THE JOURNAL OF FINANCE • VOL. LXI, NO. 6 • DECEMBER 2006

A Theory of Pyramidal Ownership and Family Business Groups

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ABSTRACT

We provide a new rationale for pyramidal ownership in family business groups. A pyramid allows a family to access all retained earnings of a firm it already controls to set up a new firm, and to share the new firm's nondiverted payoff with shareholders of the original firm. Our model is consistent with recent evidence of a small separation between ownership and control in some pyramids, and can differentiate between pyramids and dual-class shares, even when either method can achieve the same deviation from one share–one vote. Other predictions of the model are consistent with both systematic and anecdotal evidence.

MANY FIRMS HAVE A CONTROLLING SHAREHOLDER, usually a family or the state (La Porta, Lopez-de-Silanes, and Shleifer (1999)). Moreover, in several countries, single individuals or families control a large number of firms. In such an organization, typically referred to as a *family business group*, the top family often organizes the ownership of the group member firms in a *pyramidal structure*.[1,2] That is, the family achieves control by a chain of ownership relations: The family

*Heitor Almeida and Daniel Wolfenzon are at the Stern School of Business, New York University, and the National Bureau of Economic Research. We wish to thank two anonymous referees for insightful comments. We also wish to thank Ken Ayotte, Bernie Black, Mike Burkart, Luis Cabral, Mara Faccio, Rachel Hayes, Oliver Hart, Jay Hartzell, Rafael La Porta, Walter Novaes, Andrei Shleifer, Sheridan Titman, and seminar participants at the 2004 Western Finance Association meetings, the 2004 Corporate Governance Conference at the University of Texas, the 2004 UNC-Duke Conference on Corporate Finance, MIT, Princeton University, the University of Minnesota, Tilburg University, the London Business School, the NYU/Columbia joint seminar, PUC-Rio, the University of Amsterdam, the Stockholm School of Economics, and the University of California San Diego for comments and suggestions. Sadi Ozelge provided excellent research assistance. All remaining errors are our own.

[1] The literature sometimes uses the term "business group" to refer to other types of corporate groupings, such as those in which the member firms are tied together by common ethnicity of the owners, interlocking directorates, school ties, etc. An example is the Japanese keiretsu, an organization in which individual managers have considerable autonomy in their own firms but coordinate their activities through the president council and a common main bank (Hoshi and Kashyap (2001)). Another example is the horizontal financial-industrial groups in Russia (Perotti and Gelfer (2001), p. 1604). To avoid confusion, we use the term "*family* business groups" to refer to those in which member firms are controlled by the same family, as in Western Europe, Latin America, and East Asia.

[2] 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.

directly controls a firm, which in turn controls another firm, which might itself control another firm, and so forth.

Despite the ubiquity of pyramidal business groups, no formal theory explains their existence. A traditional informal explanation argues that pyramids are formed to allow a family to achieve control of a firm using only a small cash flow stake.[3] For instance, a family that directly owns 50% of a firm that in turn owns 50% of a different firm achieves control of the latter firm with an *ultimate* cash flow stake of only 25%. Securing control through such arrangements can be particularly beneficial for the family when private benefits of control are large. Because this view suggests that pyramids are created to separate cash flow from voting rights, it predicts that pyramidal firms should have a significant degree of separation between ownership and control. Indeed, the literature provides many examples of pyramidal groups that exhibit extreme degrees of separation (see Claessens et al. (2000)).

Nevertheless, a more detailed examination of the available data reveals certain facts that the traditional view cannot adequately explain. For example, the finding that pyramidal firms are associated with large deviations from one share–one vote is not universal. In many cases, the separation achieved is minimal and thus does not seem to warrant the use of a pyramid (see, e.g., Franks and Mayer (2001), Section IV).

Moreover, even the cases in which pyramids do seem to separate cash flow from voting rights are not fully explained by the traditional view. The reason is that pyramids are not the only way to achieve this separation. For example, absent regulatory restrictions on the use of dual-class shares, the family can achieve any desired degree of separation by directly owning the firm and selling shares with inferior or no voting rights. In such a case, why would a family choose to control a firm through a pyramid rather than through direct ownership with dual-class shares? The empirical evidence indicates, however, that pyramids are much more common throughout the world than are dual-class shares (La Porta et al. (1999)). The higher incidence of pyramids does not appear to be caused by restrictions on the use of dual-class shares. Although these restrictions set an effective upper bound to the deviation from one share–one vote that can be achieved with dual-class shares, many pyramidal firms have deviations that fall below this permissable upper bound (Bianchi, Bianco, and Enriques (2001)). All this evidence suggests that considerations other than the separation of cash flow from voting rights motivate the creation of pyramidal business groups.

In this paper, we present a model that provides a rationale for the existence of pyramids that does not rely on the separation of cash flow from voting rights. This model is consistent with the finding that pyramids arise even when the family can use dual-class shares to facilitate control. The model can also explain why some pyramid-controlled firms have substantial deviations between

[3] This argument goes back at least to the beginning of the twentieth century: Berle and Means (1932) and Graham and Dodd (1934) use this argument to explain the creation of pyramids in the United States of America in the early twentieth century.

ownership and control, while others do not. The theory explains both the ownership structure of such business groups (why they are organized as pyramids as opposed to other ownership structures), and their existence (why a single family controls multiple independent firms). We show that the implications of the model are consistent with anecdotal and empirical evidence regarding the characteristics of pyramidal business groups.

The model makes two key assumptions. The first is that investor protection is imperfect. When investor protection is poor, the family extracts private benefits from the firms it controls at the expense of minority shareholders. The second assumption is that new businesses are added to the group over time. That is, after the family sets up a firm, an opportunity to set up another firm arises.

When this opportunity arises, the family must decide on the ownership structure of the business group. Under a pyramidal structure, the new firm is owned by all the shareholders of the original firm. As a result, although the family shares the security benefits of the new firm with nonfamily shareholders of the original firm, it has access to all of the retained earnings (cash) of the original firm.[4] The alternative ownership structure we consider is one in which the family controls the new firm by directly holding its shares. We refer to this direct ownership structure as a *horizontal structure*.[5] Under this structure, nonfamily shareholders of the original firm have no rights to the cash flows of the new firm, and thus the family captures all the security benefits of the new firm. However, in this case, the family has access to only its share of the retained earnings of the original firm.[6]

The level of investor protection plays a crucial role in the choice of group structure. Poor investor protection leads to high diversion of cash flows (hereafter, simply "diversion"), which renders the pyramidal structure more attractive for two reasons. First, diversion increases the family's private benefits of control, though at the cost of a reduction in security benefits.[7] Because in a pyramidal structure the family shares the security benefits with nonfamily shareholders, while in the horizontal structure it keeps all the security benefits, high diversion gives a greater payoff to the family under the pyramidal structure than under the horizontal structure (*payoff advantage*). Second, because external investors anticipate diversion and discount the terms at which they are willing to provide financing, it is optimal for the controlling shareholders to use internal funds from existing firms to set up new firms before raising any external

[4] Security benefits represent the fraction of the firm's returns that is not diverted by the family and thus that accrues to all shareholders. The remaining part (the diverted value) represents a private benefit of control for the family.

[5] Admittedly, we analyze two highly stylized ownership structures. Real business groups are more complex. However, by analyzing simply defined ownership structures, we hope to provide a starting point for the analysis of more complex groups.

[6] Graham and Dodd (1934) argue that the ability to use the resources of an already established firm to set up or acquire new firms is one of the reasons for the emergence of pyramids in the United States of America in the early 1900s (see p. 564).

[7] A large empirical literature provides evidence that private benefits of control are larger in poor investor protection countries. See Zingales (1994), Nenova (2003), and Dyck and Zingales (2004).

financing.[8] This makes the family's ability to use all the retained earnings of existing group firms in a pyramid structure more valuable (*financing advantage*).

Certain firm characteristics also influence the choice of group structure. In particular, we show that firms with high investment requirements and/or low profitability are more likely to be set up in pyramids. The argument is similar to that in the previous paragraph. Specifically, because these types of firms generate lower security benefits for investors, if the family uses a pyramid to set these firms up, they find it easier to finance them and they also achieve a higher payoff.

In sum, in our model the family chooses the pyramidal structure because of the payoff and financing advantages it provides when new firms are expected to yield low-security benefits relative to the required investments. This rationale for pyramids is different from the traditional one. In particular, in our model pyramids can be optimal even if the opportunities for separating cash flow from votes by using dual-class shares are not fully utilized. This result helps to explain one of the puzzles raised above, namely, that some pyramidal firms have deviations from one share–one vote that are also possible to achieve with the use of dual-class shares.

In this paper, we distinguish between a business group (a collection of firms controlled by the same family) and the particular ownership structure used to control the group's member firms (pyramidal or horizontal). Our analysis so far assumes that the family always sets up both the original and the new firms. However, we also analyze the conditions that allow the family that set up the original firm to also control the new firm (i.e., the conditions that lead to the creation of a business group). We find that these conditions are similar to those that are conducive to the creation of pyramids. A firm is more likely to be added to a business group when its security benefits are low relative to the required investments. In such cases, it is difficult for an outside, less wealthy entrepreneur to finance the required investment in the external market. As a result, families that already own successful firms might be the only ones with sufficient financial resources to set up the new firm, regardless of whether they are the most efficient owners. Thus, business groups should be more prevalent in poor investor protection countries and they should tend to adopt a pyramidal structure.

The observation that pyramidal firms are associated with low security benefits raises another question. Because the low security benefits are shared with existing shareholders of the business group, they might not find it optimal to buy into the business group in the first place. To examine this issue, we analyze the setup of the first firm in the business group and show that pyramids can still arise. First, if the family cannot contractually commit to rule out pyramids in the future, it simply compensates shareholders for the future costs of

[8] This argument is related to the pecking order theory of external finance (Myers and Majluf (1984)). However, the wedge between external and internal financing in our model arises from a moral hazard type of problem, and not from asymmetric information about firm cash flows.

pyramiding by transferring a large enough fraction of the value of the first firm to them (through a reduced share price). Second, the family might not want to commit to rule out pyramids. Because retained earnings relax financing constraints, and because in a pyramidal structure the family has access to a greater pool of internal funds, there are situations in which the family needs to use a pyramid structure to add new firms to the group. Thus, contractual mechanisms to rule out pyramids might not be used even if it is feasible to enforce them.

We also show that observed ultimate ownership is lower and equilibrium diversion is higher in pyramid-controlled firms. This result is driven by a selection effect. New firms with low security benefits relative to their investments require that the family sell more shares to finance them. As a result, the family's ultimate stake in these firms is low and diversion is high. However, as we explain above, given high diversion, it is optimal for the family to set these firms up in a pyramidal structure. Thus, firms with low security benefits relative to their investment requirements are associated with lower ownership concentration and high diversion, and they end up in pyramidal structures. Similarly, firms with high security benefits relative to their investment requirements are associated with high ultimate ownership concentration and low diversion and are more likely to be set up in the horizontal structures, or even outside business groups. This prediction is consistent with evidence that shows significant expropriation of investors in firms that belong to pyramidal structures (Bertrand, Mehta, and Mullainathan (2002), Johnson et al. (2000)). However, in our model the pyramidal structure itself is not the cause of the increased diversion. Rather, the expectation of high diversion makes the pyramidal structure an optimal choice for the controlling family.

Although pyramidal firms are associated with lower ultimate ownership compared to firms controlled directly by the family, our model does not necessarily require (as the traditional argument does) that the ultimate ownership concentration in a pyramidal firm be small in an absolute sense.[9] In fact, our model is consistent with families holding either large or small ultimate ownership stakes in pyramidal firms, leading to either minor or substantial separation of cash flow from voting rights. This result helps explain another of the puzzles raised above, namely, that some pyramid-controlled firms have small deviations between cash flow and votes. In addition, we show that pyramidal structures with small deviations are more likely to appear in poor investor protection countries.

Finally, we consider two extensions of the basic model that address additional questions raised by the theory. First, we analyze whether it is optimal for the family to set up new firms as legally independent entities or as divisions inside existing firms. This question is important because if new firms are set up

[9] The selection argument above only suggests that families should hold smaller ownership stakes in firms that they control through pyramids, *relative* to firms that they own directly. This prediction is not incompatible with high-observed ownership stakes in pyramidal firms, in an *absolute* sense.

as divisions, the resulting structure does not match the usual definition of a pyramid. Within the framework of our model, we show that, as long as there is variation in the level of investor protection across firms in the same group, the family is very likely to set up the new firm as a partial subsidiary.

Second, we extend the model to allow for a variable scale of investment. We show that our previous conclusions remain valid for this natural extension. We also show that the family might have an incentive to overinvest in firms that are owned through pyramids because the cost of overinvestment is shared with existing shareholders of the business group. Such overinvestment is more likely when retained earnings in the group are very large. Thus, pyramids might destroy value if there is too much cash available to the family, a version of the well known free cash flow problem (Jensen (1986)).

Existing literature treats the creation of business groups and the determinants of their ownership structures separately. With respect to business groups, Leff (1978) and more recently Khanna and Palepu (1997, 1999) argue that they arise to substitute for missing markets (i.e., labor and financial markets).[10] Other benefits of groups include the ability to prop up (inject money into) failing firms (Morck and Nakamura (1999), Friedman, Johnson, and Mitton (2003)) and the use of a group's deep pockets as a strategic tool in product market competition (Cestone and Fumagalli (2005)). None of these arguments considers the ownership structure of the business group.

To explain the ownership structure of groups, the literature relies on a set of arguments that are different from ours. As we discuss above, the traditional argument for pyramids is that they arise to separate cash flow from voting rights. The question still remains as to why a pyramid is the best mechanism to achieve this separation. The same observation can be made regarding the models in Gomes (2000), who shows that separation of cash flow and voting rights might have reputation benefits, and Bebchuk (1999), who argues that an initial owner might want to separate cash flow from voting rights to prevent potential raiders from seizing valuable control. Regulatory or tax considerations might also help explain the creation of pyramids. For example, Morck (2003) provides evidence that taxes on intercompany dividends reduce the incidence of pyramidal structures.

Section I presents our basic model of pyramidal and horizontal business groups. We first consider a version of the model in which the family already owns an established firm and needs to decide on the structure (pyramidal or horizontal) to use in setting up a new firm. We use this framework to characterize the conditions under which the family chooses one structure or the other. We then consider the creation of business groups and we end the section by analyzing the creation of the first firm in the group. In Section I, we assume that diversion entails no costs. This assumption makes diversion insensitive to the firm's ownership structure, and simplifies the analysis considerably. In Section II, we relax this assumption and derive implications regarding variations in diversion and ownership concentration in the different structures. Section III

[10] See Ghatak and Kali (2001) and Kim (2004) for other value-enhancing arguments.

considers whether new projects that are taken on by the pyramid should be organized as stand-alone firms or internal divisions, and looks at the implications of a variable scale of investment in the new firm. Our theory generates a number of empirical implications that we discuss in Section IV together with the relevant empirical literature. Section V concludes.

I. Pyramidal and Horizontal Business Groups

In this section we present a framework to analyze pyramidal and horizontal business groups. The model has three dates. At date 0, a family sets up a firm (firm A), keeping a fraction α of its shares. At date 1, firm A generates cash flows of c and the opportunity to set up another firm (firm B) arises. Firm B requires investment i at date 1 and generates cash flow r by date 2 with $r > i$. We assume for now that the family is the only possible owner of firm B. In Section I.D, we analyze the effects of competition from an alternative owner.

At date 1, the family chooses the optimal ownership structure for firm B. In a pyramidal structure, the family sets up firm B as a partial subsidiary of firm A and thus can use the cash c from firm A to set up firm B. In a horizontal structure, the family itself—independently from firm A—sets up firm B. In this case, the family has access only to its personal wealth of αc. In either structure, the family sells shares of firm B to raise additional funds.

We assume that there are no legal restrictions on the use of dual-class shares. This assumption ensures that the family always retains complete control of firm B, regardless of the structure it chooses and its ultimate ownership.

Control allows the family to divert cash from firm B into its pockets. We assume that when the family diverts a fraction d of the revenue, it pays a cost of $c(d, k)r$, where k is the level of investor protection (one can think of this cost as waste involved in the diversion process).

One implicit assumption in this formulation is that diversion opportunities are the same regardless of the structure chosen. The reasoning behind this assumption is that, because the family retains the same degree of control in both structures, the set of actions the family can take should be the same, including the diversion opportunities. Of course, as we will see below, actual diversion will be affected by the incentives that the family faces in each structure. Finally, our diversion technology does not capture intrafirm diversion (diversion from firm B to firm A) or diversion directly from firm A to the family. However, our results continue to hold if we allow for these different diversion opportunities.[11]

Finally, we assume that the market interest rate is zero and that the family maximizes its date 2 payoff. We start by solving the model from date 1, taking the family stake in firm A, α, as given. In Section I.E, we endogenize α by solving the model from date 0.

[11] We analyze these alternative diversion opportunities in a previous version of this paper (available from the authors upon request).

A. Horizontal Structure

The family has personal wealth of αc. To set up firm B at date 1, the family contributes R_I^H of these funds and raises R_E^H from the external market by selling $1-\beta^H$ shares of firm B (the subscripts I and E stand for internal and external funds, respectively). The family's payoff at date 2 can be written as

$$\alpha c - R_I^H + \beta^H\left(R_I^H + R_E^H - i + (1-d)r\right) + (d - c(d,k))r. \tag{1}$$

At date 2, the family chooses the level of diversion that maximizes the above expression. Thus, $d = \arg\max_d \beta^H(1-d) + d - c(d,k)$. This expression defines $d(\beta^H, k)$.

Because investors break even in equilibrium, we can write $R_E^H = (1-\beta^H)(R_I^H + R_E^H - i + (1-d)r)$. Solving this equation for R_E^H, plugging this value into equation (1), and letting $NPV \equiv r - i - c(d,k)r$ be the net present value (NPV) of firm B net of diversion costs, we obtain the payoff of the family as of date 1:

$$U^H = \alpha c + NPV. \tag{2}$$

This expression is the family's payoff conditional on firm B's being set up. The family is able to set up firm B whenever $R_I^H + R_E^H \geq i$, which, by replacing the value for R_E^H, leads to

$$R^H \equiv R_I^H + (1-\beta^H)(1-d)r \geq i. \tag{3}$$

Assuming it is optimal to set up firm B, the family's problem is

$$\begin{gathered} \max_{R_I^H \in [0,\alpha c],\, \beta^H \in [0,1]} U^H \\ \text{subject to } R^H \geq i \\ \text{and to } d = d(\beta^H, k). \end{gathered} \tag{4}$$

B. Pyramidal Structure

Firm A has retained earnings of c, out of which it contributes R_I^P to the setup cost for firm B. In addition, it raises R_E^P from the external market by selling $1-\beta^P$ shares of firm B. The family's payoff at date 2 is given by

$$\alpha\left[c - R_I^P + \beta^P\left(R_I^P + R_E^P - i + (1-d)r\right)\right] + (d - c(d,k))r, \tag{5}$$

where $R_I^P + R_E^P - i + (1-d)r$ are the security benefits of firm B at date 2.

Again, at date 2, the family chooses the level of diversion that maximizes the above expression. Thus, $d = \arg\max_d \alpha\beta^P(1-d) + d - c(d,k)$. Comparing this expression with the corresponding one in the horizontal case, we see that in both structures diversion depends in the same way on ultimate ownership (β^H in the horizontal structure and $\alpha\beta^P$ in the pyramidal). Therefore, diversion in the pyramidal case is given by $d(\alpha\beta^P, k)$. In Section II, it will be more convenient to posit that the family chooses its ultimate ownership concentration in firm B rather than the direct ownership. Thus, for future reference we define $\omega^H \equiv \beta^H$ and $\omega^P \equiv \alpha\beta^P$.

Moving back to date 1, we write $R_E^P = (1-\beta^P)(R_I^P + R_E^P - i + (1-d)r)$. Solving for R_E and plugging this expression into equation (5), we obtain the family's payoff as of date 1:

$$U^P = \alpha c + NPV - (1-\alpha)[(1-d)r - i]. \tag{6}$$

The payoff differences between the horizontal and pyramidal structures can be derived by comparing equations (2) and (6). In the horizontal structure the family sets up firm B and, because new investors in firm B break even, the family ends up capturing the entire NPV of the project. In the pyramidal structure firm A sets up firm B, and so the NPV is shared between the family and nonfamily shareholders of firm A. However, the NPV is not distributed in proportion to the stakes in firm A because the family, but not the other shareholders of firm A, receives the diverted amount. Only the nondiverted NPV ($(1-d)r - i$) is divided in proportion to the stakes in firm A. That is, nonfamily shareholders of firm A get $(1-\alpha)[(1-d)r - i]$ and the family gets the rest.

For the family to be able to set up firm B, it must be the case that $R_I^P + R_E^P \geq i$. Replacing the value of R_E^P leads to

$$R^P \equiv R_I^P + (1-\beta^P)(1-d)r \geq i. \tag{7}$$

Assuming it is optimal to set up firm B, the family's problem is

$$\begin{gathered}\max_{R_I^P \in [0,c],\, \beta^P \in [0,1]} U^P \\ \text{subject to } R^P \geq i \\ \text{and to } d = d(\alpha\beta^P, k).\end{gathered} \tag{8}$$

C. Choice of Structure, Investor Protection, and Firm Characteristics

There are two steps to solving the family's problem. First, the family finds the optimal ownership concentration for each of the two possible structures (by solving equations (4) and (8)). Next, it chooses the structure that provides the highest payoff.

To provide the intuition for each of the two steps, we first consider a very simple cost-of-diversion function that guarantees that, in equilibrium, the cost of diversion is always zero. We show that this simplifying assumption implies that the family's payoff is independent of ownership concentration. This allows us to abstract from the effects of ownership concentration and isolate those related to the choice of structure.

In Section II, we allow diversion to be costly, using a similar framework to that in Burkart, Gromb, and Panunzi (1998) and Shleifer and Wolfenzon (2002).

With this new assumption, diversion, the cost of diversion, and consequently the family's payoff depend on ultimate ownership concentration. This assumption allows us to derive additional implications regarding the optimal ownership concentration and equilibrium levels of diversion, but it does not change the substance of the implications of the model in this section.

The first functional form for the cost of diversion we consider is

$$c(d,k) = \begin{cases} 0 & \text{if } d \leq \bar{d}(k) \\ +\infty & \text{otherwise,} \end{cases} \tag{9}$$

with $\frac{\partial \bar{d}}{\partial k} < 0$. In other words, we assume that diversion entails no cost up to a threshold $\bar{d}$. This threshold is lower in countries that provide better investor protection.

Because diversion up to $\bar{d}$ is costless, the family sets $d = \bar{d}$, regardless of the structure it uses. Using equations (2) and (6), we obtain

$$U^H = \alpha c + NPV, \text{ and} \tag{10}$$

$$U^P = \alpha c + NPV - (1-\alpha)[(1-\bar{d})r - i], \tag{11}$$

where NPV $= r - i$. However, these payoffs are conditional on firm B's being set up. Because payoffs are not affected by ownership concentration, the family is indifferent among all ownership concentration levels that allow it to raise the necessary funds. Therefore, without loss of generality, we assume that the family chooses the ownership concentration that allows it to raise the most funds.

In the case of the horizontal structure, we define

$$\bar{R}^H \equiv \max_{R_I^H \in [0,\alpha c], \beta^H} R^H = \alpha c + (1-\bar{d})r. \tag{12}$$

The horizontal structure is feasible whenever $\bar{R}^H \geq i$. In this simplified model, because diversion does not depend on ownership concentration, the family maximizes the funds raised by fully dispersing ownership in firm B. This is not a general result. As we show in Section II, with costly diversion the family always tries to keep ownership concentration as high as possible.

Similarly, for the pyramidal structure we define

$$\bar{R}^P \equiv \max_{R_I^P \in [0,c], \beta^P} R^P = c + (1-\bar{d})r. \tag{13}$$

The pyramidal structure is feasible whenever $\bar{R}^P \geq i$. In this case, firm A contributes all of its retained earnings, c, and fully disperses ownership in firm B.

The following result characterizes the choice of structure in this version of the model:

Result 1: *If the nondiverted* NPV *of firm B,* $(1-\bar{d})r - i$, *is positive, the family always chooses the horizontal structure. If the nondiverted* NPV *of firm B is* *negative and the pyramid is feasible ($\bar{R}^P > i$), the family chooses the pyramid. In all other cases firm B is not set up.*

The proof of this result is in the Appendix, along with all other proofs. When the nondiverted NPV is positive, firm B can be financed in either structure because the contribution of external investors, $(1 - \bar{d})r$, is sufficient to pay the investment cost, i. In terms of payoffs, however, the family prefers the horizontal structure: If the family sets up the pyramid, it shares this positive nondiverted NPV with the nonfamily shareholders of firm A, whereas if it chooses the horizontal structure it gets to keep the entire amount. Therefore, in this case, the horizontal structure is chosen.

When the nondiverted NPV is negative, setting up firm B is not always feasible because the maximum amount external investors contribute is less than the setup costs. Thus, firm B setup is feasible only when the internal resources are sufficiently high. In addition, when the nondiverted NPV is negative, the family prefers the pyramid because this structure allows it to share this negative value with the other shareholders of firm A. Therefore, in this region of the parameter space, the family chooses the pyramidal structure whenever it is feasible.

RESULT 2: *Assume that $\bar{R}^P \geq i$, such that setting up firm B is feasible under the pyramidal structure. Given this condition, firm B is less likely to be owned through a pyramid when:*

i. Firm B generates higher revenues,
ii. Firm B requires a smaller investment, or
iii. Investor protection increases.

This result follows from the fact that the nondiverted NPV is higher and thus more likely to be positive when profitability increases, investment decreases, or investor protection is stronger. Because the nondiverted NPV is more likely to be positive, the family is more likely to use a horizontal structure both because its payoff is higher and because it becomes easier to finance the project.[12]

Our assumption that there are no legal restrictions on the use of dual-class shares implies that the family can use either structure to secure control, regardless of how small a cash flow stake it holds. Therefore, in this framework, any argument for the existence of pyramids that relies on separation of ownership from control (e.g., the traditional argument) cannot make predictions as to which structure the family would use. Because in our model pyramids are not used to separate ownership from control, but rather to allow the family to maximize its internal sources of financing and to share the security benefits of new firms, they can be optimal in this environment. That is, in our model pyramids are not equivalent to direct ownership with the (potential) use of dual-class shares, even when there are no legal restrictions on the use of dual-class shares.

[12] We condition on the setup of firm B being feasible under the pyramidal structure because, empirically, only the set of projects that are feasible under the least restrictive conditions is observable.

D. Business Groups

We define a family business group as an organization in which a family owns and controls more than one firm. In the last section we assume that the family is the only party with the ability to set up firm B. This effectively means that we assume the existence of a business group. In this section we investigate the conditions under which a business group arises.

We introduce the possibility that, at date 1, there is an alternative owner for firm B (whom we call the entrepreneur). The setup cost of firm B for the entrepreneur is also i. The entrepreneur might be a better or a worse manager than the family, a possibility that we capture by assuming that under his control, revenues of firm B are $(1 + t)r$. The parameter t, which can be positive or negative, is a measure of the productivity differential between the family and the entrepreneur. We also assume that the entrepreneur has no personal wealth. Thus, if $t > 0$, the only advantage the family has is its higher financing capacity due to the accumulation of internal funds in the existing firms it owns (that is, the cash c of firm A).

For simplicity, we assume that the market in question allows for the operation of only one firm.[13] Thus, if $t < 0$, the family will be the natural owner of the new firm because it has both a technological and a financing advantage. If $t > 0$, while the entrepreneur is the most productive owner, it might not own the firm because of the family's wealth advantage. We capture this possibility by assuming that, if the entrepreneur can raise sufficient funds, he will be the only one to enter the market because of his higher productivity. If he cannot raise the necessary funds, then the family sets up firm B using either of the two structures described in the last section.[14] Given this assumption, we can prove the following result:

RESULT 3: *Business groups are less likely to arise when:*

i. The competing entrepreneur's productivity differential, t, is positive and large,
ii. Firm B generates higher revenues,
iii. Firm B requires a smaller investment, or
iv. Investor protection is higher.

[13] Presumably, the family and the entrepreneur would engage in some form of competition in the market, which might involve a phase during which time both enter and attempt to capture the market. Our assumption that only one can enter can be seen as a reduced form of a competition game, where one of the firms must eventually prevail.

[14] The assumption that a more productive entrepreneur will own the new firm whenever he can finance it is a bit extreme. A situation could arise in which the wealthy family manages to drive out an entrepreneur who is only marginally viable, for example, by using its financing clout to lower the output price. However, such a possibility would not lead to results that are qualitatively different from those we describe below, since the entrepreneur would still become the most natural owner if his productivity differential and/or firm B's security benefits are large enough. See also the proof of Result 3.

If $t > 0$, the family's comparative advantage is that it has accumulated wealth, and thus does not need to rely as much on external capital markets. As investor protection improves, the family's comparative advantage eventually disappears and the entrepreneur is able to set up his firm. The entrepreneur is also more likely to raise the necessary funds to set up firm B when its NPV is large, which happens when r and t are high, and i is low.

Note that conditions conducive to the formation of business groups are also conducive to the formation of pyramids (compare Results 2 and 3). In fact, in this simple model we can prove the following result:

RESULT 4: *Business groups that arise because of the family's financing advantage, that is, when* $t > 0$, *are always organized as pyramids. If* $t < 0$ *it is possible that business groups will be organized horizontally.*

If $t > 0$, competition from the entrepreneur eliminates the region of the parameter space in which a horizontal structure arises. Thus, in our model, all business groups that arise due to financing advantages are organized as pyramids. The intuition for this result is that horizontal structures appear only when the nondiverted NPV of firm B is positive, because in such cases the family does not want to share the positive NPV of firm B with the shareholders of firm A. However, under such conditions, entrepreneurial finance is possible because the fraction of the profits of firm B that can be pledged to outside investors, $(1 - \bar{d})(1 + t)r$, is greater than the investment i. Thus, the situations in which a horizontal structure is optimal are precisely the situations in which the business group loses its financing advantage over the entrepreneur. This result also implies that horizontal groups can arise only for technological reasons, that is, when $t < 0$. Finally, note that a corollary of Result 4 is that conditional on the business group's arising, a pyramid is more likely to appear when the family is *not* the most efficient owner of firm B.

It is worth discussing what is novel about the results in this section, and what is not. The idea that business groups are more likely to arise in countries with poor investor protection because external financing is more limited is not new. This idea is related to the arguments in Leff (1978) and Khanna and Palepu (1997, 1999) that we mention in the introduction. However, these authors do not consider the optimal choice of ownership structure in a business group. Result 4 suggests that, if business groups are created to substitute for financial markets that are curtailed by poor investor protection, they should also be organized as pyramids.

E. Ex ante Optimality of Pyramids

In our model, whenever the pyramidal structure is chosen, shareholders of firm A realize a loss because they share the negative nondiverted NPV with the family. This raises the question of why shareholders would buy into firm A in the first place. Even though it is possible that shareholders may not anticipate the creation of a pyramid, in this section we analyze a model in which shareholders rationally foresee this event.[15]

To analyze this question, we extend the model to date 0. We assume that, at date 0, firm A needs an investment of i_A and generates cash flows of $r_A > i_A$ at date 1. Similarly, firm B requires an investment of i_B at date 1 and generates a revenue of r_B at date 2. For simplicity, we assume that there is no diversion of the cash flows of firm A. We also assume that the family has no wealth at date 0, and that there is no competition by the entrepreneur at date 0 or at date 1.[16]

Suppose first that the family cannot commit at date 0 to rule out the use of pyramids in the future. In this case we have the following result:

RESULT 5: *Suppose that $r_A + (1 - \bar{d})r_B > i_A + i_B$, and that $(1 - \bar{d})r_B < i_B$. In this case, the family sets up firm A at date* 0 *and uses a pyramid to set up firm B at date* 1. *Shareholders of firm A break even from the perspective of date* 0.

The above result shows that, absent any contractual mechanisms to rule out pyramids, these structures can appear even when investors in the initial firm anticipate their formation. Intuitively, it would seem reasonable that the first firm the family sets up must be profitable enough to compensate initial shareholders for the future expropriation associated with pyramids. If this condition holds, the group's shares can be priced low enough that initial shareholders break even and the family can raise enough money to finance firm A.

However, Result 5 does not rule out the possibility that the family might benefit from a mechanism (such as a contract or a charter provision) that allows it to commit not to use pyramids. This commitment might be valuable because, from the perspective of date 0, the family bears all costs of future expropriation associated with pyramids.[17]

Importantly, the family may not want to rule out pyramids by contract even if it can do so. There are cases in which the only way the family can set up both firms A and B is by using pyramids, in which case ruling them out might eliminate the possibility of setting up firm B. Since firm B is a positive-NPV project, this is inefficient from an ex ante perspective.

This type of situation arises when there is uncertainty regarding the cash flow produced by firm A. Suppose that the revenue generated by firm A is

[15] Aganin and Volpin (2005) document the case of the Pesenti group. The first firm in the group, Italcementi, was established in 1865. The creation of the Pesenti pyramid happened when the family started to acquire firms in 1945. While it is theoretically possible that shareholders in 1865 foresaw the creation of a pyramid 80 years later, this is unlikely.

[16] If competition at date 0 leads to the entrepreneur's setting up firm A, then the entrepreneur essentially becomes the family in date 1. Competition at date 1 from a talented entrepreneur has the same effect as in Section I, eliminating horizontal structures if the pledgeable income of firm B is larger than the required investment.

[17] In the version of the model that we analyze in this section, pyramids do not have higher *deadweight* costs relative to horizontal structures. Conditional on the family being able to finance both firms, the family's ex ante payoff is identical under pyramidal or horizontal structures. However, this is unlikely to be a general conclusion. For example, Section III.B shows that pyramidal structures might destroy value because of the possibility of overinvestment in firm B.

$r_A = \bar{r}_A - \Delta$ with probability $\frac{1}{2}$, and $r_A = \bar{r}_A + \Delta$ with probability $\frac{1}{2}$. We can prove the following result:

RESULT 6: *Suppose that the following conditions hold:*

$$\left(1 - \frac{i_A}{\bar{r}_A}\right)\Delta + \bar{r}_A - i_A + (1 - \bar{d})r_B - i_B < 0, \tag{14}$$

and

$$\bar{r}_A - i_A + \frac{1}{2}[(1 - \bar{d})r_B - i_B] > 0. \tag{15}$$

In this case, it is not optimal for the family to rule out pyramids at date 0.

Under the conditions in equation (14), the family cannot set up firm B in a horizontal structure at date 1, even in the high-cash-flow state. In this situation it might be efficient for the family to allow pyramids to be formed at date 1, because pyramids relax the date 1 financing constraint by increasing the cash available for investments. The problem with the pyramid is that, because shareholders of firm A expect future expropriation, allowing pyramids to be formed tightens the date 0 financing constraint. The condition in equation (15) is required for the date 0 constraint to be met if the pyramid is expected to be used only in the high-cash-flow state.[18]

So far we assume that firm B can only be set up at date 1. The next result endogenizes the timing of this decision in the context of the current extension.

RESULT 7: *Suppose the family has access to both projects at date* 0. *Under the conditions of Result 6, the optimal investment policy is to set up firm A first, and then if the cash flows of firm A are high, set up firm B in a pyramid.*

Result 6 shows that pyramids can only have ex ante benefits if the sum of the pledgeable incomes of firms A and B is lower than the sum of the required investments. This follows from the first condition in Result 6, because $\bar{r}_A - i_A + (1 - d)r_B - i_B < -(1 - \frac{i_A}{\bar{r}_A})\Delta < 0$. In this case, the family cannot set up both firms at date 0. Furthermore, as we explain above, the family can still set up firm A at date 0 and then set up firm B in a pyramid if the high-cash-flow state obtains. Thus, pyramids are created following good performance of the existing firms in the group.

II. Ultimate Ownership and Diversion

The simple framework of the previous section generates several results that tell us about the conditions under which business groups appear and the types of

[18] We show in the Appendix that if conditions 14 and 15 hold, the family can never raise enough funds both to set up firm A at date 0, and to set up the pyramid in both states at date 1, because in this case shareholders of firm A cannot break even.

structures they use. However, because we assume that diversion is independent of ownership concentration, the family can fully dilute ownership without any implications for value. Thus, the previous model is not well suited to address the question of concentration of cash flow rights in pyramidal firms. Furthermore, because diversion is the same regardless of the organizational structure, the model does not provide predictions for the relationship between the pyramidal organizational form and diversion.

In this section, we endogenize diversion and the ultimate ownership concentration of firm B. Toward this end, we assume that diversion is costly. In particular, we assume that $c(0, k) = 0$, $c_d > 0$, $c_{dd} > 0$, and $c_{dk} > 0$. These assumptions imply that a high degree of investor protection (high k) corresponds to a high cost of diversion.

When diversion is costly, the family tries to reduce it by maximizing its ultimate ownership concentration in firm B. In other words, the family chooses the structure that allows it to finance the new firm with the smallest equity issuance. Because pyramids allow the family to use firm A's cash to finance firm B, it might appear that they provide the family with a higher financing capacity. However, the financing cost of using a pyramid is that the nonfamily shareholders in firm A receive shares that could have been sold on the market, had the horizontal structure been used. Thus, determining which structure maximizes financing capacity depends on the relation between the market price and the implicit price paid by nonfamily shareholders of firm A. For example, when diversion is expected to be high, the market price is low, and thus the pyramidal structure is the one that maximizes financing capacity. Conversely, when diversion is expected to be low, the horizontal structure is optimal.

A. Optimal Ownership Concentration in Each Structure

We start by solving the model at date 2. In both structures, $d(\omega, k)$ is defined by $d = \arg\max_d \omega(1 - d) + d - c(d, k)$, where ω is the family's ultimate ownership concentration in firm B. Assuming an interior solution, $d(\omega, k)$ satisfies the first-order condition of this problem, $c_d(d(\omega, k), k) = 1 - \omega$.

It follows from the properties of $c(\cdot, \cdot)$ that diversion is decreasing in ownership concentration ($d_\omega < 0$) and in the level of investor protection ($d_k < 0$). We define the NPV net of diversion costs as $\mathrm{NPV} = r - i - c(d, k)r$. We have that $\frac{\partial \mathrm{NPV}}{\partial \omega} > 0$ because higher ultimate ownership concentration reduces diversion and consequently the total cost of diversion.

Moving back to date 1, we solve the family's problem in equations (4) and (8). We obtain the following result:

RESULT 8: *In both structures the family maximizes its ownership concentration in firm B, subject to raising sufficient funds to finance it. For this reason, the internal resources contributed are set to the maximum possible ($R_I^H = \alpha c$ and $R_I^P = c$). Also, the ultimate ownership concentration is set at the highest value that is consistent with the financing requirement. That is, for the horizontal* *structure, if $\alpha c \geq i$, then $\omega^H = 1$, and if $\alpha c < i, \omega^H$ is the maximum value that satisfies*

$$\tilde{R}^H(\omega^H) \equiv \alpha c + (1 - \omega^H)(1 - d(\omega^H, k))r = i. \tag{16}$$

For the pyramidal structure, if $c \geq i$, then $\omega^P = \alpha$ (i.e., $\beta^P = 1$), and if $c < i$, ω^P is the maximum value that satisfies

$$\tilde{R}^P(\omega^P) = c + \left(1 - \frac{\omega^P}{\alpha}\right)(1 - d(\omega^P, k))r = i. \tag{17}$$

The function $\tilde{R}^H(\omega^H)$ is the amount of funds raised in the horizontal structure when the family contributes αc of its own funds and the ultimate ownership concentration in firm B is ω^H. We obtain this expression by replacing $R_I^H = \alpha c$ and $d = d(\omega^H, k)$ in the expression for R^H (equation (3)). Similarly, $\tilde{R}^P(\omega^P)$ represents the funds collected in the pyramidal structure when firm A contributes c and the ultimate ownership concentration in firm B is ω^P. We obtain this expression by replacing $R_I^P = c$ and $d = d(\omega^P, k)$ in the expression for R^P (equation (7)).

In the horizontal structure the cost of diversion falls back on the family, who receives the entire NPV of the project. Thus, the family has an incentive to maximize its ownership concentration so as to minimize diversion ($d_\omega < 0$).

In the pyramidal structure, it is not a priori clear that the family wants to minimize diversion, because reducing diversion has two opposing effects on the family's payoff (see equation (6)). First, it reduces the cost of diversion and hence increases the NPV of firm B. However, it also means that the family has to share a greater fraction of the NPV with existing shareholders (the term $(1 - \alpha)[(1 - d)r - i]$ rises). However, we show that the family always wants to maximize ownership concentration, even in this case. The reason is that the family bases its diversion decision on its ex post stake in firm B, $\omega^P = \alpha\beta^P$, and diverts $d(\alpha\beta^P, k)$. Nevertheless, from the viewpoint of date 1, the family gets fraction α of the nondiverted revenue (because diversion is priced). That is, from the viewpoint of date 1, optimal diversion is $d(\alpha, k)$. Because the ex post stake is lower than α, the family diverts too much from the perspective of date 1, and hence benefits from lower diversion.

B. Comparison of the Pyramidal and Horizontal Structures

We can now use Result 8 to find the optimal ownership levels for each structure. We then compare the family's maximum payoff under each structure to determine which of the two is optimal. To compare the payoffs under the two structures, we first need to know the relation between ω^H and ω^P.

B.1. The Relation between ω^H and ω^P

We concentrate on the most interesting cases, namely, those in which the family needs to rely on the external market to finance firm B (i.e., $c < i$). Result 8 gives the optimal ownership concentration levels, ω^H and ω^P. Rearranging equations (16) and (17) leads to

$$\tilde{R}^H(\omega^H) = \alpha c + (1-\omega^H)(1-d(\omega^H,k))r = i, \quad \text{and} \tag{18}$$

$$\tilde{R}^P(\omega^P) = \alpha c + (1-\omega^P)\left[m\left(\frac{\alpha c}{\omega^P}\right) + (1-m)(1-d(\omega^P,k))r\right] = i, \tag{19}$$

where $m \equiv \frac{\omega^P}{1-\omega^P}(\frac{1}{\alpha}-1)$.

Equations (18) and (19) highlight an important distinction between a pyramidal and a horizontal structure. In a horizontal structure, there are only two types of shareholders of firm B, the family and the new shareholders. The family keeps fraction ω^H of firm B and contributes all of its wealth, αc. New shareholders buy fraction $1-\omega^H$ of the firm and pay $(1-\omega^H)(1-d(\omega^H,k))r$, where $(1-d(\omega^H,k))r$ is the market price per share. In a pyramidal structure, there are three types of shareholders, the family, nonfamily shareholders of firm A, and new shareholders. The family retains fraction ω^P of firm B and contributes αc. The remaining fraction, $1-\omega^P$, is distributed between nonfamily shareholders of firm A and new shareholders of firm B.[19] The term in brackets in equation (19) reflects the average price of these shares in which m and $1-m$ are the proportion of each of these two types of shareholders. New shareholders pay the market price of firm B, $(1-d(\omega^P,k))r$, while nonfamily shareholders of firm A pay an implied price of $\alpha c/\omega^P$. The latter price follows from the fact that nonfamily shareholders of firm A contribute their share of retained earnings $(1-\alpha)c$ for fraction $(1-\alpha)\beta^P$ of firm B. Thus, the implied price is $(1-\alpha)c/[(1-\alpha)\beta^P] = \alpha c/\omega^P$.

As equations (18) and (19) indicate, even though the family has access to the entire stock of earnings of firm A when it chooses the pyramidal structure, this does not necessarily translate into a financing advantage. More precisely, suppose that we compare the funds raised in each structure for the same level of ultimate ownership concentration in firm B, ω. Simple algebra shows that $\tilde{R}^H(\omega) > \tilde{R}^P(\omega)$ (the horizontal structure has the financing advantage) if and only if $(1-d(\omega,k))r > \frac{\alpha c}{\omega}$ (the market price is higher than the implied price). The reason the pyramidal structure does not always have the financing advantage is that, in this structure, nonfamily shareholders receive shares that could have been sold on the market if the horizontal structure had been used instead. Thus, the horizontal structure has the financing advantage when the market price is higher than the implied price paid by shareholders of firm A.

To illustrate how the different parameters affect the optimal structure choice, we use Figure 1. In this figure we focus on a single parameter, the required investment i (Results 9 and 10 present the general case). The horizontal axis gives

[19] Nonfamily shareholders of firm A indirectly own $(1-\alpha)\beta^P = (1-\omega^P)m$ shares of firm B, and new shareholders hold $1-\beta^P = (1-\omega^P)(1-m)$ shares of firm B.

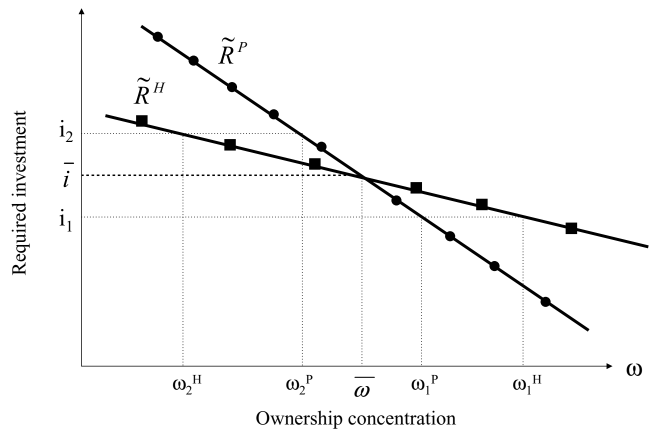

Figure 1. Determination of ultimate ownership concentration. The vertical axis displays the level of investment that is required to set up firm B. The horizontal axis shows different levels of ownership concentration in firm B if it is set up in the horizontal structure (H) or in the pyramid (P). The line marked with squares (circles) shows the ownership concentration in the horizontal structure (pyramidal structure) as a function of the required investment.

the ultimate ownership of the family in firm B (ω^H and ω^P). The vertical axis gives the amount raised in each structure for a given ownership concentration.

First, we plot the values of $\tilde{R}^H$ and $\tilde{R}^P$ as a function of the family's ultimate ownership in firm B, ω.[20] We define $\bar{\omega}$ as the ultimate ownership concentration for which the family raises the same amount of funds with either structure (we call this amount $\bar{i}$). It must then be the case that at $\omega = \bar{\omega}$, the implied price paid by nonfamily shareholders of firm A equals the market price paid by new shareholders of firm B. For higher ownership concentration levels, $\omega > \bar{\omega}$, the market price increases (because there is less diversion in firm B), and the implied price declines (because nonfamily shareholders receive more shares but contribute the same amount). Thus, as we explain above, the family raises more funds with the horizontal structure ($\tilde{R}^H(\omega) > \tilde{R}^P(\omega)$). Conversely, for lower ownership concentration levels, $\omega < \bar{\omega}$, the market price of firm B is lower than the implied price. In this case, the family raises more funds with the pyramidal structure ($\tilde{R}^H(\omega) < \tilde{R}^P(\omega)$).

Second, we show the optimal ownership concentration levels, ω^H and ω^P, for two investment levels, i_1 and i_2, with $i_1 < \bar{i} < i_2$. Because the family raises just enough funds to set up firm B, the optimal ownership concentration in the pyramidal (horizontal) structure is such that $\tilde{R}^P(\omega^P) = i(\tilde{R}^H(\omega^H) = i)$. As the figure shows, for the low investment level, i_1, the ultimate ownership is

[20] Figure 1 shows only the relevant part of the curves. Both $\tilde{R}^H$ and $\tilde{R}^P$ might have increasing and decreasing regions. However, it is never optimal for the family to set its ultimate ownership in the increasing region. This choice is suboptimal because a slightly higher ownership concentration would increase the family's payoff (see Result 8) and, at the same time, would relax the financing constraint.

lower in the pyramidal structure than in the horizontal structure ($\omega_1^P < \omega_1^H$). Conversely, at the high investment cost, i_2, $\omega_2^P > \omega_2^H$.

B.2. The Nondiverted NPV at the Optimal Ownership Concentration

The nondiverted NPV is negative for both structures when $i > \bar{i}$ and is positive for both when $i < \bar{i}$. Consider the case in which $i > \bar{i}$. Here, Figure 1 shows that $\omega^H < \omega^P < \bar{\omega}$. But we argued above that when $\omega < \bar{\omega}$, the implicit price paid by nonfamily shareholders of firm A is higher than the market price. Thus, the nonfamily shareholders of firm A realize a negative NPV from their investment in firm B, or equivalently, the nondiverted NPV of firm B is negative. A similar argument holds for the other case.

B.3. The Choice of Structure

Our final step is to compare the maximum payoff for each structure (equations (2) and (6)) at the optimal ownership concentration. The key result is that, if $i < \bar{i}$, the horizontal structure is chosen, and if $i > \bar{i}$, the pyramidal is chosen instead. As we explain above, when $i < \bar{i}$, the ultimate ownership in the horizontal structure is higher. A more concentrated ownership leads to a higher NPV (because $\frac{\partial \text{NPV}}{\partial \omega} > 0$). In addition, the nondiverted NPV in this region is positive, so it is better for the family to capture this value entirely (choosing a horizontal structure) than to share it with the nonfamily shareholders of firm A (pyramidal structure). Conversely, when $i > \bar{i}$, the ultimate ownership in the pyramidal structure is higher and the nondiverted NPV of firm B is negative. Thus, in this region, the pyramid is the best option for the family.

We summarize the above discussion in the following result:

RESULT 9: *Let* $(\bar{\alpha}, \bar{c}, \bar{r}, \bar{i}, \bar{k})$ *be parameters such that* $\omega^H = \omega^P = \bar{\omega}$. *For* $i > \bar{i}$, *the ultimate ownership in a pyramid is higher* ($\omega^P(i) > \omega^H(i)$), *the nondiverted* NPV *of firm B is negative under both structures, and, if feasible, the pyramidal structure is chosen (identical results hold when* $r < \bar{r}$ *and when* $k < \bar{k}$*). For* $i < \bar{i}$, *the ultimate ownership in a pyramid is lower* ($\omega^P(i) < \omega^H(i)$), *the nondiverted* NPV *of firm B is positive under both structures, and the horizontal structure is always chosen (identical results hold when* $r > \bar{r}$ *and when* $k > \bar{k}$*).*

As the above discussion illustrates, the model with endogenous ownership produces essentially the same results regarding pyramidal and horizontal structures that we describe in Section I.

The relative size of the family's ultimate cash flow stake in either structure depends on the parameter values. For some parameter values we have $\omega^P > \omega^H$, and for others, $\omega^P < \omega^H$. However, Result 9 cannot be taken to the data because it compares the hypothetical values of ownership concentration that would arise if each structure were to be chosen, rather than the observed (or effectively chosen) ownership concentration levels. The following result establishes that relation.

RESULT 10: *Suppose that different structures are the result of variation in r, i, or k (one by one). The ultimate ownership concentration level observed in any pyramidal structure is lower than that observed in any horizontal structure. It follows directly that diversion from firm B is higher in pyramids.*

This result is a direct implication of Result 9 and is clarified by referring to Figure 1. The pyramidal structure is chosen when $i > \bar{i}$. These investment levels map into ownership concentrations that satisfy $\omega^P < \bar{\omega}$. Also, the horizontal structure is chosen whenever $i < \bar{i}$. The associated ownership concentration levels are $\omega^H > \bar{\omega}$.

Finally, we analyze the determinants of the threshold $\bar{\omega}$.

RESULT 11: *The threshold of ultimate ownership below which the pyramid is chosen, $\bar{\omega}$, is decreasing in investor protection.*

At the threshold $\bar{\omega}$, the nondiverted NPV of firm B is zero. As investor protection deteriorates, ownership concentration must increase to keep the diversion level and the NPV constant. The implication of this result is that, in countries that provide poor investor protection, it is more likely that families will hold a large ultimate cash flow stake in pyramidal firms.

C. Discussion

We show in Result 10 that the observed ultimate ownership is lower in a pyramidal structure than in a horizontal structure. Many authors make the informal observation that ultimate ownership in a pyramid is low. The traditional argument is that the chain of control mechanically reduces ultimate ownership. As Result 9 indicates, however, if we compare the ultimate ownership a firm would have under both structures, it is not always lower in a pyramidal structure. The traditional argument ignores the fact that, because of the presence of retained earnings, the pyramid might offer a financing advantage in that the family may need to sell fewer shares to finance the new firm. Our argument in Result 10 takes this into account. The pyramid is set up when the investment required is high, revenues are low, and/or investor protection is low. But in these situations more shares need to be sold to finance the setup costs of the new firm. This selection effect explains why ultimate ownership is lower in a pyramid than in a horizontal structure.

A similar argument holds for diversion. The traditional view is that diversion is higher in a pyramidal structure because the chain of control reduces the family's ultimate ownership. This argument ignores the fact that families are interested in reducing diversion because its cost falls back on them (see Result 8). Our model is consistent with the empirical observation that there is more diversion in pyramids even when families are interested in minimizing diversion. In our model, some types of firms end up in horizontal structures and other types of firms end up in pyramidal structures. True, diversion is higher in firms that end up in pyramidal structures. However, for the firms that are optimally set up in pyramids, diversion would have been even higher (because of a lower ultimate ownership concentration) if the horizontal structure had been chosen instead. That is, in our model it is *not* the pyramidal structure *itself* that increases diversion.

Result 10 shows that the observed ultimate ownership is lower in pyramids than in horizontal structures. This does not imply that ownership concentration should be low in a pyramid in an absolute sense. In fact, the threshold of ultimate ownership at which the family switches to the pyramidal structure, $\bar{\omega}$, can be quite high. If, for example, this threshold is strictly above 50%, some pyramidal firms will have ultimate ownership concentration around 50%. Clearly, for these firms, the family could have achieved the same degree of control by simply holding shares directly. Yet the family chooses the pyramid because of its financing and payoff advantages, described above. Depending on the parameter values, our model can also predict very low ownership concentration in pyramidal firms. Thus, unlike the traditional argument for pyramids, our model accommodates both high- and low-ownership concentration in pyramidal firms. We see this as a strength of the model because the empirical evidence indicates that both cases are common in practice.

IV. Extensions

In this section we consider two extensions of our basic framework. First, we discuss a few reasons why a pyramid might be different from a single firm comprised of divisions A and B. Second, we analyze the possibility of a variable scale of investment in firm B.

A. Should Firm B Be a Separate Firm or a Division?

Our analysis so far defines a pyramid as the structure that results when firm A sets up firm B. But the definition of a pyramid also requires that firm B not be wholly owned by firm A. Otherwise, one could think of firm B simply as a project of firm A.

There are several reasons outside our model why a controlling shareholder might wish to list a firm separately (see Morck, Wolfenzon, and Yeung (2005) for a review of the relevant literature). The potential benefits include the option to separately file for bankruptcy while preserving the assets of the other companies in the group, the possibility of offering better incentives and more control for middle managers, and an increase in transparency that stems from the information in stock prices. Our model, augmented by any of these mechanisms, would produce pyramidal structures in which the two firms are legally independent firms.

One possibility related to our model is that the diversion technology might depend on the ownership structure chosen for firm B.[21] For example, two

[21] In the benchmark model, as in Section III.A.1 below, the assumption maintained is that the choice of ownership structure does not affect the diversion technology.

independent projects might be more transparent than a single diversified conglomerate composed of these two projects, specially when they are in different industries. It can be argued that higher transparency would make it more difficult to divert assets or, in the notation of our paper, that transparency increases k.[22] Under this assumption, whether the family wants to set up a pyramid with the firms as separate legal entities, or a single firm with firm B as a wholly owned subsidiary of firm A, depends on whether A and B are in the same industry. If they are not, the family would prefer a pyramid to a diversified conglomerate because the former increases transparency and commits the family not to divert. If, on the other hand, A and B are in the same industry, there is a smaller loss of transparency from having firm A own 100% of the shares of firm B. This argument suggests that separate companies organized in pyramids are more likely to correspond to separate industry ventures, while same-industry expansion could be done within existing firms.

Next, we consider an extension of our basic framework that also distinguishes between a pyramid and a conglomerate, even if the choice of ownership structure has no direct effect on the diversion technology.

A.1. Within-Country Variation in the Degree of Investor Protection

We focus on the cases in which the family chooses the pyramidal structure and analyze the optimal financing of firm B. This financing can take the form of the sale of shares of firm A, firm B, or a combination of the two. We show that, in many cases, it is optimal for the family to sell shares of firm B directly to the market, that is, it is optimal for firm A to retain less than 100% of the cash flow rights of firm B. In these cases, it is clear that the structure chosen will be a pyramid.

To analyze this case we need a model in which the optimal ownership concentration is well defined. Thus, we use the model with costly diversion from Section II. We augment that model by allowing for the possibility of diversion from firm A. Because we model diversion from both firms A and B, we can analyze the trade-off of selling shares of these firms to raise funds.

In Section II, the parameter k in the cost of diversion $c(d, k)$ is common to all firms in a country. The underlying assumption is that all firms are subject to the same laws, regulations, and institutions that protect outside investors. However, even though there is an important common component in investor protection, there is also evidence of variation within a single country (Durnev and Kim (2005)). The reason for this firm-specific heterogeneity can be purely technological, as some industries are inherently more transparent than others (Durnev, Morck, and Yeung (2004)). Firms can also take actions to modify the degree of investor protection they provide. For example, firms can hire more independent outside directors, they can have their books audited by a reputable accounting firm, etc. Accordingly, in this section we assume that there is within-country variation in the degree of investor protection that firms offer by letting

[22] We thank one of our referees for suggesting this argument.

k_A be potentially different from k_B, where k_A and k_B are the parameters in the cost-of-diversion function for firms A and B, respectively. However, we maintain the assumption that there is a significant country component. This assumption is consistent with Doidge, Karolyi, and Stulz (2004), who find that most of the variation in individual firm corporate governance measures is driven by country characteristics. We also maintain the assumption that k_A and k_B are independent of the choice of ownership structure.

As in Section II, we consider a model that starts at date 1. At this date the family has stake α_1 in firm A and the possibility of setting up firm B arises. Instead of assuming that firm A generates cash flows at date 1, we assume that it generates cash flow r_A only at date 2. Of course, the cash flow r_A that occurs at date 2 can be converted into a date 1 cash flow by selling claims against it. However, because we introduce costly diversion from firm A, this conversion will entail deadweight costs. The goal of the family is to set the ownership structure of firms A and B so as to raise the necessary funds in the most cost-efficient way.

We show in the Appendix for quadratic cost-of-diversion functions that, whenever $k_B > k_A$, it is optimal to sell shares of firm B directly to the market. The family prefers to sell shares of the firm with a higher diversion cost, because a higher cost helps it commit to low levels of diversion and thus to an overall lower deadweight cost. Since firm A holds a stake in firm B, the family could sell rights to the cash flows of firm B indirectly by selling shares of firm A. However, when $k_B > k_A$, it is more efficient to sell shares of firm B while minimizing the number of shares of firm A sold. To achieve this goal, the family needs to sells shares of firm B directly.

A.2. Discussion

We acknowledge that there are many potential reasons outside our model for firm B to be a separate legal entity. However, most of these arguments cannot, on their own, explain why the family would not prefer to create a horizontal business group, because in this structure firms are also legally independent. Furthermore, these arguments do not explain how the business group arises in the first place. In this sense, we believe that the results and ideas in this section are complementary to those in Sections I and II.

An important question, however, is whether the need for additional arguments to differentiate pyramids from single firms changes the nature of our model's empirical implications. The answer is that it depends on whether these additional arguments are orthogonal to those firm and country characteristics that are conducive to the family's using firm A to set up firm B, or whether they are correlated to those characteristics in a way that invalidates our previous implications.

We analyze this question in the context of the model presented in Section III.A.1. Consider first the empirical prediction that pyramids should be more common in countries that provide poor investor protection. If there is a country component in the determination of k (Doidge et al. (2004)) then it is more likely that firm B will be set up by firm A in countries that provide poor investor protection (see Sections I and II). However, this result does not guarantee that there will be more pyramidal firms in these countries. If, for some reason, firm A is also more likely to set up firm B as a wholly owned subsidiary in countries with poor investor protection, then our result will break down. However, in Section III.A.1 we show that, conditional on firm A's setting up firm B, whether shares of firm B are sold directly to the market (pyramid) or not (wholly owned subsidiary) depends only on the *relative* magnitudes of k_A and k_B. Because there is no reason to expect the probability of $k_B > k_A$ to vary systematically with investor protection, the proportion of pyramids to wholly owned subsidiaries should not vary systematically across countries.

In addition, we show in the Appendix that whether the family prefers a pyramid or a wholly owned subsidiary does not depend on the inherent profitability of firm B. We conclude that the additional considerations that we introduce in Section III.A.1 to distinguish between a pyramid and a wholly owned subsidiary do not change the empirical implications that we derived in Sections I and II.

B. Variable Scale and Overinvestment in Pyramids

In this section we allow the family to choose the size of the investment in firm B. We use the model of Section I with one modification. Firm B now produces cash flow $r(i)$ at date 2 if an amount i is invested at date 1. The function $r(i)$ satisfies $r'(\cdot) > 0, r''(\cdot) < 0$, and $\lim_{i\to 0} r'(i) = \infty$. The expressions for U^P, U^H, R^P, and R^H are identical to those in Section I, except that $r(i)$ replaces r. The family computes the optimal investment in each structure and then chooses the one with the highest payoff. We show in the Appendix that Result 1 essentially holds in this extension:

RESULT 12: *Let the first best level of investment be defined by $r'(i_{FB}) = 1$. If $(1 - \bar{d})r(i_{FB}) - i_{FB} < 0$, the pyramid is always chosen.*

The intuition for this result is very similar to that in Section I, with the additional complication that the level of investment is now endogenous. The key expression, $(1 - \bar{d})r(i) - i$, should now be evaluated at the first-best level of investment (i_{FB}), which maximizes the total NPV of firm B and is consequently the optimal level of investment in the horizontal structure. If $(1 - \bar{d})r(i_{FB}) - i_{FB} < 0$, then the pyramid yields a higher payoff than the highest one possible under the horizontal structure. In addition, pyramids are associated with greater financing capacity. Thus, pyramids must be optimal. Because the condition that determines whether the pyramid is chosen is almost identical to that in Section I, the comparative statics of Result 2 hold.

The analysis in this section has an important additional implication. In Section I, we assume that firm B must always be a positive-NPV investment, taking into account both security and private benefits. In contrast, the next result shows that the family might have an incentive to make investments in firm B that are, on the margin, negative NPV. The following proposition characterizes the possibility of overinvestment:[23]

RESULT 13: *Suppose that* $i_{FB} \leq c + (1 - \bar{d})r(i_{FB})$. *If the family chooses the pyramid, it will overinvest (relative to the first best) in firm B.*

The family generally has incentives to invest more than the first-best level in the pyramidal structure because the costs of overinvestment are shared with the existing shareholders of firm A. However, when the conditions in Result 13 do not hold, the family will not have the resources to finance investment levels above the first best.

The other reason why we might not see overinvestment is that the family might prefer to use the horizontal structure, which is always associated with the first-best investment level. In particular, Result 12 shows that the horizontal structure is more likely to be optimal when firm B's security benefits are high at that level of investment. In such cases, the family might choose to forgo the private benefits of overinvestment in pyramids and set up a horizontal structure instead.

We conclude that the clearest case for overinvestment in pyramids happens when firm B's security benefits are low (because of high diversion, for example), but the family has accumulated a significant amount of cash in firm A.[24] In this case the excess availability of cash might effectively destroy value in the pyramid, in the sense that firm B would have produced a higher combination of private and security benefits if the pyramidal structure had been ruled out.

V. Empirical Implications

Our theory generates a number of empirical implications, which we list and discuss next. We also highlight empirical and anecdotal evidence that is consistent with our theory, and suggest additional implications that can be tested in the future. We discuss first the implications that are unique to our theory, and then the implications that are shared with the traditional argument.

As we discuss in the introduction, the traditional argument for pyramids is that they are devices to separate ownership from control and thus entrench the controlling family. However, as the first two empirical observations suggest, considerations other than separation of cash flow from voting rights motivate the creation of pyramidal business groups.

1. *It is possible to observe pyramids in which the controlling family has high-cash flow stakes in member firms, in which case the separation between ownership and control is not large.*

The literature offers a number of examples of pyramids in which the family achieves substantial deviation from one share–one vote (see La Porta et al.

[23] We thank one of our referees for suggesting that we pursue this argument.

[24] The underlying logic here is very similar to Jensen's (1986) free cash flow problem.

(1999), Claessens et al. (2000)). However, there are also many other cases in which the separation achieved is small and does not warrant the use of a pyramid. For example, Franks and Mayer (2001) find in their sample of German firms that, in 69% of the pyramid-controlled firms, the controlling shareholder could have achieved the same level of control simply by holding shares in the firm directly. The authors conclude that, in Germany, pyramids are *not* used as a device to achieve control.[25] In a study of ownership and control of Chilean firms, Lefort and Walker (1999) find that the controlling shareholder owns more cash flow than necessary to achieve control. They compute the ultimate cash flow ownership of the controlling shareholder for all the member firms of a pyramidal group and find that this integrated ownership is 57% on average. Thus, the separation of ownership from control achieved through pyramids is minimal. Attig, Fischer, and Gadhoum (2003) find that, in Canada, the cash flow stake of the controlling shareholder in a pyramid is 31.78% on average, while the controlling stake is only a bit higher, 41.68%. Faccio and Lang (2002) report that both dual-class shares and pyramids are commonly used in Western European countries. However, they find large deviations between ownership and control in only a few of the countries they analyze. Demirag and Serter (2003) report similar findings for Turkey, where cash flow and voting rights appear to be closely aligned despite the widespread prevalence of pyramidal structures. Finally, Valadares and Leal (2001) draw a similar picture for Brazil, where according to the authors, pyramids do not appear to be a mechanism to deviate from one share–one vote.

Our model is consistent with these examples. Even though the ultimate ownership concentration is lower in pyramids than in horizontal structures, the ultimate ownership in a pyramid can still be high in an absolute sense (see Section II.C). In fact, depending on the parameter values, pyramidal firms can have either low or high ultimate ownership concentration (and consequently large or small separation of ownership and control). This is consistent with the evidence that in some pyramids significant separation is achieved, while in others virtually no separation of ownership and control obtains. In addition, Result 11 indicates that violations of the traditional story (pyramidal firms with high ultimate ownership) are more likely to be found in countries with poor investor protection.

2. *The family might strictly prefer to create a pyramid, even when restrictions on the issuance of dual-class shares are not binding.*

[25] Franks and Mayer define 25%, 50%, and 75% as critical control levels and argue that voting power between any of these critical levels provides the same degree of control. They show that in 69% of their sample of pyramidal firms, the cash flow and control rights do not straddle a control threshold. To see how, when this is the case, the pyramid is not used to separate ownership and control, consider the following example: A family's ultimate cash flow rights in a firm that belongs to a pyramid are 55% and their voting rights are 70%. If the same controlling party held 55% of the shares directly in the firm, he would have 55% of the votes (assuming one share–one vote). Because 55% and 70% are between the same two critical levels, direct holdings in the firm and the pyramid provide the controller with the same degree of control.

Because we identify a rationale for pyramids over and above the separation of cash flow from voting rights, our model can distinguish between pyramids and direct ownership with dual-class shares even if there are no legal restrictions on the use of dual-class shares. Therefore, according to the model, it should not be surprising to find that pyramids arise even if families have not exhausted the possibility of issuing dual-class shares. In contrast, in such cases the traditional story cannot differentiate between a pyramid and a horizontal structure with dual-class shares.

Indeed, pyramids do arise in situations in which the family could have achieved the same separation with dual-class shares alone. For example, with respect to Italy, Bianchi et al. (2001) measure the ultimate ownership in each firm that belongs to a pyramid, compute the number of units of capital that the family controls with one unit of its own capital, and average this ratio for all the firms in a pyramid. As a benchmark, consider a family that directly holds 50% of the cash flows and votes in a firm. In this case the ratio is two. The family can increase this ratio because Italian law allows the issuance of 50% of the firm's capital in nonvoting shares (savings shares or *azioni di risparmio*). If the family issues the maximum fraction of dual-class shares and retains 50% of the voting shares (i.e., 25% of the total capital), it can achieve a ratio of four. Bianchi, Bianco, and Enriques find that, while some pyramids allow the controlling shareholder to control a large amount of capital (e.g., the ratio for the De Benedetti group is 10.33 and that for the Agnelli group is 8.86), the ratio for other groups is below four, and sometimes even below two (e.g., for the Berlusconi group it is 3.66, and for the Pirelli group only 1.95). Brazil is another country in which dual-class shares can be issued. The evidence in Valadares and Leal (2001) suggests that pyramids are common there despite the fact that many Brazilian firms do not exhaust the possibility of issuing shares with superior-voting rights.

Besides these two key implications, our model generates at least two more that we believe to be unique to our framework.

3. *Pyramids tend to be created over time, following good performance of existing family firms.*

While the timing of the model is exogenously specified in most of the analysis, Result 7 endogenizes it. This result shows that pyramids evolve over time as a function of the performance of the existing firms.

This implication is consistent with the claim of Khanna and Palepu (2000), that one of the most important roles of groups is to set up new firms in which the family and the member firms acquire equity stakes. Aganin and Volpin (2005) describe the evolution of the Pesenti group in Italy and show that it was created by adding new subsidiaries to the firms the Pesenti family already owned. One of their conclusions is that in Italy, business groups expand through acquisitions when they are large and have significant cash resources. Claessens et al. (2002) find that firms with the highest separation of votes and ownership (those at the bottom of the pyramid) are younger than those with less separation (those at the top).

4. *Separate companies in pyramids are more likely to correspond to separate-industry ventures by the controlling family, and are less likely to be in the same industry.*[26]

We argue in Section III.A that, if there is variation in investor protection across firms in a country, some of a group's new firms will enjoy higher investor protection than existing firms. In this case, it is optimal for the family to sell shares of the new firms directly to the market. Doing so sets total diversion lower than if the new firm is set up as a wholly owned subsidiary and capital is raised by selling shares of the parent firm. Implication 4 follows from the observation that, for the same legal and institutional environment (i.e., within the same country), investor protection is more likely to vary across industries than within the same industry (Durnev et al. (2004)).[27]

We note that, because there are other reasons outside our model why the family might want to list group firms separately (see Section III.A) it is possible to observe pyramids that are composed of firms in similar industries. However, the model does predict that, all else constant, multindustry pyramids should be easier to find in the data than single industry ones. We are not aware of any systematic evidence on this implication.

The next two implications are also consistent with the traditional view that pyramids are entrenchment devices that magnify agency costs. However, our theory suggests a different interpretation for the empirical evidence.

5. *Diversion is higher for firms placed in a pyramid than for firms controlled directly by the family. This is not due to the fact that pyramids facilitate diversion. Instead, higher diversion in pyramidal firms is due to a selection effect.*

We show that the observed ultimate ownership is lower in pyramidal firms, and thus diversion is higher (Result 10). This prediction is consistent with empirical findings that pyramids are associated with high expropriation (Bertrand et al. (2002), Bae, Kang, and Kim (2002)).

The traditional argument for pyramids is also consistent with a positive (negative) correlation between pyramidal ownership structures and diversion (ultimate ownership). In fact, it is often argued that pyramids are chosen precisely because they allow the family to divert more resources. The problem with this argument is that, if expropriation is priced, it is not clear why the controlling family has incentives to choose a structure that maximizes it.

In contrast, in our model the family chooses a pyramidal structure to minimize, not to facilitate, diversion. In addition, our model is consistent with the empirical evidence that, in the cross-section, we should observe more expropriation in pyramids. This result is driven by a selection effect. When the new firm requires a large startup investment and generates low revenues, and when investor protection is low, diversion is expected to be high in both structures.

[26] We thank one of our referees for suggesting this empirical implication.

[27] As we mention in Section III.A, this implication would also follow from the assumption that single-industry firms are more transparent than diversified conglomerates.

In such cases the pyramid is optimal. In the opposite case (low investment, high revenues, good investor protection), expropriation is expected to be low under both structures and the horizontal structure is chosen as optimal. Thus, our model predicts a positive association between pyramids and expropriation. However, this is not the same as saying that pyramids maximize diversion. In fact, if the family were forced to set up the new firm in a horizontal structure in the parameter region in which pyramids are optimal, ultimate ownership would be lower and diversion higher than under a pyramid structure.

6. *Firm value and firm performance are lower in pyramid-owned firms than in unaffiliated firms or horizontal structures. As in implication 5, in our model this correlation is due to a selection effect.*

Our model predicts that projects of lower profitability are undertaken as part of a pyramid (Results 2 and 9). Thus, even if the pyramid does not have a direct negative effect on performance, one should see a negative relationship between measures of firm value such as Tobin's Q and pyramidal membership, because low-value firms are selected into the pyramid. Claessens et al. (2002) and Volpin (2002) provide evidence that firms in business groups organized as pyramids have lower Tobin's Q than stand-alone firms and firms organized in horizontal groups. Holmen and Hogfeldt (2004) suggest that this undervaluation is greater if the controlling shareholder has lower ultimate ownership. Claessens et al. (2002), Lemmon and Lins (2003), Lins (2003), Mitton (2002), and Joh (2003) report evidence that the separation of ownership and control is detrimental to performance.[28] Finally, Attig et al. (2003) show that low Tobin's Q predicts membership in a pyramidal group. This last result is particularly consistent with the idea that pyramids undertake lower profitability projects. We emphasize that while the negative correlation between pyramidal ownership and firm performance is also a prediction of the traditional argument for pyramids, the particular interpretation of this correlation as a selection effect is unique to our paper.

Finally, the model generates four implications that should also follow from the traditional argument for pyramids. We discuss these implications to show that our model does not contradict existing empirical evidence on pyramidal business groups.

7. *Family business groups should be more prevalent in countries with poor investor protection.*

In our model, families have a financing advantage over potentially more efficient but less wealthy entrepreneurs because families can use the funds of the firms they already control. In countries that provide low investor protection, this financing advantage is more important because it is more difficult to secure

[28] There is also a literature that examines the relationship between valuation and firm membership in business groups, without distinguishing between pyramids and other types of groups. See Khanna and Rivkin (2001), Khanna and Palepu (2000), Fisman and Khanna (2000), and Claessens, Fan, and Lang (2002).

external financing (see Result 3). Thus, the fraction of the corporate sector that ends up in business groups should be higher in such countries.

This implication is in the spirit of Khanna and Palepu (1997, 1999), who argue that business groups arise in countries with underdeveloped markets. However, it could also be consistent with the traditional argument for pyramids, which broadly predicts a greater concentration of corporate control in countries in which control is more valuable (i.e., countries that provide poor investor protection).[29] We find no systematic evidence on this implication, but there is some scattered and anecdotal evidence. For example, Claessens et al. (2002) show that the incidence of business groups is high in developing Asian countries, where more than 50% of the firms in their sample are affiliated with business groups. Faccio and Lang (2002) report similar results for Europe.

8. *Family business groups are more likely to be organized as pyramids, especially in countries with poor investor protection.*

In our model, the conditions that are conducive to the appearance of business groups also support the choice of pyramids over horizontal structures. Families choose the pyramidal structure if the security benefits associated with the new firm are low (high investment, low revenues, and poor investor protection). However, it is precisely in these cases that a talented outside entrepreneur cannot finance the new venture in the external capital market. As a result, the business group is created and the pyramid employed.

As we discuss in Section I.D, if there are other reasons for firm B to be set up in a business group (for example, if the family is also the most efficient owner of firm B), then the group may be organized horizontally. However, in this case the underlying rationale for the existence of the business group does not necessarily correlate with investor protection. A more general way to state the implication of our model is that the *types* of business groups that appear because of poor investor protection (in our model, those that appear because of financial market underdevelopment) tend to be organized as pyramids. Thus, while business groups are likely to use pyramidal structures in countries with poor investor protection, they might be organized horizontally in other countries with higher investor protection.

The traditional argument also predicts that pyramids should be widely used by the business group's controlling family to magnify the separation between ownership and control.

La Porta et al. (1999) show evidence that pyramids are very common in countries with poor investor protection. Another piece of evidence that business groups are typically organized as pyramids is that researchers have treated these two terms as synonymous when analyzing the role of family control in developing countries.

9. *Firms in pyramids are larger, or they are more likely to belong to capital-intensive industries.*

[29] See, for example, Bebchuk (1999).

We show that as the required investment increases, firms are more likely to belong to pyramidal business groups (Results 2 and 9). In addition, in the extension in Section III.B we show that pyramids might lead to overinvestment. Both arguments suggest that pyramidal firms should be associated with larger scales of capital investment. Nevertheless, this implication may also follow from the traditional argument because a greater degree of separation between ownership and control might be needed for the family to control larger firms. Attig et al. (2003) find evidence consistent with this implication, using Canadian data. Claessens et al. (2002) also find that in East Asia, group firms tend to be larger than unaffiliated firms. Bianchi et al. (2001) find similar evidence for Italy.

10. *When a new firm is added to a pyramidal structure, the existing nonfamily shareholders of the pyramid realize a negative return.*

Results 1 and 9 show that pyramids can be chosen only when the pledgeable income of firm B is lower than the required investment. This condition implies that existing shareholders of firm A realize an ex post loss when the pyramid is formed. As we show in Section I.E, this does not mean that shareholders also lose in an ex ante sense, because the shares in the parent firm are probably priced to reflect future expropriation.

Because the traditional argument associates pyramids with high agency costs, this implication also appears to be consistent with the usual argument for pyramids. We are not aware of any direct tests of this hypothesis in the empirical literature.

VI. Concluding Remarks

We believe that a full understanding of the structure of business groups requires answers to three different questions: (1) Why are multiple assets concentrated in the hands of a single family? (2) Why are these assets grouped into legally independent firms? (3) What determines the choice of ownership structure of these firms? In this paper, we provide answers to these questions by using a single imperfection, namely, poor investor protection.

Our theory explains why families use a pyramidal structure to achieve control of several firms in a business group, as opposed to holding shares directly in these firms (a horizontal structure). It shows that pyramids have both a payoff and a financing advantage over horizontal structures when the amount of diversion is expected to be high (e.g., because investor protection is poor). It also shows that the cases in which the pyramidal structure is optimal for the family are also cases in which the business group itself is more likely to appear. Thus, our theory provides a rationale for why it is so common for business groups to adopt a pyramidal ownership structure.

Our argument departs from the traditional story that pyramids are a device to separate cash flow from voting rights. The model can thus generate cases in which pyramidal firms have only minor deviations from one share–one vote. It can also explain why pyramids arise even if the family is free to deviate from one share–one vote with the use of dual-class shares, that is, it explains why pyramids are different from dual-class shares. Our theory can help us understand recent empirical evidence, with which the traditional view of pyramids is not consistent, that some pyramidal firms are associated with small separation between ownership and control. While some predictions of our model are consistent with existing empirical findings, other predictions are backed only by anecdotal evidence. Future empirical work could test these implications in a more systematic way to help us better understand these complex organizations.

Another important issue for future theoretical work is the normative implications of the existence of business groups. We argue here that pyramidal business groups can be efficient for the family. However, this is not enough to establish efficiency from the perspective of social welfare. Previous authors argue that family business groups can have deleterious effects on overall economic efficiency because they foster an inefficient allocation of corporate control through family inheritances (Morck et al. (2000)), they hamper the development of external capital markets (Almeida and Wolfenzon (2005)), and they lobby for regulations that impede financial development (Rajan and Zingales (2003a, 2003b) and Morck and Yeung (2004)). A model that blends these ideas into our current framework might generate interesting normative implications regarding pyramidal business groups.

Appendix: Proofs

Proof of Result 1: When $(1-\bar{d})r > i$, it holds that $U^H > U^P$ and $\bar{R}^H \geq i$. Therefore, the horizontal structure is chosen.

When $(1-\bar{d})r < i$, it holds that $U^H < U^P$. In this case, we cannot guarantee that the pyramidal structure is always feasible. However, because $\bar{R}^P \geq \bar{R}^H$, the pyramidal structure is feasible whenever the horizontal structure is. As a result, the family chooses the pyramidal structure whenever it is feasible (i.e., it is never the case that the pyramid is preferred but only the horizontal is feasible). Q.E.D.

Proof of Result 2: The condition $(1-\bar{d})r < i$ is more likely to hold when r is low, i is high, and investor protection is low (i.e., $\bar{d}$ is high). Q.E.D.

Proof of Result 3: If $t < 0$, the entrepreneur never owns the firm. If $t > 0$, whenever the entrepreneur can finance the required investment i, he will set up firm B and business groups will not appear. Thus, the condition required for business groups not to appear is that the income that the entrepreneur can pledge to outside investors, $\bar{R}^E$, is enough to finance the investment:

$$\bar{R}^E = (1-\bar{d})(1+t)r \geq i. \tag{A1}$$

Clearly, if r is high, t is high and/or i is low, equation (A1) is more likely to hold. Furthermore, an increase in investor protection k decreases diversion $\bar{d}$ and facilitates entrepreneurial finance.

As we claim in footnote 14, note that if the family can drive out entrepreneurs who are just marginally viable (that is, if $\bar{R}^E - i$ is positive but small), then r

and t would have to be higher and/or i and $\bar{d}$ would have to be lower to generate entrepreneurial ownership. Such a possibility would thus lead to a result that is qualitatively identical to Result 3. Q.E.D.

Proof of Result 4: By Result 1, a horizontal structure can only arise when $(1-\bar{d})r \geq i$. However, this condition implies that when $t > 0$, $\bar{R}^E = (1-\bar{d})(1+t)r \geq i$, and thus the entrepreneur can finance the project. In this case, the business group does not appear. If $t < 0$, the family always owns firm B, and the horizontal group appears under the same conditions characterized in Result 1. Q.E.D.

Proof of Result 5: In order to finance firm A, the family sells a fraction $(1-\alpha)$ of this firm and raises R. Because $(1-\bar{d})r_B < i_B$, at date 1 the family sets up firm B in a pyramid. Thus, firm A does not pay a dividend at date 1, but rather invests the cash $c = R - i_A + r_A$ of firm A to set up firm B. To raise additional financing at date 1, firm A sells stake $(1-\beta_P)$ of firm B to the market. We assume without loss of generality that firm A raises just enough cash to set up firm B, that is, $R - i_A + r_A + (1-\beta_P)(1-\bar{d})r_B = i_B$. At date 2, firm A receives dividends of $\beta_P(1-d)r_B$, which by the previous equation equals $R - i_A + r_A + (1-\bar{d})r_B - i_B$. Because investors in firm A break even, we have that $R = (1-\alpha)[R - i_A + r_A + (1-\bar{d})r_B - i_B]$, or $R = \frac{1-\alpha}{\alpha}[r_A - i_A + (1-\bar{d})r_B - i_B]$. Note that as long as $r_A - i_A + (1-\bar{d})r_B - i_B > 0$, the family can raise any amount of money at date 0. In particular, the family can raise enough to fund firm A and to make the pyramid feasible at date 1. Q.E.D.

Proof of Result 6: Consider first the case in which pyramids are ruled out by contract. At date 0, the family sells a fraction $1-\alpha$ of firm A to raise the set up cost, i_A (this is without loss of generality, that is, we can show there is no benefit in raising more funds). We have $(1-\alpha)\bar{r}_A = i_A$. Let $\alpha^* = 1 - \frac{i_A}{\bar{r}_A}$ denote the stake that the family retains in firm A.

The cash that the family holds at date 1 is $\alpha^* r_A$. Thus, setting firm B in a horizontal structure is feasible if and only if $\alpha^* r_A + (1-\bar{d})r_B > i_B$. In the low cash flow state this inequality becomes

$$-\alpha^*\Delta + \bar{r}_A - i_A + (1-\bar{d})r_B > i_B. \tag{A2}$$

This inequality never holds since, by assumption, $\bar{r}_A - i_A + (1-\bar{d})r_B < i_B$. In the high cash flow state the horizontal structure is feasible when

$$\alpha^*\Delta + \bar{r}_A - i_A + (1-\bar{d})r_B > i_B. \tag{A3}$$

Consider now the case in which pyramidal structures are not ruled out. In this case, the horizontal structure never arises since $(1-\bar{d})r_B < i_B$ implies that, at date 1, the family either chooses the pyramidal structure or does not set up firm B.

At date 0, the family sells fraction $1-\alpha$ of firm A and raises R. We consider the equilibrium in which date 0 investors expect the family to set up firm B in a pyramid only when the cash flows of firm A are high (we show below that it will never be an equilibrium to expect that the family sets up the pyramid when cash flows are low). Below, we provide the condition under which this equilibrium is feasible.

We compute the cash flows that date 0 investors expect to receive. In the low-cash-flow state at date 1, the family pays the cash in firm A ($c = R - i_A + \bar{r}_A - \Delta$) as dividends and does not set the pyramid. In case of a high cash flow state at date 1, the family uses all the cash in firm A to set up firm B in a pyramid. Thus, firm A shareholders do not receive anything at this date, but instead wait until date 2. To set up firm B, the family sells $1 - \beta_P$ shares to raise additional cash. We assume without loss of generality that the family raises just enough cash to set up firm B, that is

$$R - i_A + \bar{r}_A + \Delta + (1 - \beta_P)(1 - \bar{d})r_B = i_B. \tag{A4}$$

At date 2, firm A receives dividends of $\beta_P(1 - \bar{d})r_B$ from firm B, which by the last equation equal $R - i_A + \bar{r}_A + \Delta + (1 - \bar{d})r_B - i_B$. Firm A then uses these proceeds to pay a dividend to its shareholders.

To establish the relation between R and α, we combine the cash flows that date 0 investors expect to receive. Because R must equal the expected cash flows to date 0 investors, we have

$$R = (1 - \alpha)\left[\frac{1}{2}\left(R - i_A + \bar{r}_A - \Delta\right) + \frac{1}{2}(R - i_A + \bar{r}_A + \Delta + (1 - \bar{d})r_B - i_B)\right], \tag{A5}$$

or

$$R = \frac{1 - \alpha}{\alpha}\left[\bar{r}_A - i_A + \frac{1}{2}((1 - \bar{d})r_B - i_B)\right]. \tag{A6}$$

To sustain the equilibrium, R needs to be set large enough so that the pyramid is feasible in the high-cash-flow state, but low enough so that the pyramid is not feasible in the low-cash-flow state. That is, we need

$$R - i_A + \bar{r}_A + \Delta + (1 - \bar{d})r_B \geq i_B, \tag{A7}$$

and

$$R - i_A + \bar{r}_A - \Delta + (1 - \bar{d})r_B < i_B. \tag{A8}$$

Note from equation (A6) that as long as

$$\bar{r}_A - i_A + \frac{1}{2}[(1 - \bar{d})r_B - i_B] > 0, \tag{A9}$$

R can be set to any positive value by an appropriate choice of α. In particular, when equation (A6) holds, R can be set so as to satisfy equations (A7) and (A8). Equation (A9) is sufficient for the existence of the equilibrium in which the pyramidal structure is set up in the high-cash-flow state.

Furthermore, note that the only possible equilibrium when equation (A9) holds is the one in which shareholders expect the family to set up the pyramid only when cash flows are high. It might seem that R can be set sufficiently high so as to finance the pyramid in all states. However, this is not an equilibrium because if R is such that the pyramid is feasible in both states, investors will anticipate that the family will always set up firm B in a pyramid, and the expression for R would change to $R = \frac{1-\alpha}{\alpha}[\bar{r}_A - i_A + (1-\bar{d})r_B - i_B]$. Since the right-hand side is always negative, this is not an equilibrium. We can also see from this explanation why is it not possible to have a pyramid only when the cash flows are low. If the pyramid is feasible in the low-cash-flow state, it will also be feasible in the high-cash-flow state and the family will not be able to raise any money at date 0.

Finally, note that when equation (A9) holds, but equation (A3) does not, ruling out pyramids eliminates the possibility of setting up firm B, whereas not ruling them out at least allows the family to set up firm B in the high-cash-flow state. There is a region of the parameter space in which it is possible to have both equation (A9) holding but not equation (A3). This region is defined by

$$\alpha^*\Delta + \bar{r}_A - i_A + (1-\bar{d})r_B < i_B < 2(\bar{r}_A - i_A) + (1-\bar{d})r_B. \tag{A10}$$

Because $2(\bar{r}_A - i_A)$ can be greater than $\alpha^*\Delta + \bar{r}_A - i_A$, this inequality is possible. Q.E.D.

Proof of Result 7: If the pyramid is set up at date 0, the maximum pledgeable income of firms A and B is $\bar{r}_A - i_A + (1-d)r_B - i_B < (1 - \frac{i_A}{\bar{r}_A})\Delta + \bar{r}_A - i_A + (1 - d)r_B - i_B < 0$, where the last inequality follows from condition 14. Thus the family cannot set up the pyramid at date 0 even if firm B is available at that date. Q.E.D.

Proof of Result 8: We just need to show that, in both structures, the family benefits from committing to a low level of diversion. For the horizontal structure, this follows from the fact that $\frac{\partial U^H}{\partial d} = -c_d < 0$. For the pyramidal case, the optimal diversion level from the perspective of date 1 solves $\frac{\partial U^P}{\partial d} = 0$ or $1-\alpha = c_d(d,k)$, which using the definition of $d(\cdot,\cdot)$ can be expressed as $d(\alpha,k)$. However, diversion is decided at date 2, when the family's ultimate ownership is $\alpha\beta^P$. Thus, actual diversion is given by $d(\alpha\beta^P,k)$. Since $\frac{\partial^2 U^P}{\partial d^2} = -c_{dd}(d,k)r < 0$, the closer $d(\alpha\beta^P,k)$ is to $d(\alpha,k)$, the higher is U^P. Because $d(\alpha\beta^P,k) > d(\alpha,k)$, the family gains from reducing diversion. Q.E.D.

Proof of Result 9: We first show that, for the parameter values $(\bar{\alpha},\bar{c},\bar{r},\bar{i},\bar{k})$, it follows that $(1-d(\bar{\omega},\bar{k})) - \bar{i} = 0$, and $U^P = U^H$. By equations (18) and (19),

$$\begin{aligned}
\tilde{R}^H(\bar{\omega}) &= \tilde{R}^P(\bar{\omega}),\\
\bar{\alpha}\bar{c} + (1-\bar{\omega})(1-d(\bar{\omega},\bar{k}))\bar{r} &= \bar{c} + \left(1 - \frac{\bar{\omega}}{\bar{\alpha}}\right)(1-d(\bar{\omega},\bar{k}))\bar{r}, \quad \text{and}\\
(1-d(\bar{\omega},\bar{k}))\bar{r} &= \frac{\bar{\alpha}\bar{c}}{\bar{\omega}}.
\end{aligned} \tag{A11}$$

Thus, as we explain in the text, for these parameter values, the market price, $(1-d(\bar{\omega},\bar{k}))\bar{r}$, and the implied price, $\frac{\bar{\alpha}\bar{c}}{\bar{\omega}}$, are the same. Plugging the last equality into equation (18) leads to $(1 - d(\bar{\omega}, \bar{k}))\bar{r} = \bar{i}$. Now, $U^P = \bar{\alpha}\bar{c} + NPV - (1 - \bar{\alpha})[(1 - d(\bar{\omega}, \bar{k}))\bar{r} - \bar{i}] = \bar{\alpha}\bar{c} + NPV = U^H$.

Now, we prove another intermediate result. Let $i_1 > i_2 > c$. Then, it must be that $\omega^H(i_1) < \omega^H(i_2)$ and $\omega^P(i_1) < \omega^P(i_2)$.[30] We prove this result only for the horizontal structure (the pyramidal case is identical). Suppose, arguing by contradiction, that $i_1 > i_2 > c$ and $\omega^H(i_1) \geq \omega^H(i_2)$. First, because $\tilde{R}^H(1) = \alpha c < c < i_2 < i_1 = \tilde{R}^H(\omega^H(i_1))$, then by the Intermediate Value Theorem (R^H is continuous) there exists a $\hat{\omega} \in (\omega^H(i_1), 1)$ such that $\tilde{R}^H(\hat{\omega}) = i_2$. Now, since by assumption $\omega^H(i_1) \geq \omega^H(i_2)$, it must be that $\hat{\omega} > \omega^H(i_2)$. But this is a contradiction because ω^H (i_2) is defined as the highest ω such that $\tilde{R}^H(\omega) = i_2$.

We now prove the result for i. Proofs for r and k are identical. We consider the parameter set $(\bar{\alpha}, \bar{c}, \bar{r}, i, \bar{k})$, with $i > \bar{i}$. Recall that we are considering only investment levels strictly above c, that is, $\bar{i} > c$.

By the intermediate result shown above, $\omega^H(i) < \omega^H(\bar{i}) = \bar{\omega}$ and $\omega^P(i) < \omega^P(\bar{i}) = \bar{\omega}$. Also, because $(1 - d(\omega, k))r - i$ is increasing in ω and decreasing in i, and because $(1 - d(\bar{\omega}, \bar{k}))\bar{r} - \bar{i} = 0$, it must be that $(1 - d(\omega^H(i), \bar{k}))\bar{r} - i < 0$ and $(1 - d(\omega^P(i), \bar{k}))\bar{r} - i < 0$.

Next, we show that $\omega^P(i) > \omega^H(i)$. We show above that $(1 - d(\omega^H(i), \bar{k}))\bar{r} - i < 0$. Replacing $i = \tilde{R}^H(\omega^H(i)) = \alpha c + (1 - \omega^H(i))(1 - d(\omega^H(i), \bar{k}))\bar{r}$ into this last inequality and rearranging leads to $\frac{\bar{\alpha}\bar{c}}{\omega^H(i)} > (1 - d(\omega^H(i), \bar{k}))\bar{r}$. Now, evaluating $\tilde{R}^P$ at $\omega^H(i)$ we have

$$\begin{aligned}\tilde{R}^P(\omega^H) &= \bar{\alpha}\bar{c} + \left(\frac{\omega^H}{\bar{\alpha}} - \omega^H\right)\left(\frac{\bar{\alpha}\bar{c}}{\omega^H}\right) + \left(1 - \frac{\omega^H}{\bar{\alpha}}\right)(1 - d(\omega^H, \bar{k}))\bar{r} \\ &> \bar{\alpha}\bar{c} + \left(\frac{\omega^H}{\bar{\alpha}} - \omega^H\right)(1 - d(\omega^H, \bar{k}))\bar{r} + \left(1 - \frac{\omega^H}{\bar{\alpha}}\right)(1 - d(\omega^H, \bar{k}))\bar{r} \\ &= \bar{\alpha}\bar{c} + (1 - \omega^H)(1 - d(\omega^H, \bar{k}))\bar{r} = \tilde{R}^H(\omega^H) = i, \end{aligned} \tag{A12}$$

where the inequality follows from $\frac{\bar{\alpha}\bar{c}}{\omega^H(i)} > (1 - d(\omega^H(i), \bar{k}))\bar{r}$. Since $\tilde{R}^P(\omega^H(i)) > i > c = \tilde{R}^P(\alpha)$, by the Intermediate Value Theorem there must be a $\hat{\omega} \in (\omega^H(i), \alpha)$ such that $\tilde{R}^P(\hat{\omega}) = i$. Because ω^P (i) is defined as the highest ω such that $\tilde{R}^P(\omega) = i$, it must be that $\omega^P(i) \geq \hat{\omega}$, and consequently $\omega^P(i) > \omega^H(i)$.

Finally, we compare utilities under both structures

$$\begin{aligned} U^P &= \bar{\alpha}\bar{c} + \mathrm{NPV}(\omega^P) - (1 - \bar{\alpha})[(1 - d(\omega^P, \bar{k}))\bar{r} - \bar{i}] \\ &> \bar{\alpha}\bar{c} + \mathrm{NPV}(\omega^H) = U^H. \end{aligned} \tag{A13}$$

The inequality follows because (1) $\mathrm{NPV}(\omega^P) > \mathrm{NPV}(\omega^H)$ since $\omega^P > \omega^H$ and $\mathrm{NPV}(\omega)$ is increasing, and (2) $(1 - d(\omega^P, \bar{k}))\bar{r} - i < 0$. Q.E.D.

[30] This intermediate result simply says that to finance a larger investment level, the family needs to sell more shares. The reason why the proof is not trivial is that we cannot guarantee that the functions R^H and R^P are always decreasing with ω. In fact, there are regions in which these functions are increasing.

Proof of Result 10: Fix a parameter vector $(\bar{\alpha}, \bar{c}, \bar{r}, \bar{i}, \bar{k})$ such that, for these parameters, $\omega^H = \omega^P = \bar{\omega}$. Suppose that the different structures are chosen due to variation in i (an identical argument can be made with respect to the other parameters). We know from Result 9 that the pyramidal (horizontal) structure is chosen for $i > \bar{i} (i < \bar{i})$. Thus, $\omega^P(i > \bar{i}) < \bar{\omega}$ and $\omega^H(i < \bar{i}) > \bar{\omega}$. That is, all pyramids we observe have ultimate ownership below $\bar{\omega}$ and all horizontal structures have ultimate ownership above $\bar{\omega}$. Q.E.D.

Proof of Result 11: Recall that $\bar{\omega}$ is the ultimate ownership concentration at which both the pyramidal and the horizontal structures raise the same amount i. This value is defined by $\tilde{R}^H(\bar{\omega}) = i$ and $\tilde{R}^P(\bar{\omega}) = i$. We can rewrite this system as

$$\bar{\omega}(1 - d(\bar{\omega}, k))r = \alpha c, \tag{A14}$$

and

$$(1 - d(\bar{\omega}, k))r = i. \tag{A15}$$

Because the system has two equations, for it to hold after a change in k, at least two parameters need to change. We consider the effect on $\bar{\omega}$ and i. Differentiating the first equation with respect to k leads to $r[\bar{\omega}_k(1 - d) - \bar{\omega} d_\omega \bar{\omega}_k - \bar{\omega} d_k] = 0$, or $\bar{\omega}_k = \bar{\omega} d_k/(1 - d - \bar{\omega} d_\omega) < 0$, because $1 - d \geq 0, d_\omega < 0$, and $d_k < 0$. The solution to i can be found from the second equation. Q.E.D.

Proof of the result of Section III.A.1 that, when $k_A < k_B$, the family sets $\beta^P <$ 1. To simplify the analysis we assume specific cost-of-diversion functions for firms A and B. In particular, we assume that the cost of diversion for firm $i = A, B$ is given by $c_i(d_i, k_i) = \frac{k_i d_i^2}{2}$.

To raise funds, firm A sells fraction $1 - \beta_2$ of firm B and, in addition, issues new shares of its own. Letting α_2 be the family's final stake in firm A, the amount of funds raised is given by

$$R^P = \left(1 - \frac{\alpha_2}{\alpha_1}\right)((1 - d_A)r_A + \beta_2(1 - d_B)r_B) + (1 - \beta_2)(1 - d_B)r_B. \tag{A16}$$

The first term is the amount collected by selling shares of firm A, and the second term is the amount raised by selling shares of firm B. Note that because firm A keeps a fraction β_2 of firm A, the family sells a fraction of firm B indirectly through the sale of shares in firm A.

The family's payoff at date 2 is given by

$$U^P = \alpha_2((1 - d_A)r_A + \beta_2(1 - d_B)r_B) + \left(d_A - \frac{k_A d_A^2}{2}\right)r_A + \left(d_B - \frac{k_B d_B^2}{2}\right)r_B, \tag{A17}$$

where the first term is the security benefits of both firms, and the last two terms are the diverted amount from each firm net of the cost of diversion.

At date 2 the family chooses d_A and d_B to maximize its payoff, U^P. Using the first-order conditions (and assuming an interior solution), we have $d_A = (1-\alpha_2)/k_A$ and $d_B = (1-\alpha_2\beta_2)/k_B$.

From the viewpoint of date 1, the problem of the family is to choose α_2 and β_2 to maximize its payoff, U^P, subject to raising enough funds to set up firm B ($R^P \geq i_B$), and subject to the expressions $d_A = (1-\alpha_2)/k_A$ and $d_B = (1-\alpha_2\beta_2)/k_B$. It will be convenient to divide this problem into two steps. In the first step we fix β_2 and find the optimal α_2 and the maximum attainable payoff for the given value of β_2. We let $\alpha_2(\beta_2)$ and $U^P(\beta_2)$ be the optimal value of α_2 and the maximum attainable payoff, respectively. Equipped with $U^P(\beta_2)$, the second step is simply to maximize $U^P(\beta_2)$ over β_2.

We start with the first step. The function $U^P(\beta_2)$ is defined by

$$
\begin{aligned}
U^P(\beta_2) &= \max_{\alpha_2} U^P, \\
&\text{subject to:} \\
R^P &\geq i_B, \qquad\qquad (A18)\\
d_A &= (1-\alpha_2)/k_A, \text{ and} \\
d_B &= (1-\alpha_2\beta_2)/k_B.
\end{aligned}
$$

It can be shown using a procedure similar to that in the proof of Result 8 that, due to costly diversion, the family does not raise more funds than the strictly necessary to set up firm B. The optimal α_2 is then the largest value that satisfies $R^P = i_B$. Or, using equation (A16), $\alpha_2(\beta_2)$ is implicitly defined by

$$
\left(1-\frac{\alpha_2}{\alpha_1}\right)((1-d_A)r_A + \beta_2(1-d_B)r_B) + (1-\beta_2)(1-d_B)r_B = i_B, \quad (A19)
$$

with $d_A = (1-\alpha_2)/k_A$ and $d_B = (1-\alpha_2\beta_2)/k_B$. The expression for $U^P(\beta_2)$ can be found by plugging $\alpha_2(\beta_2)$ into the objective function

$$
U^P = \alpha_1((1-d_A)r_A + (1-d_B)r_B - i_B) + \left(d_A - \frac{k_A d_A^2}{2}\right)r_A + \left(d_B - \frac{k_B d_B^2}{2}\right)r_B, \quad (A20)
$$

where this equation obtains from equation (A17) and $R^P = i_B$.

We move to the second step. The optimal value of β_2 is the one that maximizes $U^P(\beta_2)$. Because we are only interested in showing that $\beta_2 < 1$, it will be sufficient to show that $U^{P\prime}(\beta_2)|_{\beta_2=1} < 0$ (where the prime refers to the derivative with respect to β_2).

Differentiating the objective function in equation (A20) and recognizing that α_2 is a function of β_2, $d_A = (1-\alpha_2)/k_A$, and $d_B = (1-\alpha_2\beta_2)/k_B$, we have

$$U^{P\prime}(\beta_2) = \frac{-\left(k_A\, r_B\, \alpha_2{}^2\, \beta_2\right) + \alpha_1\, \alpha_2'(k_B r_A + k_A r_B \beta_2) + \alpha_2\left(k_A\, r_B\, \alpha_1 - \left(k_B r_A + k_A r_B \beta_2{}^2\right)\alpha_2'\right)}{k_A\, k_B}, \tag{A21}$$

where we use α_2 instead of $\alpha_2(\beta_2)$ and α_2' instead of $\alpha_2'(\beta_2)$ to lighten notation. Next, we obtain $\alpha_2'(\beta_2)$ by completely differentiating equation (A19) with respect to β_2 and rearranging:

$$\alpha_2'(\beta_2) = \frac{k_A r_B \alpha_2(1 - k_B + \alpha_1 - 2\alpha_2\beta_2)}{-(k_A r_B(1+\alpha_1)\beta_2) + k_B(r_A(-1 + k_A - \alpha_1) + k_A r_B \beta_2) + 2\alpha_2\left(k_B\, r_A + k_A r_B \beta_2{}^2\right)}. \tag{A22}$$

Finally, we replace $\alpha_2'(\beta_2)$ into equation (A21) and evaluate the expression at $\beta_2 = 1$ to obtain

$$U^{P\prime}(\beta_2)|_{\beta_2=1} = \frac{(k_A - k_B) r_A r_B (\alpha_1 - \alpha_2)\alpha_2}{-k_B r_A(1 + \alpha_1 - k_A) - k_A r_B(1 + \alpha_1 - k_B) + 2(k_B r_A + k_A r_B)\alpha_2}. \tag{A23}$$

We show that this expression is negative. Note that the numerator is negative, because $k_B > k_A$ and $\alpha_1 > \alpha_2(1)$. To understand this last inequality note that it is always the case that $\alpha_1 \geq \alpha_2(\beta_2)$, because the family sells some non-negative amount of shares of firm A. However, when $\beta_2 = 1$, the inequality is strict. If it were not (i.e., if $\alpha_1 = \alpha_2$ when $\beta_2 = 1$), then R^P would be zero, which is not possible.

We now show that the denominator is positive. We do this by deriving a condition that $\alpha_2(1)$ must satisfy. We go back to the problem in equation (A18), and solve it for $\beta_2 = 1$. Let $\hat{R}_P(\alpha_2)$ be the expression for the amount raised given in equation (A16) as a function of α_2 when $\beta_2 = 1$:

$$\hat{R}_P = \left(1 - \frac{\alpha_2}{\alpha_1}\right)((1 - d_A)r_A + (1 - d_B)r_B). \tag{A24}$$

By replacing the expressions for $d_A = (1 - \alpha_2)/k_A$ and $d_B = (1 - \alpha_2\beta_2)/k_B = (1 - \alpha_2)/k_B$ into the above expression, and differentiating twice with respect to α_2, we obtain $\frac{\partial^2 \hat{R}_P}{\partial \alpha_2^2} = \frac{-2(\frac{r_A}{k_A} + \frac{r_B}{k_B})}{\alpha_1} < 0$. This implies that $\hat{R}_P$ first increases and then decreases with α_2. We let $\bar{\alpha}$ be the value of α_2 at which $\hat{R}_P$ achieves its maximum. The value of $\bar{\alpha}$ can be found by solving $\frac{\partial \hat{R}_P}{\partial \alpha_2} = 0$ and is equal to

$$\bar{\alpha} = \frac{1}{2}\frac{k_B r_A(1 + \alpha_1 - k_A) + k_A r_B(1 + \alpha_1 - k_B)}{k_B r_A + k_A r_B}. \tag{A25}$$

Note that $\alpha_2(1) \geq \bar{\alpha}$. Suppose not, that is, $\alpha_2(1) < \bar{\alpha}$. By increasing α_2 to $\bar{\alpha}$ two things happen. (1) The family's payoff increases. Recall that, when diversion is costly, the family always benefits by increasing its ultimate ownership (see Result 8). (2) The financing constraint relaxes. This follows because the concavity of $\hat{R}^P$ implies that $\frac{\partial \hat{R}_P}{\partial \alpha_2} > 0$ for $\alpha_2 < \bar{\alpha}$. We reach a contradiction because (1) and (2) imply that the hypothesized α_2 is not optimal. We conclude that $\alpha_2(1) \geq \bar{\alpha}$.

Finally, using the expression for $\bar{\alpha}$ in equation (A25) and the fact that $\alpha_2(1) \geq \bar{\alpha}$, it follows straightforwardly that the denominator in equation (A23) is positive.

In sum, we show that the numerator in equation (A23) is negative and the denominator positive. Therefore, $U^{P\prime}(\beta_2)|_{\beta_{2=1}} < 0$, which implies that the optimal value of β_2 satisfies $\beta_2 < 1$.

We also claim in Section III.A.1 that the magnitude of r and i does not affect our result. The proof above shows that the denominator in equation (A23) is always positive. In addition, we also show above that the sign of the numerator only depends on the relative values of k_A and k_B. Q.E.D.

Proof of Result 12: If $(1-\bar{d})r(i_{FB}) - i_{FB} < 0$, then $U^P(i_{FB}) > U^H(i_{FB}) = \max_i U^H(i)$. Thus, if $\bar{R}^P(i_{FB}) \geq i_{FB}$, then the pyramid is chosen since it yields a higher payoff than the maximum possible payoff under the horizontal structure. If $\bar{R}^P(i_{FB}) < i_{FB}$, then the financing constraint will bind in both structures, and investment must be lower than i_{FB}.[31] The investment levels in this case are determined directly by the financing constraints

$$\bar{R}^H(i) = i^H, \quad \text{and} \tag{A26}$$

$$\bar{R}^P(i) = i^P. \tag{A27}$$

Since the pyramid has a larger financing capacity, we have $i_{FB} > i^P > i^H$ in this case. Thus, given that i_{FB} is the first best investment level, $U^H(i^P) > U^H(i^H)$. Finally, in order for the constraint to bind, it must be that $(1-\bar{d})r(i^P) - i^P < 0$. Therefore, $U^P(i^P) = U^H(i^P) - (1-\alpha)[(1-\bar{d})r(i^P) - i^P] > U^H(i^H)$. We conclude that whenever $(1-\bar{d})r(i_{FB}) - i_{FB} < 0$, the pyramid must be chosen.

If $(1-\bar{d})r(i_{FB}) - i_{FB} > 0$, on the other hand, we know that $U^H(i_{FB}) > U^P(i_{FB})$. We also have $\bar{R}^H(i_{FB}) = \alpha c + (1-\bar{d})r(i_{FB}) > i_{FB}$, so that the horizontal structure can finance the first best investment level. Since $U^H(i_{FB}) = \max_i U^H(i)$, the family invests at i_{FB} if it chooses the horizontal structure. Nevertheless, optimal investment in the pyramid is not necessarily i_{FB}. The investment that yields the largest payoff for the pyramid solves the following problem:

$$i^P_* = \arg\max_i U^P(i), \text{ s.t. } \bar{R}^P(i) \geq i. \tag{A28}$$

If the financing constraint is not binding, the first order condition is

$$\alpha[r'(i^P) - 1] + (1-\alpha)dr'(i^P) = 0. \tag{A29}$$

[31] Note that in order for the financing constraint to bind at an investment level i, we must have that $(1-\bar{d})r'(i) < 1$, such that it is not possible to relax the financing constraint simply by increasing the level of investment. Under this condition, if the firm cannot finance an investment level i_1, feasible investment will be necessarily lower than i_1.

Since $r'(i^P) - 1 > 0$ for $i^P < i_{FB}$, and $r'(i^P) > 0$, the investment level that solves this equation is larger than i_{FB}. Denote this level of investment by $\hat{i}$, and let $i_{\max}$ be the maximum amount of investment that a pyramid can finance:

$$\bar{R}^P(i_{\max}) = i_{\max}. \tag{A30}$$

Clearly, $i_*^P = \min(\hat{i}, i_{\max})$. If $(1-\bar{d})r(i_{FB}) - i_{FB} > 0$, it must be that $i_{FB} \le i_*^P$. In order for the horizontal structure to be chosen, we must have that $U^P(i_*^P) < U^H(i_{FB})$. We can write

$$U^H(i_{FB}) - U^P\left(i_*^P\right) = U^H(i_{FB}) - U^H\left(i_*^P\right) + (1-\alpha)\left[(1-\bar{d})r\left(i_*^P\right) - i_*^P\right]. \tag{A31}$$

While the first term is always positive, it is possible that $(1-\bar{d})r(i_*^P) - i_*^P < 0$, and that $U^P({i^P}_*) > U^P(i_{FB})$ if $(1-\bar{d})r(i_*^P) - i_*^P$ is small enough. We conclude that $(1-\bar{d})r(i_{FB}) - i_{FB} > 0$ is a necessary but not necessarily sufficient condition for the horizontal structure to be chosen. Q.E.D.

Proof of Result 13: As we show in the proof of Result 12, the unconstrained optimal investment in the pyramid $(\hat{i})$ is larger than i_{FB}, and actual investment is $i_*^P = \min(\hat{i}, i_{\max})$, where $\bar{R}^P(i_{\max}) = i_{\max}$. If $i_{FB} \le c + (1-\bar{d})r(i_{FB}) = \bar{R}^P(i_{FB})$, we know that $i_{\max} \ge i_{FB}$, and thus ${i^P}_* \ge i_{FB}$. Q.E.D.

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