loops as there are infinite chains leading to these firms.

In light of these problems, we define our own measure of control, the *critical control threshold*. We do this in two steps. We first define the set of firms controlled by the family for any arbitrary control threshold. Next, for each firm, we define the *critical control threshold*, or CC in short, as the maximum threshold for which the firm belongs to the set of firms controlled by the family. This new definition has several appealing features. First, it can be defined for any group structure, regardless of its complexity. Second, it is derived from clearly stated assumptions about the characteristics of control. Finally, it turns out that this measure is equivalent to the weakest link when cross-shareholdings and multiple links are absent (that is, for simple pyramids).[22] In that sense, it is a reasonable generalization of that simple, intuitive concept.

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, directly or indirectly.*

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

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

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

[21] Simple examples are available from the authors upon request.

[22] In particular, if cross-shareholdings and multiple links are absent or not very substantial the weakest link methodology can be used to compute control rights. For example, Faccio and Lang (2002) show that neither problem is very prevalent in Europe, justifying the use of the weakest link as a measure of control in their sample.

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

$$C(T) = \{i \in N : f_i + \sum_{j \in C(T),\ j \neq i} s_{ji} \geq T\}. \tag{8}$$

In other words, the set $C(T)$ is the solution to a fixed point problem.[23] In Appendix B we describe an algorithm that can be used to find $C(T)$, in general.

3.2.2 Critical control threshold: definition

We can now define our new measure of control rights:

Definition 2 *For any firm $i \in N$, the* critical control threshold *is given by*

$$CC_i = \max\{T \mid i \in C(T)\} \tag{9}$$

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

3.2.3 Centrality of a firm for the control of the group

In the empirical tests we need to identify group firms that the controlling family uses to set up and control new firms. We identify such firms as those that are important for the control of other firms. This leads to the following definition.[24]

Definition 3 *We define the* centrality *of a firm i as:*

$$central_i = \frac{\sum_{j \neq i} CC_j - \sum_{j \neq i} CC_j^{-i}}{\sharp N - 1}, \tag{10}$$

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 computation essentially determines how central a firm is, by comparing the average critical control treshold with and without including the stakes the firm holds in other firms. This formula, as the previous ones, can be implemented for group structure, regardless of its complexity.

In order to show that the empirical results are not driven by the control proxy that we use, we also experiment with an alternative measure of *centrality* that is based only on the *direct* equity stakes that each firm holds in other group firms. If we let A_j be the total assets and E_j be the total equity of firm j, we have the following definition:

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

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

Definition 4 *We define the aggregate equity* stake *of firm i in other group firms as:*

$$stake_i = \frac{\sum_j s_{ij} E_j}{A_i}, \tag{11}$$

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

3.2.4 Consistent voting rights

Besides the weakest link, the previous literature has also used an alternative measure of voting rights, namely the sum of the direct stakes held by the controlling shareholder, and all stakes held by firms controlled by this shareholder (LaPorta et al., 1999, and Lins, 2003).[25] Using this alternative measure of voting rights allows us to test whether our results on *position* and *centrality* are robust to controlling for different measures of separation between ownership and control.

Definition 5 *Given a threshold* T, *the* consistent voting rights *of the family in firm* $i \in C(T)$ *are defined as:*

$$VR_i(T) = f_i + \sum_{j \in C(T),\ j \neq i} s_{ji} \tag{12}$$

In words, to compute the sum of the votes held by the family in firm i, we simply add the direct votes held by the family in firm i with all the 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. This VR measure is also the measure that is used by Korean regulators to compute the separation between ownership and control in *chaebol* firms.

4 Data Description

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

[25] Some researchers attribute the weakest link measure to the paper by La Porta et al. (1999), but, in fact, they use a different definition of voting rights which is closer to the VR measure. Specifically, they measure indirect ownership in a firm i as the percentage of votes that other group firms hold *directly* in firm i, provided that these other group firms are also controlled by the family (under control thresholds of either 10% or 20%). See Table I in p. 478 of their paper.

4.1 Ownership Data

The ownership data for our study are from the Korean Fair Trade Commission (KFTC), which was established in 1981 with the purpose of regulating competition. In particular, the KFTC's stated goal is to deter excessive concentration of economic power in a small number of large companies, including *chaebols.* Among other regulatory constraints, the KFTC requires that *chaebol* firms report complete ownership data. *Chaebols* are required to report the status of affiliate shareholders and persons with special interest and the financial status of group companies as of April 30 of each year. Ownership data are recorded in detail. Shareholders are categorized into seven types; family owner, the relatives of family owner, affiliates, nonprofit affiliate, group officer, treasury stock, and others. In addition, our data contain the name, the holding quantity, and the ratio of common stocks and preferred stocks of each individual shareholder.

The KFTC's definition of a *chaebol* consists of two steps.[26] In the first step, the KFTC defines the set of firms that belong to a *business group.* There are two criteria for this. The first is based on stock ownership. According to this criterion, a firm belongs to a business group if ownership by the controlling shareholder and related persons (relatives and other affiliated companies of the same business group) amounts to more than 30 per cent, excluding preferred shares. The second criterion is qualitative. Firms are also classified as belonging to a business group when the controlling shareholder exercises "controlling influence" over it. The latter criterion is further detailed to include cases of exchange of directors and managers, and also substantial business transactions between a firm that belongs to the business group and the company in question. Because this criterion of controlling influence is interpreted broadly, some companies legally belong to a group even though neither the families, nor other affiliated companies in the group own shares in those companies.

In the second step, some business groups are designated as *chaebols* based on size, which is defined as the value of the combined total assets of affiliated companies in the group. From 1987 to 2001, the KFTC annually designated the 30 largest business groups as *chaebols.* From 2002 onwards, the KFTC started using a new category by including any group with total combined assets greater than a certain cutoff in their definition of *chaebol.* Currently, these are business groups with combined assets greater than two trillion won.[27]

From the ownership and financial database that the KFTC has maintained, we obtained data for the period 1998-2004. We focus only on business groups with the ownership of a natural person (i.e., family business groups), and exclude other business groups such as government-controlled business groups. Our ownership data contains 3,545 firm-year observations. This is the sample that we use below in the tests that do not involve accounting and financial data.

[26] To be more precise, the KFTC's definition that we describe here is that of a *large business group.* A *chaebol* is a *large business group* that is controlled by a family. Because our sample contains only family controlled groups, we refer to *chaebols* and *large business groups* interchangeably.

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

4.1.1 Summary statistics: ownership variables and firm characteristics

Table 1 shows the average values for the ownership variables across all firm-years in our sample (Panel A), and the cross-correlation matrix (Panel B). We also include other firm characteristics that we use in the analysis.

Panel A shows that there are a total of 47 groups and 1085 firms that were present at some point in the sample between 1998 and 2004. The controlling family holds 13% of the cash flows of the median firm, but it holds substantially more votes according to our two alternative measures of voting power. The *consistent voting rights* measure (VR) yields the largest voting power. The family and the affiliate firms hold 68% of the votes of the median firm in the sample. In contrast, the *critical control threshold* (CC) of the median firm is 30%.

The data also indicate a substantial degree of pyramiding in Korean *chaebols* (the median *position* of a firm is 2.06), but with substantial cross-sectional variation. Some firms are owned directly (25% of the firms show an average *position* lower than 1.40), with few ownership links with other group firms. The typical pyramid is not deep (the 75th percentile of the *position* variable is approximately 2.5). Thus, while many *chaebol* firms are owned through pyramids, most of the time there is only one intermediate firm between the firm in question and the family.

Regarding *centrality*, the main pattern is that only a few firms are central for the group structure. The 75th percentile of *centrality* is zero. Similarly, the median aggregate stake held by group firms in other firms is zero, and the 75th percentile is just 3.5%. Again, this statistic suggests that only a small fraction of firms hold substantial stakes in other firms.

Most *chaebol* firms are private (74% of firm-years involve unlisted firms). The median *chaebol* firm is 13 years old and has 190 employees. Therefore, despite the presence of a few very large firms in the sample, a typical *chaebol* involves many firms that are small, young and privately held.

The summary statistics also show that 25% of the firm-years involve firms in indirect cross-shareholding loops. The fraction of firms participating in cross-shareholding loops may seem surprising, given the Korean regulation restricting direct cross-shareholdings. However, out of the 893 firm-years in which firms are involved in cross-shareholdings, we find that 72% belong to loops involving three firms, 13% are in loops involving four firms, and 6% are in loops involving five firms or more. Thus, Korean *chaebols* appear to circumvent the regulations prohibiting cross-shareholdings by creating loops of three and more firms. The high incidence of cross-shareholdings also underscores the importance of using measures of cash flow and voting rights that can handle the impact of cross-shareholdings.

In Panel B, we present the simple correlations among the ownership variables and the other firm characteristics in Panel A. The correlations show that public firms, central firms and firms in cross-shareholding loops tend to be higher up in the group structure (negative correlation with *position*). These variables are also correlated among themselves, that is, central firms are more likely to be public and belong to loops. Regarding firm characteristics, central firms are on average older, larger, and more likely to be public than other group firms. The same pattern holds for cross-shareholdings, which are more common among public, larger, and older firms. *Position*, in turn, is negatively correlated with age, public status and the number of employees.

The measures of cash flow rights and separation between ownership and control display expected patterns. The family has higher ultimate ownership in private, and smaller firms. *Position* is positively correlated with both of the separation measures, indicating that firms in pyramids have higher separation between ownership and control. While the two measures of separation are positively correlated, they show different correlations with some variables. Central firms have lower separation according to the VR measure, but (weakly) higher separation according to the CC measure of control. Firms with high VR separation are much more likely to be younger and private, but these patterns are not observed if we measure separation using CC. These summary statistics suggest that the two measures of separation have different distributions in our data, and therefore, it is important to control for both in the empirical tests that we present below.

4.1.2 The typical structure of a Korean *chaebol*

Figure 2 summarizes the statistics above by charting the ownership structure of the typical *chaebol*. We can think of a typical *chaebol* structure as being organized in three layers. Some firms (firms 1, 2 in the figure) are owned directly at the very top of the group (a *position* value close to 1), without ownership links to the other firms. The middle layer contains firms that belong to cross-shareholding loops, and also central firms (firms 3, 4 and 5). Unlike the firms in the top layer, firms in this middle layer hold equity stakes in other *chaebol* firms, including other firms in the middle layer and firms in the bottom layer (such as firms 6, 7, etc.). Central firms in the middle layer tend to be public, and they are, on average, larger and older than other *chaebol* firms. In the bottom layer, in contrast, we observe firms that are more likely to be private, smaller and younger. These firms do not own substantial stakes in other firms. Most chaebol firms belong to this bottom layer.

Overall, this snapshot of *chaebol* structure is largely consistent with the historical evolution of *chaebol*s. *Chaebol*s grew as the controlling family used successful (e.g., large, public) group firms to set up and acquire new group firms that are placed at the bottom of the group i.e., those with high *position* values.[28] In particular, the picture in Figure 2 is consistent with Implication 1 that states that central firms should be older than firms that are owned through pyramids.

4.2 Accounting and financial data

In addition to the data obtained from the KFTC, we also used two other databases developed by Korea Listed Companies Association (KLCA) and Korea Investors Service (KIS), respectively, to obtain additional financial information. KLCA and KIS's databases contain information not only on listed companies, but also some private firms that are subject to external audit. We follow the standard procedure of dropping the data on financial institutions (insurance, brokerage and other financial institutions), which comprise 316 firm-years of the 3,545 firm-years of the sample described in section 4.1. These firms are subject to specific regulations and accounting rules that make their financial statements less comparable to the other *chaebol* firms, which are mostly in the manufacturing sector.

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

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

There are similar issues involved in the computation of a measure of Tobin's Q for *chaebol* firms. The market value of a publicly-listed *chaebol* firm includes the value of the equity stakes that this firm holds in other *chaebol* firms, both listed and unlisted. To adjust for this, we derive the value of the equity stakes using the ownership matrix and the equity values of other group firms (for private firms we assume that the value of equity equals its book value). We compute "stand alone Q" by:

$$Q_{sa} = \frac{EV + \text{Book value of liabilities - Value of equity stakes}}{\text{Stand alone assets}}. \tag{13}$$

where EV is the market value of equity. The resulting Q measure can be interpreted as the Q that a group firm would have if it were valued as a stand-alone entity.

The main issue with this measure is that, as discussed above, we need to make an assumption about the value of the stakes in private firms.[29] Instead of working with different assumptions, we also use a measure of Q that is unadjusted for the value of equity stakes:

$$Q = \frac{EV + \text{Book Value of Liabilities}}{\text{Book Value of Assets}}. \tag{14}$$

4.2.1 Summary statistics: accounting and valuation data

Table 2, panel A, reports the summary statistics for the accounting and valuation variables. Given data availability and after elimination of some outliers,[30] we end up with a sample of 2,695 firm-years between 1998 and 2004. Our benchmark measure of profitability is stand-alone return on assets (ROA), defined as stand-alone profits divided by stand-alone assets. For comparison, we also report a measure of profitability unadjusted for the equity stakes (ordinary income by total assets). The average unadjusted measure overstates average profitability by a small amount. Naturally, stand-alone assets are lower than total assets because of the adjustment for equity stakes (approximately by 10% on average). Next, we present statistics on the two measures of Q and the equity values that we use to compute them. There are a total of 823 firm-years available for public firms between 1998 and 2004.

[29] This problem does not arise in the computation of stand-alone profits because the financial statements tell us exactly the amount by which the numbers were adjusted.

[30] The data are winsorized at the first and 99th perecentiles, both in terms of stand-alone return on assets and stand-alone Q.

Notice that Q_{sa} and Q have very similar distributions.[31] We also use capital expenditures divided by stand-alone assets to measure capital intensity, and non-current liabilities divided by stand-alone assets to measure leverage.[32]

Panel B displays some of the correlations between the financial and ownership variables. None of the ownership variables seem to be strongly correlated to stand-alone ROA. Stand-alone assets are positively correlated with *centrality* and negatively correlated with *position*, which are the same properties observed for the measure of size in Table 1 (number of employees). Q is negatively correlated with both *centrality* and separation between ownership and control, but only if such separation is measured using the CC measure of control. Finally, notice that capital expenditures are positively correlated with *position*. Several of these correlation patterns will be confirmed in the more fully specified regressions that we present below.

5 Empirical tests

We start with the hypothesis about the relative age of group firms (Implication 1). Then we move on to the hypotheses that relate group structure to accounting and financial variables (Implications 2, 3 and 4).

5.1 Historical evolution of group structure

As explained above, theory suggests that pyramidal business groups are created as the controlling family uses existing group firms to set up and acquire new firms. In the context of Figure 2, Implication 1 suggests that firms in the bottom layer of the group (those with pyramidal ownership) should be younger than central firms. It is less clear whether firms in the top layer of the group (non-central firms with direct ownership) should also be younger than the central firms. Note that the top layer can include young firms that the family chose to control directly, but also older firms that have not become central firms.

The evidence in Table 1 that central firms are older and pyramidal firms younger than other group firms is consistent with Implication 1. To provide additional evidence, we use two different specifications that relate age to the firm's placement in the group structure. First, we regress the *centrality* measure in the firm's age. We include group dummies since we want to show that, within each group, central firms tend to be the older ones. We also include year dummies and other firms characteristics (size and public status), since public and larger firms could be both older and more likely to be central. In the second specification, we regress the firm's *position* on the age variable. In addition to the same set of controls used in the first specification, we also control for *centrality*. This regression allows us to

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

[32] Korean cash flow statements disaggregate gross investments in tangible assets (e.g., *increase in buildings*) from the liquidation of tangible assets (e.g., *decrease in buildings*). Our capital expenditure measure is the sum of all gross investment items minus the sum of all liquidation items (e.g., net capital expenditures).

compare the age of firms in the bottom layer of the group (which tend not to be central) with the age of firms owned directly by the family, but which are also not central for group control. All standard errors are clustered at the firm level.

Table 3 presents the results. The first regression shows that, within each group, older firms are more likely to be central. Age and *centrality* continue to be correlated even after controlling for other firm characteristics such as public status and size, which are also related to *centrality*. The age coefficient in column (2) implies that 15 additional years of age are associated with an increase in *centrality* of 0.012, which is close to the average value of *centrality* in Table 1.[33] Consistent with expectations, public and larger firms are also more likely to be central. Columns (3) and (4) show that age is also related to *position* in a way that is consistent with Implication 1. The age coefficient in column (4) implies that 15 years of age decrease *position* by approximately 0.2, or 10% of the average *position*. Finally, notice that *position* is negatively related to age even after controlling for *centrality* (column (5)). This implies that even among non-central firms, those in lower tiers of the pyramid are, on average, younger than those at the top of the group. Overall, these results largely support Implication 1.

5.2 Pyramids, profitability and capital intensity

Implications 2 and 3 relate the profitability and capital intensity of group firms to their *position* in the group. In particular, in terms of the structure in Figure 2, the theory predicts that firms with lower profitability and higher capital intensity should be placed in the bottom layer of the group. The theory has no clear prediction about the relative profitability and capital intensity of the central firms (those at the middle layer of Figure 2).

In order to test Implications 2 and 3, we use the following empirical model:

$$\begin{aligned} Position_{i,t} &= \alpha_1 \text{Stand-alone } ROA_{i,t-1} + \alpha_2 Capex_{i,t-1} + \boldsymbol{\beta}\mathbf{Controls}_{it} + \\ &\quad + \sum_j industry_j + \sum_t year_t + \varepsilon_{i,t}, \end{aligned} \tag{15}$$

This regressions test whether lagged profitability and lagged capital expenditures predict a firm's position in the group. Implication 2 suggests that the coefficient α_1 should be negative, and Implication 3 suggests that the coefficient α_2 should be positive. We use lagged accounting variables because the theory on group formation suggests that profitability and capital intensity should predict pyramidal ownership, and not the other way around. We recognize, though, that simply lagging the performance variables is not sufficient to prove causality, and we address the issue of causality in greater detail below. The vector of controls include firm size (measured by the log of stand-alone assets), age and public status, leverage, *centrality*, and, in some specifications, the measures of separation between ownership and control. We control for size, age and public status because all these variables seem to be correlated with *position* (see Tables 2 and 3), and they could also be related to performance. Controlling for leverage is important because the profitability measure that we use is computed after interest payments. We control for *centrality* since the theoretical prediction is

[33] The coefficients on firm age are multiplied by one hundred.

specifically about firms that are not central for the control of the group.[34] In addition, we control for separation between ownership and control because the standard arguments in the literature suggest that the link between pyramidal ownership and profitability (in particular) is due to the separation between ownership and control induced by pyramids. We also control for industry and year fixed effects. The industry classification corresponds roughly to a 2-digit SIC classification in the US (there are 45 different industries in the sample). In some specifications, we also include group fixed effects to measure within-group effects. The standard errors are clustered at the level of the firm.

The results are reported in Table 4. Column (1) shows that both lagged profitability and lagged capital expenditures are correlated with *position* in a way that is consistent with Implications 2 and 3. The control variables have the expected sign. For example, central and older firms are more likely to be at the top of the group. The next regressions (columns (2) and (3)) include our two proxies for separation between ownership and control (separVR and separCC). As expected, these variables are correlated with *position*. Nevertheless, profitability and capital expenditures retain their explanatory power. These results suggest that the relation between profitability and pyramidal ownership that we uncover is not due to the separation between ownership and control induced by pyramids. Finally, in columns (4) to (6), we introduce group fixed effects. The results suggest that ,*within groups,* firms owned through pyramids are less profitable and more capital intensive than those owned directly. These results are consistent with Implications 2 and 3.[35]

5.2.1 Are the results due to separation between ownership and control?

The traditional theory of pyramids argues that pyramids are created to separate ownership and control. If low profitability, for example, is correlated with high private benefits of control, then the traditional story would suggest that low profitability should predict larger separation between ownership and control. While we have already controlled for measures of separation in Table 4, we can also check whether lagged profitability and capital intensity indeed predict separation by estimating the following regression:

$$\begin{aligned} Separation_{i,t} \;=\; & \alpha_1 \text{Stand alone } ROA_{i,t-1} + \alpha_2 Capex_{i,t-1} + \boldsymbol{\beta}\mathbf{Controls}_{it} + \\ & + \sum_j industry_j + \sum_t year_t + \varepsilon_{i,t}. \end{aligned} \tag{16}$$

The results are presented in Table 5. Clearly, there is no correlation between capital intensity and the separation between ownership and control. The results show some weak evidence that lagged profitability is also correlated with the separation between ownership

[34] We have also experimented with specifications in which we eliminate central firms from the sample. These tests yield results that are qualitatively similar to those reported here.

[35] In unreported regressions (available from the authors), we replace our continuous measure of position with a dummy variable that creates a stronger contrast between pyramidal and direct ownership. Specifically, we construct a variable called *pyramid*, which is equal to one if the average position of a group firm is larger than two (a natural cutoff for pyramidal ownership), and is equal to zero if the average position is in the 25th percentile or lower. The goal of this variable is to show that the results in Table 4 are in fact driven by differences in profitability and capital across firms in the top and bottom layers of the group. We find very similar results to those reported in Table 4.

and control (columns 1 and 2). However, the correlation is weaker or non-existent, once we control for *position* (column 3 and 4). Finally, notice that there is no correlation between profitability and separation, after controlling for group dummies (columns 5 and 6).[36] Thus, the evidence indicates that the correlations between lagged profitability and lagged capital intensity with *position* cannot be explained by the traditional argument.[37]

5.2.2 Does profitability predict pyramidal ownership?

While the negative correlation between profitability and *position* reported in Table 4 is consistent with Implication 2 that low profitability firms are placed in pyramids, it is possible that such correlation is driven by reverse causality. For example, it could be that the separation of ownership and control in firms lower down in the pyramid causes agency problems that ultimately affect their profitability. Indeed, the previous literature has interpreted this correlation in this way.

To provide further evidence that low profitability causes firms to be placed lower down in the pyramid, we exploit the dynamic nature of our data. Specifically, we have 303 firms that are appear as *chaebol* firms for the first time in our sample window. For 161 of these firms, we also have data on performance the year before they are added. While the size of this sample is drastically reduced when compared to Table 4, examining a firm's profitability *before* it is added to a *chaebol* allows for sharper tests of causality. To wit, if lower profitability does predict pyramidal ownership (Implication 2), then the relationship uncovered in Table 4 should also hold if we measure the firm's profitability before it became a *chaebol* firm. Presumably, a firm's profitability in the year prior to becoming a *chaebol* firm cannot be affected by the ownership structure chosen by the *chaebol*'s controlling family. However, pre-*chaebol* profitability should explain the firm's ownership structure, according to Implication 2.

Table 6 contains the results. In columns (1) to (3), we run the regression in Equation (15) using *only* new firms.[38] Low profitability continues to predict that the new firm will be controlled through a pyramid (high *position*). This result holds irrespective of whether we control for separation between ownership and control (columns (2) and (3)), or not (column (1)). These results clearly support the direction of causality suggested by Implication 2. If anything, the economic magnitude of the profitability effect increases after considering only the sample of new firms. In column (3), for example, the estimates imply that a one standard-deviation in profitability increases the *position* of the firm in the group by approximately 0.12 (which corresponds to 14% of the overall standard deviation of the *position* variable according to Table 1).

In columns (4) to (7), we examine the degree of separation between ownership and control as a function of pre-*chaebol* profitability. That is, we estimate Eq. 16 for the sample of new firms. If profitability is a proxy for private benefits, the traditional theory of pyramids

[36]This result is not inconsistent with the previous empirical literature, because as far as we know, no other empirical paper has examined the *within-group* correlation between profitability and separation between ownership and control. In addition, in Table 5 we lag the profitability measure whereas the existing literature looks at the contemporaneous relationship between separation and profitability.

[37]See also the results described below, in columns (4) to (7) of Table 6.

[38]We cannot include group dummies in these regressions due to the small sample size.

would predict a negative coefficient on profitability. However, as in Table 5, there is very weak evidence that this is the case. Profitability does not predict separation, if we use the CC measure of control. It does predict separation if we use the VR measure, but only if we do *not* control for the firm's *position*. These results further suggest that the selection of low profitability firms into pyramids cannot be explained by the family's desire to separate ownership and control.

5.3 Valuation and centrality

We now test Implication 4 that central firms should trade at a discount relative to non-central firms in the group. According to theory, this valuation discount is due to minority shareholders' anticipation of future pyramidal investments by central firms. We run the following regression:

$$Q_{i,t} = \gamma_1 central_{i,t} + \boldsymbol{\mu}\mathbf{Controls}_{it} + \sum_j industry_j + \sum_t year_t + \varepsilon_{i,t,} \tag{17}$$

where the controls include firm size (measured by the market value of total assets), age and public status, leverage, capital expenditures (to control for growth opportunities), and stand-alone ROA (to control for current profitability). In some specifications, we control for measures of separation to ensure that the traditional story cannot explain away our findings. To measure *centrality*, we use both the benchmark measure (Equation (10)), and also the firm i's aggregate equity stake in other firms normalized by firm i's assets (Equation (11)). We also include the *loop* variable among the controls because, as explained in Section 5.1, central firms also tend to be part of cross-shareholding loops. We control for industry and year fixed effects, and standard errors are clustered by firm. Implication 4 suggests that the coefficient γ_1 should be negative.

Table 7 presents the results. Column (1) indicates that *centrality* is negatively related to firm valuation. The other variables have the expected signs. Larger and younger firms have higher Q, as do firms with high growth opportunities, proxied by their capital expenditures. There is also some indication that firms in cross-shareholding loops also trade at a discount, though this effect is not significant statistically. These results essentially remain the same after controlling for the separation between ownership and control (columns (2) and (3)). Interestingly, only the measure based on the *critical control threshold* is significant in these regressions, with the standard negative sign that other papers in the literature have documented. In columns (4) to (6), we include group dummies in the empirical model. The results also hold within groups, suggesting that, in each group, central firms carry lower valuations than other group firms. These results support Implication 4.

The magnitude of central firms' valuation discount also appears significant. The distribution of the *centrality* variable is very modal (see Table 1), with 75% of the firms having a zero value for *centrality* while a few firms (5% of the sample) have *centrality* values greater than 10%. If we look at these extremes, the coefficients on Table 7 (which range approximately from 0.4 to 0.6) imply that a firm with *centrality* value equal to 10% would have a Q that is 4.5% to 6.5% lower than a firm with zero *centrality*.[39]

[39] This calculation assumes that other variables are evaluated at their unconditional averages, that is, the discount is 4.5% to 6.5% of average Q (which is 0.9 in our data according to Table 2).

Table 8 presents some important robustness checks. Given the difficulties in measuring control, which is a crucial component of our *centrality* measure, we also use the *stake* variable. Since *stake* does not depend on our measure of control, these tests help alleviate concerns that the results are driven by the particular control measure we used. The results in columns (1) to (3) suggest that this is not the case - *stake* is also negatively related to firm valuation. In columns (4) to (6), we vary the definition of Q that we use to value *chaebol* firms. Given the difficulty to adjust Q for the values of equity stakes (see Section 4.2), we use unadjusted Q in our benchmark regressions. However, the results in columns (4) to (6) suggest that the results are robust to using Q_{sa} (the implied stand-alone market-to-book ratio of *chaebol* firms) in the valuation regressions.

In addition to the systematic evidence, there are many examples of the low valuation of central *chaebol* firms. A well known case is that of SK Corporation, the most central firm in the SK group. 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. The value of these equity stakes alone (i.e., assuming a zero value for the stakes in private firms) was 4.4 billion dollars. Thus, the implied equity value of SK Corporation's stand alone 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 of liabilities equal to 8.1 billion dollars). If we add the entire amount of the book liabilities to SK Corporation's stand alone equity value, we obtain a stand alone market value of 6.6 billion dollars for SK Corporation. Under these assumptions, the implied stand-alone Q (Q_{sa}) of SK Corporation was 0.68 in December 2003. The true Q_{sa} was likely to be even lower, because the stakes in private firms are not worthless, and because the book value of liabilities probably overestimates the true market value of debt of SK corporation.

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 Corporation shares in the market during 2003 and started issuing takeover threats. Sovereign's attack subsequently raised SK Corporation's equity value. As a result, by December 2004, SK Corporation's Q_{sa} had increased to 0.92.

The initial low valuation of SK Corporation is consistent with the argument that central firms should be discounted due to anticipated pyramiding. In addition, the increase in its market value after the Sovereign Fund amassed a large stake might be due to the market's realization that the large blockholder would prevent some of this pyramiding.

5.3.1 Discussion: central firms' valuation discount

The key characteristic of central firms is that they hold substantial equity stakes in other firms. Thus, the finding that central firms have low valuations bears 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.[40] In particular, some of the explanations developed to explain the closed-

[40] See Rommens, Deloof and Jegers (2008), for related evidence using data from Belgian holding companies.

end fund puzzle bear some resemblance to Implication 4. It is possible, for example, that shareholders of the closed-end fund expect poor portfolio management in the future (similar to Implication 4). Nevertheless, not all arguments regarding the closed end fund puzzle seem equally relevant. For example, the investor sentiment story explained in Shleifer (2000) applied to the *chaebol* context would require individual investors to be more likely to trade shares of the parent company relative to the subsidiaries. Although we do not examine this issue directly in this paper, there is no reason to expect that condition to hold in the Korean data.

Cornell and Liu (2001), Mitchell, Pulvino and Stafford (2002) and Lamont and Thaler (2003) provide evidence on another phenomenon that bears some resemblance to the central firm discount (the "parent company discount"). 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. Lamont and Thaler (2003) show some extreme examples of potential misvaluations (such as the Palm and 3Com example), in which a commitment by the parent to spin-off the shares of the subsidiary at a fixed rate in a future date creates an apparently clear "arbitrage" opportunity.[41] The standard explanation for this phenomenon in the US is that it is due to noise traders bidding up the prices of the subsidiary stocks, and arbitrage costs that make a price correction difficult to sustain (a large fraction of the firms analyzed in these studies are in the internet sector). We believe this market inefficiency story is also not likely to explain the central firm discount in Korea. First, the Korean phenomenon seems to be more general and persistent than the internet bubble-related discounts in the US. In particular, the subsidiaries of central Korean firms are not concentrated in any particular industry. Second, given the particular governance and ownership characteristics of Korean corporate finance, it seems a priori very likely that the valuation discount should be linked to agency issues related to family control of business groups rather than mispricing of *chaebol* firms.[42]

6 Final remarks

The main contribution of this paper is to analyze the determinants of group ownership structure in light of existing theoretical arguments. In doing this, we depart from the standard approach of assuming that ownership structure is exogenously given. We take advantage of a unique dataset that allows us to observe the details of the ownership structure of Korean *chaebols*, and to have a small window on how *chaebol* structure evolves over time. We see this paper as a first step towards the understanding of the evolution of business groups. Naturally, many questions are open for future research.

First of all, it would be interesting to see if our findings about group structure are particular to Korean *chaebol*s or if they extend to groups in other countries as well. For that

[41] 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. Ross (2004) offers a rational explanation for this phenomenon.

[42] 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.

purpose we note that the metrics of ownership structure that we derive in the paper (such as the *critical control threshold*, *position*, and *centrality*) can be easily applied to other data. To facilitate the implementation of our measures, we provide algorithms that can be used to calculate these variables for groups of any complexity.

Second, while our short time series allows us to observe a few major changes in ownership structure (such as the addition of new firms to the group), there are many questions that require a longer time series. For example, besides observing that central firms are the most established firms in the group, we have little to say about how the family chooses central firms among several candidate group firms. Given that *centrality* changes little over time, addressing such a question requires a much longer time series than the one we currently have.

Third, we have focused exclusively on understanding the family's choice of ownership for *chaebol* firms, ignoring the question of why a given firm becomes a *chaebol* member in the first place. Clearly, understanding the selection of firms into *chaebol* is an essential component of a complete theory of business group structure. In addition, while we have taken the presence of cross-shareholdings into account to compute our ownership measure, we have not attempted to understand the reasons that motivate the family to create cross-shareholding loops among chaebol firms. Both of these questions could be analyzed in future research.

References

Aganin, Alexander, and Paolo Volpin, 2005, History of corporate ownership in Italy, in Randall Morck, ed.: *The history of corporate governance around the world: Family business groups to professional managers* (University of Chicago Press, Chicago, IL).

Almeida, Heitor, and Daniel Wolfenzon, 2006, A theory of pyramidal ownership and family business groups, *Journal of Finance* 61, p. 2637-2681.

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

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

Baek, Jae-Sung, Jun-Koo Kang , and Kyung Suh Park, 2004, Corporate governance and firm value: evidence from the Korean financial crisis, *Journal of Financial Economics 71,* pp. 265-313.

Baek, Jae-Sung, Jun-Koo Kang , and Inmoo Lee, 2006, Business groups and tunneling: Evidence from private securities offerings by Korean *chaebol*s, *Journal of Finance* pp. 2415-2449.

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

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

Bebchuk, Lucien, Kraakman, Reinier and George Triantis, 2000, Stock pyramids, cross-ownership, and dual class equity: The creation and agency costs of separating control from cash-flow rights, in *Concentrated Corporate Ownership* (R. Morck, ed.), pp. 445-460.

Bennedsen, M. and K. Nielsen, 2007, The principle of proportional ownership, investor protection and firm value in Western Europe, working paper, Copenhagen Business School and CEBR.

Berle, Adolph A., and Gardiner C. Means, 1932, *The modern corporation and private property*, (McMillan, New York).

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

Bertrand, M., Johnson, S., Samphantarak, K. and Schoar, A., 2004, Mixing family with business: A dtudy of Thai business groups and the families behind them, forthcoming, *Journal of Financial Economics*.

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

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

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

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

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

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

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

Cornell, Bradford, and Liu, Qiao, 2001, The parent company puzzle: When is the whole worth less than one of the parts?, *Journal of Corporate Finance* 7: 341–66.

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

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

Flath, David, 1992, Indirect shareholdings within Japan's business groups, *Economics Letters* 38: 223-227.

Franks, Julian, and Colin Mayer, 2001, Ownership and control of German corporations, *Review of Financial Studies* 14, 943-977.

Franks, Julian, Colin Mayer, Paolo Volpin and Hannes F. Wagner, 2008, Evolution of family capitalism: A comparative study of France, Germany, Italy and the UK. Working paper.

French, Kenneth R. and James M. Poterba, 1991, Were Japanese stock prices too high?, *Journal of Financial Economics* 29: 337-363.

Gopalan, R., V. Nanda and A. Seru, 2006, Affiliated firms and financial support: Evidence from Indian business groups, *Journal of Financial Economics* 86 (3), 759-795.

Gopalan, R., V. Nanda and A. Seru, 2007, Do business groups use dividends to fund investments?, working paper.

Graham, Benjamin, and David L. Dodd, 1934, *Security analysis* (McGraw-Hill, New York.)

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

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

Kang, Hyung Cheol, Kyung Suh Park and Hasung Jang, 2006 a, The choice of group structure: Divide and rule, *The Korean Journal of Finance* 19: 188-230 (in Korean language).

Kang, Hyung Cheol, Kyung Suh Park and Hasung Jang, 2006b, Determinants of internal transactions among the member firms of Korean conglomerates, *The Korean Journal of Finance* 19: 77-118. (in Korean language)

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

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

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

Khanna, Tarun and Caterine Thomas, 2005, Relationships and stock price comovements: Evidence from an emerging market. Working paper, HBS.

Khanna, Tarun and Yishay Yafeh, 2007, Business groups in emerging markets: Paragons or parasites? Forthcoming, *Journal of Economic Literature.*

Kim, W. and T. Sung, 2006, What makes group-affiliated firms go public? working paper, KDI School of Public Policy and Management.

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

Lamont, Owen, and Richard Thaler, 2003, Can the market add and subtract? Mispricing in tech stock carve-outs, *Journal of Political Economy,* p. 227-268.

Leontief, Wassily, *Input-output economics*, 2nd ed., New York: Oxford University Press, 1986.

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

Masulis, Ronald, Peter Kien Pham, and Jason Zein, 2008, Pyramids: Empirical evidence on the costs and benefits of family business groups. Workig paper.

Marisetty, Vijaya, and Marti Subrahmanyam, 2008, Group affiliation and the performance of initial public offerings in the Indian stock market, *Journal of Financial Markets*, forthcoming.

Mitchell, Mark, Todd Pulvino, and Erik Stafford, 2002, Limited arbitrage in equity markets, *Journal of Finance* 57: 551–84.

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

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

Rommens, An, Marc Deloof and Marc Jegers, 2008, Why do holding companies trade at a discount? A clinical study, working paper.

Ross, S., 2004, *Neoclassical Finance.* Princeton University Press.

Shleifer, A., 2000. *Inefficient markets: An introduction to behavioral finance.* Oxford University Press.

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

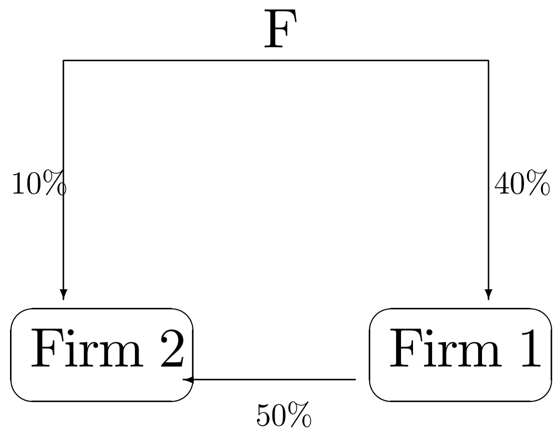

Figure A1: A simple group

A Numerical examples of *position*, voting rights and centrality

We illustrate the computation of our main ownership measures using a simple example. The group is represented in Figure A1. The family owns a 40% direct stake in firm 1 and a 10% direct stake in firm 2. In addition, firm 1 owns a 50% stake in firm 2. While this simple structure is not representative of real world *chaebol* structures, it can help the reader understand the logic behind the new measures.

Cash flow rights

Cash flow rights are easy to compute. The family's cash flow rights in firm 1 are 40% and in firm's 2 are 10% + (40%)(50%) = 30%.

Position

Firm's 1 *position* is clearly equal to 1 as there is only one chain leading to that firm. The formula we propose leads to the same answer: $\frac{.4}{.4} \cdot 1 = 1$. Regarding firm 2, the family holds the direct stake of 10%, and it also retains a 20% ownership stake through firm 1. Our formula yields:

$$pos_2 = \frac{0.1}{0.3} \cdot 1 + \frac{0.2}{0.3} \cdot 2 = 1.7. \tag{18}$$

This is intuitive, since firm 2's ownership is close to a pure pyramid (the biggest stake is held through firm 1), but it is not a pure pyramid because of the direct stake of 10%.

Voting rights

Take, for example, a control threshold equal to 30% ($T = 30\%$). In that case, the family controls firm 1 (since it holds 40% of its votes). According to our formula, the family has 50% of the votes in firm 2 (10% directly and 50% through firm 1, which it controls). Thus, the family also controls firm 2. Clearly, the family controls both firms for any control threshold lower than or equal to 40%. Thus:

$$C(T) = \{1, 2\} \text{ for any } T \leq 40\%. \tag{19}$$

For T above 40%, the family no longer cotrols firm 1. Also, the votes it controls in firm 2 are only 10% (we no longer add the 50% since for $T > 40\%$ the family does not control firm 1). Thus, the family does not control firm 2 either:

$$C(T) = \emptyset \text{ for any } T > 40\%. \tag{20}$$

It follows that the *critical control threshold* measures are:

$$CC_1 = CC_2 = 40\%. \tag{21}$$

The VR measures for any $T \leq 40\%$ are:

$$\begin{aligned} VR_1 &= 40\% \\ VR_2 &= 10\% + 50\% = 60\%. \end{aligned}$$

The VR measure adds the entire stake held by firm 1 in firm 2 to the direct stake of 10%, as long as the family retains control of firm 1. If $T > 40\%$, VR_2 drops to 10%.

Centrality

To compute *centrality* measures we compute the average *critical control threshold* with and without the relevant firm. Let's start with firm 2. We know that $CC_1 = 40\%$. If we eliminate firm 2 from the group and recompute CC_1, we would still have $CC_1 = 40\%$. This implies that elimating firm 2 from the group does not affect the average voting rights in other group firms. Accordingly, the *centrality* of firm 2 is 0.

In contrast, if we eliminate firm 1, the family will only control firm 2 if $T \leq 10\%$. That is, CC_2 goes to 10%. Thus:

$$central_1 = \frac{40\% - 10\%}{1} = 30\%.$$

B Computing the set $C(T)$

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

Definition 6 *(Algorithm) Let the sequence of sets* $S(0) \supseteq S(1) \supseteq S(2)...$ *be defined by* $S(0) = N$, *and* $S(n+1) = \{i \in S(n) : f_i + \sum_{j \in S(n),\, j \neq i} s_{ji} \geq T\}$.

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

Proposition 4 *$S(\sharp N)$ satisfies condition (8) which we re-write here:*

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

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

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

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

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

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

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

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

$$f_k + \sum_{j \in S(\sharp N),\, j \neq i} s_{jk} \geq T. \tag{22}$$

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

$$T > f_k + \sum_{j \in S(n-1),\, j \neq k} s_{jk} \geq f_k + \sum_{j \in S(\sharp N),\, j \neq k} s_{jk}, \tag{23}$$

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 22 and 23 cannot hold at the same time. Putting together steps 2 and 3 leads to the statement of the Proposition.■

One problem that we need to address is the existence of multiple sets that satisfy condition 4. Consider the example in Figure A2, and assume that $T = 25\%$. Clearly, we have that $C(25\%) = \{1, 2, 3\}$ because the set $\{1, 2, 3\}$ satisfies condition 4. However, the null set also satisfies condition 4 for the same control threshold. To see this, suppose that the family

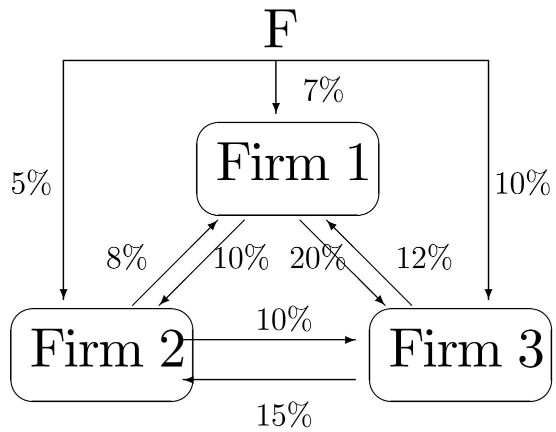

Figure A2: A complex group with many cross-shareholdings

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 8 and at the same time has the maximum number of firms. We can prove the following Proposition.

Proposition 5 *Consider all possible sets of firms that satisfy condition 8 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 8. This is important since it removes the arbitrariness of picking a set among many. Second, the proposition tells us that the outcome of the algorithm is precisely the set we are looking for.

The proof of this result is divided into two steps.

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

By Proposition 4, we know that $S(\sharp N)$ satisfy Condition 8, 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 8 the following is true:

$$\text{For all } k \in C_m,\ f_k + \sum_{j \in C_m,\ j \neq k} s_{jk} \geq T \tag{24}$$

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

$$T > f_k + \sum_{j \in S(n-1),\, j \neq k} s_{jk} \geq f_k + \sum_{j \in C_m,\, j \neq k} s_{jk}, \tag{25}$$

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 24 and 25 cannot hold at the same time. This proves step 2. Finally, putting together steps 1 and 2 leads to the statement of the proposition.■

C Accounting measures of stand-alone assets and stand-alone profits

After January 1st, 2003, the item 'stocks accounted in equity method' (code number KLCA 123560) reports the aggregate book value of the shares subject to the equity method. Before 2003, however, 'stocks accounted in equity method' was not separately recorded but pooled into all investment securities. The data are available from the footnotes to financial statements, which we examined to calculate this item for the remaining years. Regarding profits, the profits coming from affiliate companies (call it "equity method profits") are recorded in two items in the non-operating portion of the income statement of parent companies. If equity method profits are positive, they are called "Gain on valuation of Equity Method" (KLCA # 242100). If they are negative, they are called "Loss on valuation of Equity Method" (KLCA # 252600).

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

$$\text{Stand-alone Assets} = \text{Total Assets - Equity Method Stock}, \tag{26}$$

and:

$$\text{Stand-alone Profits} = \text{Total Profits - Gains from Equity Method} + \text{Losses from Equity Method}, \tag{27}$$

where we define stand-alone 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 stand-alone 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 27 (specifically, we use *ordinary income* to measure total profits).

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

Table 1: Summary Statistics of Ownership Variables and Firm Characteristics

Panel A presents summary statistics of ownership variables of Korean *chaebol* firms for the period 1998-2004. Data is from the Korean Fair Trade Commission (KFTC). The variables are defined in detail the text (see Section 3). *Ultimate ownership* is a measure of the family's cash flow rights, and *VR* (*consistent voting rights*) and *CC* (*critical control threshold*) are two alternative measures of voting rights. *Separation CC* and *separation VR* are defined, respectively, as *CC* minus *ultimate ownership*, and VR minus *ultimate ownership*. *Position* is a measure of the distance of a firm relative to the controlling family in the group structure. *Centrality* is the average drop in voting rights when a firm's votes are not taken into account to compute *CC* for the other group firms. *Stake* is the book value of equity stakes held by a *chaebol* firm in other firms, normalized by assets. *Cross-shareholdings* takes a value of 1 if the firm belongs to a cross-shareholding loop. *Public* is a variable that takes the value of 1 if the firm is publicly traded. Panel B presents the correlation matrix for the variables summarized in Panel A.

Panel A: Basic Statistics

Variable	Mean	StDev	Median	25%	75%	Firm-years
Ultimate ownership	0.21	0.22	0.13	0.05	0.28	3545
VR	0.68	0.28	0.68	0.47	1.00	3545
CC	0.33	0.19	0.30	0.19	0.43	3545
Separation VR	0.47	0.29	0.44	0.23	0.73	3545
Separation CC	0.12	0.11	0.12	0.03	0.19	3545
Position	2.11	0.82	2.06	1.40	2.56	3545
Centrality	0.02	0.05	0.00	0.00	0.00	3521
Stake	0.08	0.34	0.00	0.00	0.04	3545
Cross-shareholdings	0.25	0.43	0.00	0.00	1.00	3545
Public	0.26	0.44	0.00	0.00	1.00	3545
Employees	1198	3755	190	43	840	3545
Firm age	17	14	13	4	26	3545
No.Firms	1085					
No.Groups	47					

Table 1, cont.

Panel B: Correlations among variables in Panel A

	Ult Own	Separ VR	Separ CC	Position	Centrality	Cross-SH	Public	Employees
Separation VR	-0.42							
Separation CC	-0.50	0.28						
Position	-0.52	0.60	0.54					
Centrality	0.10	-0.25	0.06	-0.26				
Cross-SH	-0.06	-0.20	-0.04	-0.18	0.21			
Public	-0.16	-0.44	0.06	-0.23	0.37	0.42		
Employees	-0.09	-0.18	0.01	-0.16	0.24	0.30	0.35	
Firm age	0.01	-0.33	-0.04	-0.31	0.39	0.46	0.59	0.32

Table 2: Summary Statistics of Accounting and Financial Variables

This table presents summary statistics for financial and accounting variables for *chaebol* firms during 1998-2004. Insurance, pension firms and other financial institutions are excluded from the sample. Data is from KLCA and KIS. *ROA* is ordinary income divided by book assets. *Stand-alone ROA* and *assets* are computed after an adjustment that takes into account the effect of equity stakes held in other *chaebol* firms (see Appendix B for details). See Eq. (13) and (14) for the definitions of *Q*, *Qsa*, and the stand-alone market value of equity. *Leverage* is defined as non-current liabilities divided by stand-alone assets. Panel A presents summary statistics, and Panel B presents the correlations among these variables and the ownership measures described in Table 1.

Panel A: Basic Statistics

	Mean	StDev	25%	Median	75%	Firm-years
Stand-alone ROA	0.263	0.124	-0.008	0.030	0.088	2695
ROA	0.027	0.124	-0.006	0.031	0.090	2695
Assets (million USD)	794	2,320	29	110	527	2695
Stand-alone assets (million USD)	714	2,029	27	103	489	2695
Q	0.917	0.324	0.734	0.838	0.994	823
Qsa	0.908	0.363	0.707	0.828	1.011	806
Mkt value of equity (million USD)	2,089	5,191	224	706	1,968	823
Stand alone mkt value of equity (million USD)	1,905	4,833	214	634	1,811	806
Capital expenditures/stand-alone assets	0.056	0.148	0.008	0.029	0.073	2601
Leverage	0.213	0.296	0.043	0.146	0.301	2644

Panel B: Correlations

	Stand-alone ROA	Stand-alone assets	Q	Capex / stand-alone assets	Leverage
Stand-alone assets	0.045				
Q	0.117	0.154			
Capex/stand-alone assets	0.076	-0.005	0.246		
Leverage	-0.251	0.075	-0.004	0.009	
Separation VR	-0.033	-0.190	-0.027	0.068	0.011
Separation CC	-0.003	0.028	-0.101	0.037	0.051
Position	0.037	-0.137	0.082	0.139	-0.021
Centrality	-0.001	0.252	-0.147	-0.057	0.068
Cross-shareholdings	-0.014	0.332	-0.025	-0.092	0.090

Table 3: Historical Evolution of *Chaebol* Structure

This Table presents the tests described in Section 5.1, which examine the relative age of firms in the *chaebol*. The variables are defined in Table 1. *Position* is a measure of the distance of a firm relative to the controlling family in the group structure. *Centrality* is the average drop in voting rights when a firm's votes are not taken into account to compute the *critical control threshold* for the other group firms. *Public* is a variable that takes the value of 1 if the firm is publicly traded. The coefficients on firm age are multiplied by one hundred.

	Dependent variable				
	Centrality	Centrality	Position	Position	Position
	(1)	(2)	(3)	(4)	(5)
Firm age	0.142 ***	0.082 ***	-1.722 ***	-1.287 ***	-1.043 ***
	(8.14)	(5.01)	(-10.88)	(-6.00)	(-4.76)
Public		0.024 ***		-0.152 **	-0.099
		(4.66)		(-2.20)	(-1.43)
No employees		0.000 ***		0.000 ***	0.000 ***
		(3.21)		(-3.23)	(-2.73)
Centrality					-2.707 ***
					(-7.87)
Group FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	3521	3521	3545	3545	3545
R-squared	0.23	0.28	0.30	0.31	0.33

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

Table 4: Determinants of a Firm's Position in the Chaebol

This Table contains the tests described in Section 5.2, which relate a firm's position in the group to firm characteristics (Equation (15)). *Lagged ROA* is equal to the firm's *Stand-alone ROA* in year t -1, and *lagged capex* is capital expenditures / stand-alone assets in year t -1. Ln assets is the logarithm of the book value of assets. *Position* is a measure of the distance of a firm relative to the controlling family in the group structure. *Centrality* is the average drop in voting rights when a firm's votes are not taken into account to compute the *critical control threshold* for the other group firms. *Public* is a variable that takes the value of 1 if the firm is publicly traded. *Separation CC* and *separation VR* are defined, respectively, as *CC* (*critical control threshold*) minus *ultimate ownership*, and *VR* (*consistent voting rights*) minus *ultimate ownership. Leverage* is defined as non-current liabilities divided by stand-alone assets. The coefficients on firm age are multiplied by one thousand.

	Dependent variable: Position					
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged ROA	-0.388 ***	-0.160	-0.230 **	-0.329 **	-0.193 *	-0.239 **
	(-2.61)	(-1.62)	(-2.21)	(-2.12)	(-1.92)	(-2.32)
Lagged Capex	0.323 ***	0.314 ***	0.214 **	0.385 ***	0.359 ***	0.188 **
	(2.69)	(2.78)	(2.20)	(3.55)	(3.58)	(2.05)
Firm age	-4.908 **	-2.586	-1.471	-4.413 *	-2.512	-1.179
	(-2.01)	(-1.27)	(-0.80)	(-1.73)	(-1.22)	(-0.57)
Ln Assets	-0.017	-0.043 **	-0.018	-0.060 **	-0.048 **	-0.048 **
	(-0.73)	(-2.29)	(-0.97)	(-2.59)	(-2.59)	(-2.56)
Public	-0.099	0.307 ***	-0.201 ***	-0.065	0.289 ***	-0.203 ***
	(-1.16)	(4.18)	(-3.01)	(-0.82)	(4.14)	(-3.26)
Leverage	-0.107	-0.100 *	-0.160 **	-0.104	-0.116 **	-0.105 **
	(-1.49)	(-1.88)	(-2.58)	(-1.64)	(-2.31)	(-2.09)
Centrality	-2.661 ***	-2.072 ***	-3.015 ***	-2.495 ***	-2.237 ***	-2.317 ***
	(-6.86)	(-6.58)	(-9.57)	(-5.98)	(-6.69)	(-7.38)
Separation (VR)		1.657 ***			1.560 ***	
		(16.07)			(15.61)	
Separation (CC)			3.528 ***			3.646 ***
			(19.41)			(17.72)
Group FE	No	No	No	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2084	2084	2084	2084	2084	2084
R^2	0.32	0.53	0.54	0.48	0.62	0.64

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

Table 5: Determinants of Separation Between Ownership and Control

This Table contains the tests described in Section 5.2.1, which relate a firm's degree of separation between ownership and control to firm characteristics (Equation (16)). *Lagged ROA* is equal to the firm's *Stand-alone ROA* in year t -1, and *lagged capex* is capital expenditures / stand-alone assets in year t -1. Ln assets is the logarithm of the book value of assets. *Position* is a measure of the distance of a firm relative to the controlling family in the group structure. *Centrality* is the average drop in voting rights when a firm's votes are not taken into account to compute the *critical control threshold* for the other group firms. *Public* is a variable that takes the value of 1 if the firm is publicly traded. *Separation CC* and *separation VR* are defined, respectively, as *CC* (*critical control threshold*) minus *ultimate ownership*, and *VR* (*consistent voting rights*) minus *ultimate ownership. Leverage* is defined as non-current liabilities divided by stand-alone assets. The coefficients on firm age are multiplied by one thousand.

	Dependent variable: Separation using as voting rights					
	VR	CC	VR	CC	VR	CC
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged ROA	-0.137 **	-0.045 *	-0.064 *	-0.008	-0.028	0.003
	(-2.50)	(-1.85)	(-1.73)	(-0.49)	(-0.78)	(0.25)
Lagged Capex	0.006	0.031	-0.055	0.001	-0.052	0.021
	(0.12)	(1.44)	(-1.29)	(0.04)	(-1.29)	(1.50)
Firm age	-1.401	-0.974 **	-0.479	-0.515	-0.429	-0.509 *
	(-1.64)	(-2.23)	(-0.67)	(-1.55)	(-0.60)	(-1.76)
Ln Assets	0.015 **	0.000	0.019 ***	0.002	0.003	0.002
	(1.99)	(0.07)	(3.14)	(0.70)	(0.49)	(0.81)
Public	-0.245 ***	0.029 **	-0.227 ***	0.038 ***	-0.215 ***	0.044 ***
	(-8.68)	(2.31)	(-9.40)	(3.95)	(-9.35)	(5.50)
Leverage	-0.004	0.015	0.016	0.025 **	0.026	0.009
	(-0.14)	(1.20)	(0.68)	(2.29)	(1.32)	(1.36)
Centrality	-0.355 **	0.101	0.145	0.350 ***	0.281 **	0.165 ***
	(-2.20)	(1.21)	(1.11)	(5.04)	(2.40)	(3.42)
Position			0.188 ***	0.094 ***	0.179 ***	0.086 ***
			(17.26)	(16.37)	(15.92)	(18.40)
Group FE	No	No	No	No	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2084	2084	2084	2084	2084	2084
R^2	0.34	0.16	0.55	0.43	0.63	0.60

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

Table 6: Does Pre-Chaebol Profitability Predict Position and Separation?

This Table contains the tests described in Section 5.2.2, which relate a firm's position and separation between ownership and control to firm characteristics (Equations (15) and (16)). These regressions use a sample of firms in the years in which they first appear as a member of a chaebol. *Lagged ROA* is equal to the firm's *Stand-alone ROA* in year t -1, and *lagged capex* is capital expenditures / stand-alone assets in year t -1. Ln assets is the logarithm of the book value of assets. *Position* is a measure of the distance of a firm relative to the controlling family in the group structure. *Centrality* is the average drop in voting rights when a firm's votes are not taken into account to compute the *critical control threshold* for the other group firms. *Public* is a variable that takes the value of 1 if the firm is publicly traded. *Separation CC* and *separation VR* are defined, respectively, as *CC* (*critical control threshold*) minus *ultimate ownership*, and *VR* (*consistent voting rights*) minus *ultimate ownership. Leverage* is defined as non-current liabilities divided by stand-alone assets. The coefficients on firm age are multiplied by one thousand.

	Dependent variable						
	Position			Separ (VR)	Separ (CC)	Separ (VR)	Separ (CC)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lagged ROA	-1.145 **	-0.652 *	-0.912 **	-0.299 **	-0.053	-0.110	0.027
	(-2.57)	(-1.67)	(-2.29)	(-2.12)	(-1.05)	(-0.95)	(0.57)
Firm age	13.728 *	7.617	11.486	3.705 **	0.508	1.439	-0.444
	(1.72)	(1.11)	(1.63)	(2.13)	(0.59)	(0.92)	(-0.56)
Ln Assets	0.017	0.039	-0.053	-0.014	0.016 *	-0.016	0.015 **
	(0.25)	(0.69)	(-0.94)	(-0.77)	(1.90)	(-1.10)	(2.19)
Public	-0.739 ***	-0.135	-0.615 ***	-0.366 ***	-0.028	-0.244 ***	0.023
	(-2.80)	(-0.55)	(-2.65)	(-5.51)	(-0.84)	(-3.65)	(0.79)
Leverage	-0.467	-0.131	-0.403	-0.204 *	-0.014	-0.127	0.018
	(-1.28)	(-0.38)	(-1.41)	(-1.71)	(-0.40)	(-1.20)	(0.64)
Centrality	-3.125	-3.641 *	-3.707	0.313	0.132	0.829	0.349
	(-1.44)	(-1.84)	(-1.36)	(0.56)	(0.37)	(1.55)	(0.88)
Separation (VR)		1.649 ***		0.000 ***	0.000 ***		
		(6.48)		(0.00)	(0.00)		
Separation (CC)			4.411 ***	0.000 ***	0.000 ***		
			(5.68)	(0.00)	(0.00)		
Position						0.165 ***	0.069 ***
						(6.00)	(7.41)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	161	161	161	161	161	161	161
R^2	0.52	0.65	0.66	0.46	0.38	0.61	0.57

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

Table 7: Valuation and Centrality

This Table contains the tests described in Section 5.3, which relate a firm's valuation to firm characteristics (Equation (17)). The dependent variable is Tobin's Q, as defined in Eq. (14). *Size* is the log of the market value of equity. *Centrality* is the average drop in voting rights when a firm's votes are not taken into account to compute the *critical control threshold* for the other group firms. *Separation CC* and *separation VR* are defined, respectively, as *CC* (*critical control threshold*) minus *ultimate ownership*, and *VR* (*consistent voting rights*) minus *ultimate ownership. Leverage* is defined as non-current liabilities divided by stand-alone assets. The coefficients on firm age are multiplied by one thousand.

	Dependent variable: Tobin's Q					
	(1)	(2)	(3)	(4)	(5)	(6)
Centrality	-0.545 ***	-0.564 ***	-0.515 ***	-0.401 **	-0.392 **	-0.402 **
	(-3.69)	(-3.78)	(-3.41)	(-2.36)	(-2.41)	(-2.35)
Cross-shareholdings	-0.051	-0.052	-0.051	-0.043	-0.042	-0.043
	(-1.59)	(-1.59)	(-1.55)	(-1.03)	(-1.00)	(-1.03)
Firm age	-4.302 ***	-4.350 ***	-4.357 ***	-4.614 ***	-4.568 ***	-4.607 ***
	(-3.70)	(-3.67)	(-3.72)	(-3.34)	(-3.24)	(-3.33)
Size	0.089 ***	0.089 ***	0.089 ***	0.091 ***	0.091 ***	0.091 ***
	(6.46)	(6.48)	(6.47)	(5.37)	(5.35)	(5.33)
Stand-alone ROA	0.077	0.077	0.076	0.188	0.187	0.189
	(0.32)	(0.31)	(0.31)	(0.83)	(0.83)	(0.83)
Capex	0.432 *	0.428 *	0.419 *	0.331	0.330	0.331
	(1.94)	(1.93)	(1.89)	(1.57)	(1.57)	(1.57)
Leverage	0.052	0.058	0.058	0.003	0.001	0.002
	(0.38)	(0.43)	(0.43)	(0.02)	(0.01)	(0.02)
Separation (VR)		-0.069			0.031	
		(-0.81)			(0.35)	
Separation (CC)			-0.214 *			0.014
			(-1.89)			(0.12)
Group FE	No	No	No	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	807	807	807	807	807	807
R^2	0.42	0.42	0.42	0.52	0.52	0.52

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

Table 8: Valuation Results: Robustness Checks

This Table contains the tests described in Section 5.3, which relate a firm's valuation to firm characteristics (Equation (17)). In columns (1) to (3), the dependent variable is Tobin's Q, as defined in Eq. (14). In columns (4) to (6), the dependent variable is Q_{sa}, defined in Equation (13). In columns (1) to (3), *Size* is the log of the market value of equity. In columns (4) to (6), *Size* is the log of the stand-alone market value of equity. *Centrality* is the average drop in voting rights when a firm's votes are not taken into account to compute the *critical control threshold* for the other group firms. *Separation CC* and *separation VR* are defined, respectively, as *CC* (*critical control threshold*) minus *ultimate ownership*, and *VR* (*consistent voting rights*) minus *ultimate ownership. Stake* is the book value of equity stakes held by a *chaebol* firm in other firms, normalized by assets. *Leverage* is defined as non-current liabilities divided by stand-alone assets.

	Dependent variable:					
	Tobin's Q			Stand-alone Tobin's Q		
	(1)	(2)	(3)	(4)	(5)	(6)
Stake	-0.202 **	-0.211 **	-0.210 **			
	(-2.34)	(-2.38)	(-2.36)			
Centrality				-0.340 **	-0.350 **	-0.329 *
				(-1.99)	(-2.02)	(-1.89)
Cross-shareholdings	-0.020	-0.019	-0.019	-0.090 ***	-0.090 **	-0.090 **
	(-0.56)	(-0.54)	(-0.53)	(-2.63)	(-2.61)	(-2.61)
Firm age	-4.820 ***	-4.871 ***	-4.822 ***	-4.737 ***	-4.755 ***	-4.767 ***
	(-4.04)	(-4.00)	(-4.01)	(-3.63)	(-3.61)	(-3.63)
Size	0.076 ***	0.075 ***	0.076 ***	0.113 ***	0.113 ***	0.113 ***
	(5.55)	(5.53)	(5.61)	(7.66)	(7.66)	(7.65)
Stand-alone ROA	0.123	0.125	0.119	0.129	0.128	0.129
	(0.50)	(0.51)	(0.49)	(0.50)	(0.50)	(0.51)
Capex	0.433 *	0.430 *	0.412 *	0.368	0.365	0.363
	(1.93)	(1.92)	(1.85)	(1.62)	(1.60)	(1.59)
Leverage	0.044	0.048	0.053	0.131	0.134	0.133
	(0.32)	(0.35)	(0.39)	(0.92)	(0.95)	(0.94)
Separation (VR)		-0.054			-0.035	
		(-0.62)			(-0.37)	
Separation (CC)			-0.273 **			-0.084
			(-2.43)			(-0.68)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	814	814	814	790	790	790
R^2	0.41	0.41	0.42	0.44	0.45	0.45

Figure 1. Ownership Structure of Hyundai Motor in 2004

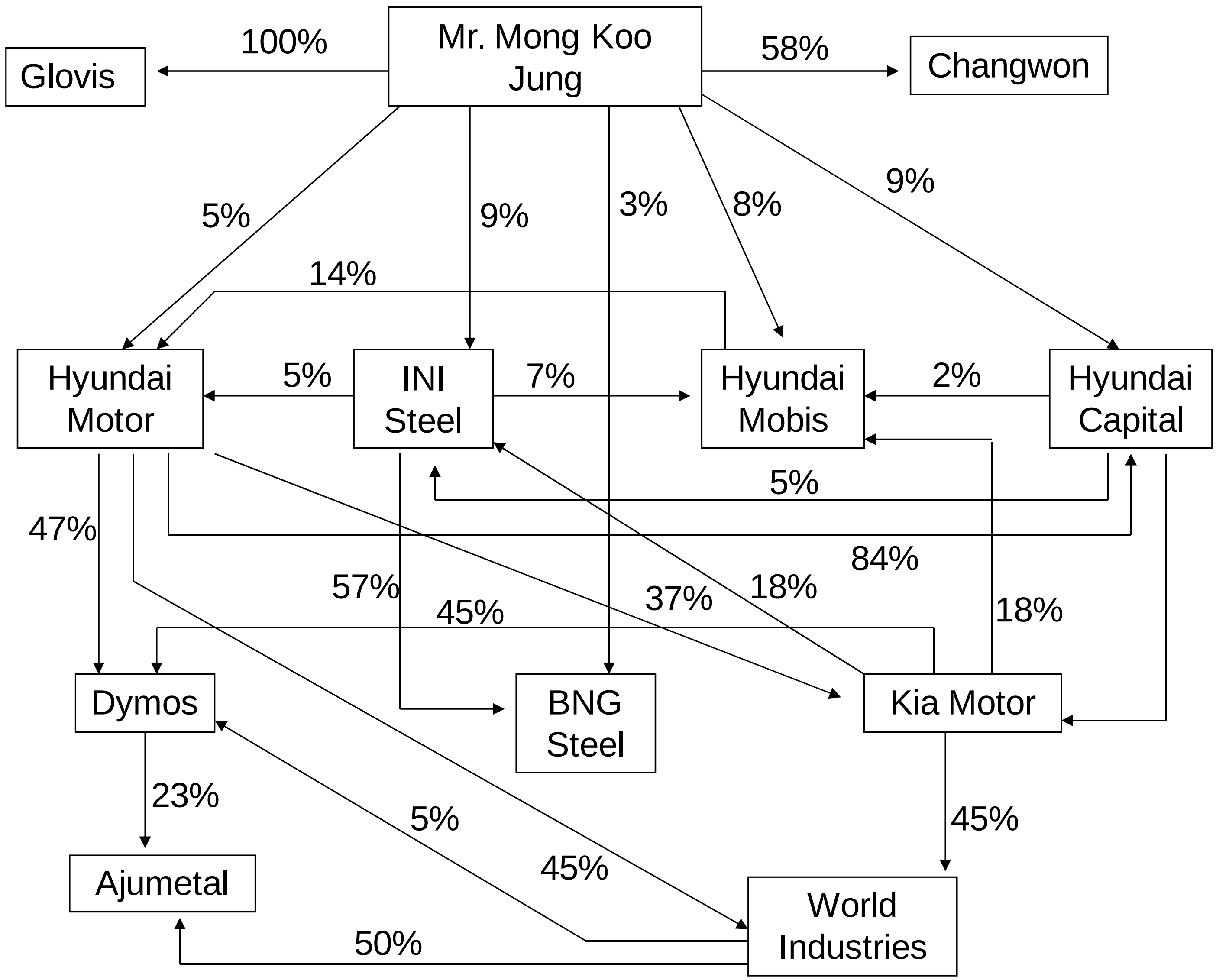

Figure 2. Average Ownership Structure of a Korean Chaebol, 1998-2004