Do Internal Capital Markets in Business Groups Mitigate Firm Financial Constraints?

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Abstract

We develop a new rationale for investment in business groups subject to moral hazard. Our model suggests that productivity and pledgeable income are the key drivers of financial allocation within an internal capital market. This prediction is contrary to the “socialist” view that there is a cross-subsidization within business groups. One central implication is that business groups tend to allocate financial resources from financially poor to financially strong firms. Our empirical results show that internal capital markets do not necessarily compensate the failures of external financial markets for financially weak firms. Other empirical implications of the model are proposed.
1 Introduction

How do business groups allocate resources in their internal capital markets? Do internal capital markets alleviate the financial constraints of affiliated firms that have limited access to external finance? The business group literature aims at explaining these and other questions about the role of internal capital markets. This research draws primarily on theories explaining resource allocation in conglomerates. One stream of theoretical corporate finance research argues that diversified conglomerates can perform a capital market function, that is, allocate financial resources to projects with higher productivity, overcoming imperfections from external financial markets and improving access to funding of otherwise constrained firms (Williamson, 1975; Gertner et al., 1994; Stein, 1997). Another stream asserts that rent-seeking and incentive problems can lead to inefficient resource allocation in internal capital markets (Scharfstein and Stein, 2000; Rajan et al., 2000).

The empirical literature also shows mixed evidence, both in conglomerates’ and business groups’ internal capital markets, keeping the previous questions open. For example, Shin and Stulz (1998); Rajan et al. (2000); Billett and Mauer (2003); Ozbas and Scharfstein (2010) propose that internal capital markets in diversified conglomerates allocate resources inefficiently. Empirical studies in Korean business groups (Chaebols) show that firm’s investment are sensitive to the cash flow of other companies in the group (Shin and Park, 1999). In addition, Shin and Park (1999) show that investment rates are not different between high- and low-growth opportunity Chaebols firms, but high-growth non-Chaebol firms invest significantly more than low-growth non-Chaebol firms. Gopalan et al. (2007), studying Indian business groups, find that growth opportunities do not drive intra-group loans, suggesting that efficiency is likely not the primary goal in Indian internal capital markets. These findings are consistent with the notion of active internal capital markets and provide evidence of inefficient allocation of capital in business groups.

More recently, however, Kuppuswamy and Villalonga (2010); Hovakimian (2011); Matvos and Seru (2014) indicate that allocative efficiency improves when financial constraints are more likely to be binding in conglomerates and Almeida et al. (2015) find that Korean Chaebols improved their allocative efficiency in the aftermath of the Asian crisis. They show that Korean Chaebols have reallocated capital across member firms, favoring firms with high-growth opportunities.
In this article, we aim to provide a better understanding of internal capital markets in business groups. Theoretically, we develop a simple model of investment in business groups subject to moral hazard. Business groups “typically consist of legally independent firms, operating in multiple (often unrelated) industries, which are bound together by enduring formal (e.g., equity) and informal (e.g., family) ties” (Khanna and Yafeh, 2007, p. 331, emphasis added). This independence allows each firm in a business group to directly access external capital markets and to secure financing on its own merits. In this regard, resource allocation within a business group might be related to the same factors that drive resources in the external capital markets.

Our model proposes that a firm’s productivity and pledgeable income (external financing capacity) jointly explain the (efficient) allocation of internal resources. If two companies have different amounts of pledgeable income, it may be better to allocate resources to the firm with the greatest ability to multiply its wealth rather than to the most productive firm. For example, suppose that Firm 1 has an investment with a net present value of $0.15 per unit of a dollar and can raise $0.80 from outside investors per unit of internal wealth. Firm 2 has an investment with a net present value of $0.20 per unit of a dollar and can raise $0.30 from outside investors per unit of internal wealth. If the entrepreneur has equal cash flow rights in both firms, she maximizes her wealth by allocating the maximum possible amount of internal resources to firm 1. For each $1 of internal wealth, Firm 1 generates an economic surplus of $0.27 = (1 + 0.8) \times 0.15, while firm 2 generates a surplus of $0.26 = (1 + 0.3) \times 0.20. This example illustrates our central argument in two ways. First, productivity alone should not explain the resource allocation of internal capital markets within a business group. Second, pledgeable income is an important factor (if not the most important) in financing investments across firms within business groups.

Our model predictions challenge the argument that the efficiency of an internal capital market is related to the allocation of resources only in the more productive firms. We propose that, if productivity varies little relative to pledgeable income across firms in the same business group, pledgeable income tends to be the most important driver of resource allocation within business groups. Therefore, if one analyzes the determinants of the internal allocation of financial resources, taking pledgeable income for granted, one may conclude that the internal capital markets are inefficient. This conclusion is especially troubling if there is a negative correlation between productivity and pledgeable income (as in the example above).

For example, Shin and Park (1999) and Lee et al. (2009) concluded that internal capital markets do not improve the efficiency of resource allocation, because Chaebols invest more than
non-Chaebols in poor growth opportunity firms (low productivity firms). However, it is worth noting that their research does not control for variables associated with pledgeable income, such as: private benefits, tangible assets, or risk-shifting; all of which are potentially misleading evidence of inefficient allocation.

Empirically, using a sample of Brazilian publicly listed firms from 1998 to 2007, our results suggest that financially weak firms (low pledgeable income) affiliated to business groups invest less than stand-alone firms with similar characteristics (including growth opportunities), while financially strong (high pledgeable income) affiliates tend to invest more than their stand-alone counterparts. This result supports our prediction that pledgeable income is a key determinant for internal resource allocation in business groups and reject, to some extent, the traditional argument that internal capital markets alleviate financial constraints, especially for financially weak firms.

Our main theoretical prediction also finds support in the empirical literature. For example, in Chilean business groups, Buchuk et al. (2014) show that net receivers of intra-group loans tend to be the firms with the most growth opportunities (Tobin’s $Q$), high tangibility of assets (property, plant, and equipment), and of the smallest size. This evidence is consistent with the prediction that productivity (growth opportunities) and pledgeable income (tangibility of assets) jointly determine the allocation of internal resources in business groups.\textsuperscript{1}

This study contributes to the corporate finance literature in two ways. First, we theoretically propose and provide empirical evidence that internal capital markets in business groups work the same way as external financial markets. In other words, our model implies that the same factors that limit a firm’s access to external finance also reduce its access to resources in internal capital markets. According to the literature, a company that has considerable private benefits, few tangible assets (i.e., collateral), and/or high risk-shifting problems may have difficulties in raising external finance.\textsuperscript{2} If this firm is affiliated to a business group, it will face the same constraints in the internal capital market. More specifically, it is likely that this focal firm will be a provider of (and not a receiver of) resources for other companies in the business group. This theoretical prediction is contrary to the view that internal capital markets of business groups

\textsuperscript{1}In contrast to our predictions, Gopalan et al. (2007) show that net intra-group loans are insensitive to growth opportunities and decreases with the tangibility of assets in Indian business groups. As we argue latter, Chilean firms operate in an institutional environment that resembles the structure of our model more than Indian firms. This in part explains the apparent conflicting findings.

can mitigate the negative effect of external financial markets failures (Khanna and Palepu, 2000; Khanna and Yafeh, 2007).

Second, our model generates new testable implications. For example, we distinguish between “receivers” and “providers” of intra-group loans. Only the investment of receivers is sensitive to other affiliates’ cash flow, because receivers benefit from the internal capital market while providers support it. As pledgeable income enables firms to multiply internal wealth and increase investment spending, the investment sensitivity to other affiliates’ cash flow tends to be positive and to increase with pledgeable income.

Moreover, the likelihood that a firm will receive intra-group loans increases with productivity, pledgeable income, and controlling shareholder cash flow rights. In other words, the same factors that make a firm a good candidate for external finance also increase the odds of it accessing the internal capital market. Finally, if financially strong firms are those that receive resources from other affiliates in business groups, these firms will be able to invest more than their stand-alone counterparts. On the flip side, if the financially weak firms in a business group tend to support the internal capital market by sharing its positive cash flow with other affiliates, these firms will have fewer resources available, and, consequently, they will invest less than similar non-business-group firms.

It is worth noting that our predictions do not depend on the production technology assumption, on the way firms transfer resources in the internal capital market (e.g. direct loans or cross-shareholdings); or on the correlation between productivity and pledgeable income. They hinge rather on the assumption that only internal resources can be transferred across group firms, and that any firm within the business group can raise external resources only to fund its investments. When a group firm approaches outside investors, it depends solely on its own merits, and so it makes sense to allocate internal wealth to firms with the greatest capacity to multiply this wealth; in other words, firms with high productivity and pledgeable income (external finance capacity).

The closest paper to ours is Samphantharak (2006), who develops a dynamic investment model in business groups with costly external finance. In that model, if a controlling shareholder can freely transfer resources within the group, including funds raised in the external financial markets, all firms in the group will borrow until their marginal costs of external finance are equal. Samphantharak (2006, p. 11) notes that in this case there is an “insurance effect” across affiliated firms. That is, through internal transfers, the entire business group absorbs an
idiosyncratic shock affecting the cost of external finance in one particular firm. These transfers also give rise to a “tunneling effect” in which firms with lower costs of external finance provide resources to firms with higher costs of capital.

None of these effects are present in our model. By construction, we establish that one firm cannot raise external finance to lend to another low-pledgeable income affiliate. According to our model, a group firm can only get external resources to finance its investment projects. Moreover, if a firm is hit by an external shock that compromises its pledgeable income, the shock reduces the likelihood it can get resources in the internal capital market. That is, the external shock is amplified within the business group (and not the contrary).

The differences between our model and Samphantharak (2006) arise mainly because of different assumptions regarding transfers within a business group. We assume that only internal wealth can be transferred across affiliated firms, while Samphantharak (2006) proposes that both internal and external resources can be shifted freely among business groups’ affiliates. If we had assumed that each affiliate can transfer resources from external financing to fund other business groups’ affiliates investments, our model would produce the “insurance” and “tunneling” effects that characterize Samphantharak (2006) model. In this case, our model predictions would conform the mainstream expectation, that is, that internal capital markets can mitigate firms financial constraints (Khanna and Palepu, 2000; Khanna and Yafeh, 2007).

This study also relates to Almeida and Wolfenzon (2006a,b). In Almeida and Wolfenzon (2006a), by assuming that internal capital markets mitigate the limited pledgeability problem that characterizes external financial markets, the authors show that conglomerates’ internal capital markets can dampen the efficiency of economy-wide capital allocation. This result is especially noteworthy in countries with intermediate levels of investor protection. We do not look for such equilibrium effects. Our model suggests that internal capital markets in business groups may deliver the same characteristics as external markets. Therefore, internal capital markets may not mitigate the limited pledgeability problem. If this is the case, there could be an even greater efficiency loss of economy-wide capital allocation than Almeida and Wolfenzon (2006a) point out.

Finally, Almeida and Wolfenzon (2006b) are concerned with the formation of family business groups, particularly the ownership structure. They show, for example, that family business groups should be more common in countries with low levels of investor protection because families can use resources from firms they already control to finance new ones. They argue
that this financing advantage over other entrepreneurs is more important in countries with weak protection for investors, because in these countries pledgeable income tends to be lower. Almeida and Wolfenzon (2006b) suggest that financial factors may foster the formation of family business groups in weak investor protection environments. Our model suggests that these same factors could be the key drivers of resource allocation in the internal capital markets in business groups.

The paper proceeds as follows. In the next section we develop our model for financial resource allocation in business groups and propose a testable hypothesis. In Section 3, we describe our sample and empirical strategy. Section 4 details our empirical results and Section 5 concludes.

2 The Model

We develop a simple model in the spirit of Tirole (2006) to derive empirical implications about the investment behavior and external/internal financing in business group affiliated firms. We propose a one-period model in which a risk-neutral entrepreneur owns entirely (and directly) a firm named U (Up). Firm U, along with outside investors (also risk-neutral), owns a second firm, called D (Down). The entrepreneur controls these two firms and owns a fraction $\beta$ of the capital (economic rights) of firm D (directly and indirectly through firm U).

The entrepreneur is thought to retain control over firm D, whatever the size of $\beta$.\footnote{We opt for a pyramidal structure of control, but results will be the same if we use a horizontal structure.} At date 0, both firms have opportunities to invest. If firm $U$ invests $I_U$ at date 0, it will receive a cash flow of $K^U I_U$ with probability $p$ (success), or 0 with probability $(1 - p)$ (failure) at date 1. Similarly, if firm $D$ invests $I_D$ at date 0, it will receive a cash flow of $K^D I_D$ with probability $p$, or 0 with probability $(1 - p)$ at date 1 (the two projects are independent).\footnote{In the appendix, we develop a model with more general production functions.} The timing of the model is shown in Figure 1.

To introduce moral hazard, we assume that the probability of success (of each project) depends on the entrepreneur’s efforts. Therefore, if the entrepreneur behaves (exerts effort) the probability of success is $p_H$, and there are no private benefits. If the entrepreneur misbehaves, the probability of success is $p_L < p_H = p_L + \Delta_p$ and the private benefits are $B^U$ ($B^D$) per unit of investment of firm $U$ ($D$).\footnote{Note that we are assuming that private benefits are asset-specific, not human-specific. While we recognize that business groups can transfer human resources across affiliates, in our model changing the entrepreneur doesn’t change the private benefits associated with each firm in the group.} That being said, as long as the projects are funded, the
entrepreneur can work on either of them, or work on both, or cheat on both. Only projects with probability $p_H$ of success are taken as socially desirable. In other words, $p_L$ is assumed to be such that, if the entrepreneur misbehaves, the expected net present value (social surplus) per unit of investment is negative even if the private benefits are taken into consideration.

$$p_H K^U > 1,$$
$$p_L K^U + B^U < 1,$$  \hspace{1cm} (A1)
$$p_H K^D > 1,$$
$$p_L K^D + B^D \div \beta < 1.$$  \hspace{1cm} (A2)

In order to achieve a finite level of optimum investment, we need to make an additional assumption about the productivity of investment and the extent of moral hazard (regarding pledgeable income). As in Tirole (2006), the expected net present value per unit of investment is lower than the per-unit agency cost related to the entrepreneur misbehavior (that is, the minimal income that is incentive compatible):

$$p_H \left( K^U - \frac{B^U}{\Delta_p} \right) < 1,$$
$$p_H \left( K^D - \frac{B^D}{\beta \Delta_p} \right) < 1.$$  \hspace{1cm} (A2)

Therefore, there is a limit to the value that firms can raise from external investors, imposing a specific investment level, even though infinite levels of investment are optimal under no moral
hazard. At date 0, firm $U$ ($D$) has liquid assets (i.e. cash holdings) of $A^U$ ($A^D$) and there is an internal capital market, in which firms $U$ and $D$ can transfer resources between them at date 0 in exchange for an income at date 1. We denote by $(1 - \alpha^T)$, with $T \in \{U, D\}$, the (observable) fraction of cash at date 0 that is transferred from one firm to another. An upper bound on the internal transfers (perhaps as a result of legal and statutory limits) is imposed, requiring that $\alpha^T \in [\alpha, 1]$, with $0 < \alpha < 1$.

We also assume that business groups use direct loans to make internal transfers across affiliated firms. Direct loan is a common mechanism with which to allocate resources within business groups (see Gopalan et al., 2007 and Buchuk et al., 2014). As Buchuk et al. (2014, p. 194) point out, the widespread existence of preemptive rights is the main reason why direct loans (internal debt) are often more convenient than internal equity (cross-ownership) as a way of transferring resources within a business group. In part, this is because preemptive rights give current shareholders the right to buy new shares issued by the firm, protecting them against the dilution of control as well as shrinking the value of their shares.

Finally, we assume that date 1 income from internal transfers cannot be contracted out of the business group. In other words, the lending firm cannot pledge this income to outside investors. For simplicity, interests rates are set to zero (no time discount). Under these conditions, the borrower, say, $U$, needs to promise an amount of $(1 - \alpha^D)A^D \div p_H$ at date 1, in the case of success, in exchange for a loan of $(1 - \alpha^D)A^D$ at date 0 (we opt for a conditional debt contract between firms).

Because firm $U$ and firm $D$ are *legally independent*, we assume that there is no cross-pledging, in which one firm could potentially pledge another affiliate income to external investors (lenders). Furthermore, we assume that the lender sector is competitive. Therefore, by having control over both firms, the entrepreneur will offer a contract to outside investors as follows:

- Firms’ income in each state of the world (success ($S$) or failure ($F$)): $R^T_S \geq 0$ and $R^T_F \geq 0$, with $T \in \{U, D\}$. That is, both lender and borrower’s limited liability imply that firm’s will receive 0 in the case of failure;
- Level of investment of each firm: $I^T \geq 0$, with $T \in \{U, D\}$; and
- Internal transfers from one firm to another: $(1 - \alpha^T)A^T$, with $T \in \{U, D\}$.

The contract will solve the following problem (for details see the appendix):
subject to four constraints that are binding at the optimal solution. The “investor rationality” constraints, $IR^U$ and $IR^D$, require that, on average, outside investors get back their investment:

$$p_H \left( K^U I^U - R^U_S \right) - (1 - p_H) R^U_F \geq I^U - \alpha^U A^U - (1 - \alpha^D) A^D, \quad (IR^U)$$

$$p_H \left( K^D I^D - R^D_S \right) - (1 - p_H) R^D_F \geq I^D - \alpha^D A^D - (1 - \alpha^U) A^U, \quad (IR^D)$$

and the incentive compatibility constraints, $IC^U$ and $IC^D$, ensure that the entrepreneur will choose to behave well in both projects:

$$\Delta_p \left( (R^U_S - R^U_F) - (1 - \beta) \frac{(1 - \alpha^D) A^D}{p_H} \right) \geq B^U I^U, \quad (IC^U)$$

$$\Delta_p \left( \beta (R^D_S - R^D_F) + (1 - \beta) \frac{(1 - \alpha^U) A^U}{p_H} \right) \geq B^D I^D. \quad (IC^D)$$

The non-negativity and the internal transfer limitations constraints are expressed as follows:

$$R^U_S \geq 0, \quad R^U_F \geq 0, \quad R^D_S \geq 0, \quad R^D_F \geq 0, \quad I^U \geq 0, \quad I^D \geq 0,$$

$$\alpha^U \in [\alpha, 1], \quad \alpha^D \in [\alpha, 1].$$

Because the lender sector is competitive, the firms will earn the entire surplus. Under our assumptions about the productivity of investments and moral hazard (A1) and (A2) and the limits of internal transfers, it is optimal that both firms invest: $I^U > 0$ and $I^D > 0$.

The investor’s rationality constraints are binding; otherwise, firms could increase their payoffs without violating the incentive compatibility constraints. To show that the incentive compatibility constraints are also binding at the optimum, suppose that $(IC^U)$ is not binding (the same applies to $(IC^D)$). Then, an increase in $R^U_S$, $R^U_F$, and $I^U$ could be made as long as the
difference $R^U_S - R^U_F$ is constant and the increase in the payoffs is limited to $(p_H K^U - 1)$ times the increase in $I^U$. These changes will increase the value of the objective function without violating the investors’ rationality constraint, so this solution cannot be optimal.

With strictly positive investment, the incentive compatibility constraint ($IC^U$) implies that $R^U_S > R^U_F \geq 0$ (again, the same applies to firm $D$). Because the entrepreneur is risk-neutral and will earn the entire social surplus of the investment, it is best for her to set the firm payoffs at a level that maximizes the pledgeable income. From investors’ rationally constraint ($IR^U$), the pledgeable income is given by:

$$p_H K^U I^U - p_H (R^U_S - R^U_F) - R^U_F.$$

Keeping the difference $R^U_S - R^U_F$ to satisfy the incentive compatibility constraint and setting $R^U_F = 0$ maximizes the pledgeable income.$^6$ Under these conditions, the incentive compatibility constraints can be used to determine the payoffs in the case of success:

$$R^U_S = \frac{B^U I^U}{\Delta_p} + \frac{(1 - \beta)(1 - \alpha^D)A^D}{p_H},$$

$$R^D_S = \frac{B^D I^D}{\beta \Delta_p} - \frac{(1 - \beta)(1 - \alpha^U)A^U}{\beta p_H}.$$  

The investors’ rationality constraints determine the level of investment of each firm (after replacing $R^U_S$ and $R^D_S$ by (1) and (2)), as follows:

$$I^U = \frac{\alpha^U A^U + \beta (1 - \alpha^D) A^D}{1 - p_H \left( K^U - \frac{R^U_F}{\Delta_p} \right)} = M^U \times (\alpha^U A^U + \beta (1 - \alpha^D) A^D),$$

$$I^D = \frac{\beta \alpha^D A^D + (1 - \alpha^U) A^U}{\beta \left[ 1 - p_H \left( K^D - \frac{B^D}{\Delta_p} \right) \right]} = M^D \times (\beta \alpha^D A^D + (1 - \alpha^U) A^U).$$

In (3) and (4), respectively, $M^U$ and $M^D$ are the equity multipliers, where equity means the entrepreneur wealth $(A^U + \beta A^D)$, split between firms by internal transfers. One can see that, under assumptions (A1) and (A2), both multipliers are greater than one but finite. They are finite because, under assumption (A2), the minimal income that is incentive compatible increases faster than the net present value when investment is increased. Therefore, the investors’

$^6$In the appendix, we provide the proof that, at the optimum, $R^U_F = 0$ and $R^D_F = 0$ using the Karush-Kuhn-Tucker multipliers.
rationality constraints bind with finite levels of investments. In short, moral hazard implies limits to the investment level, reducing the entrepreneur’s utility.

It is worth noting that, if firms $U$ and $D$ were stand-alone entities, their equity multipliers would be the same as in (3) and (4), respectively. However, in this case, each firm can only rely on the entrepreneur’s wealth. Internal capital markets in business groups can transfer entrepreneur’s wealth across group firms. Hence, with the right incentives, the entrepreneur can increase the total output (over what it would be if the group firms were stand-alone entities).

The entrepreneur will earn the surplus from investment according to her shares owned in each firm, and thus will benefit from higher multipliers. Taking the partial derivatives of the multipliers with respect to the exogenous parameters, we can see that:

- Multipliers increase with $p_H$ and $\Delta_p$. All else being equal, the higher the $p_H$ ($\Delta_p$), the greater the income that can be pledged to outside investors and the lower the minimal income that makes the entrepreneur behave;
- $M^U$ ($M^D$) increases with $K^U$ ($K^D$). All else being equal, more productive investment attracts more external finance;
- $M^U$ ($M^D$) decreases with $B^U$ ($B^D$). The minimal income that the entrepreneur needs to behave increases with private benefits, reducing the pledgeable income;
- $M^D$ (but not $M^U$) increases with $\beta$. All else being equal, the higher the entrepreneur’s cash flow rights in firm $D$, the lower the minimal income that she needs to behave and, consequently, the higher firm $D$’s pledgeable income.\(^7\)

What remains to be determined are the internal transfers between firms: $\alpha^U$ and $\alpha^D$. To show how the internal capital market works, the entrepreneur problem is rewritten using the optimal values of the endogenous variables, except $\alpha^U$ and $\alpha^D$. The expected total income of the entrepreneur equals the expected net present value of the investment of firm $U$ plus a fraction $\beta$ of the expected net present value of the investment of firm $D$ plus the entrepreneur’s initial wealth, $A^U + \beta A^D$, as follows:

\[
(p_H K^U - 1) I^U + \beta (p_H K^D - 1) I^D + A^U + \beta A^D.
\]

\(^7\)Our assumption is that the entrepreneur has all the cash flow rights in firm $U$. Had we assumed that the cash flow rights are of size $\beta^U$, the equity multiplier of this firm, $M^U$, will also increase with $\beta^U$. 

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Substituting (3) and (4) into $I^U$ and $I^D$, respectively, the entrepreneur objective function becomes:

$$F(\alpha^U, \alpha^D) = (p_H K^U - 1) \frac{\alpha^U A^U + \beta (1 - \alpha^D) A^D}{1 - p_H \left( K^U - \frac{B^U}{\beta} \right)} +$$

$$+ (p_H K^D - 1) \frac{\beta \alpha^D A^D + (1 - \alpha^U) A^U}{1 - p_H \left( K^D - \frac{B^D}{\beta} \right)} + A^U + \beta A^D. \quad (6)$$

Next, it is possible to determine how entrepreneur expected total income changes when $\alpha^U$ or $\alpha^D$ increases:

$$\frac{\partial F(\alpha^U, \alpha^D)}{\partial \alpha^U} = \frac{(p_H K^U - 1) A^U}{1 - p_H \left( K^U - \frac{B^U}{\beta} \right)} - \frac{(p_H K^D - 1) A^U}{1 - p_H \left( K^D - \frac{B^D}{\beta} \right)}, \quad (7)$$

$$\frac{\partial F(\alpha^U, \alpha^D)}{\partial \alpha^D} = \frac{(p_H K^D - 1) \beta A^D}{1 - p_H \left( K^D - \frac{B^D}{\beta} \right)} - \frac{(p_H K^U - 1) \beta A^D}{1 - p_H \left( K^U - \frac{B^U}{\beta} \right)}. \quad (8)$$

Note that the partial derivatives depend only on the exogenous parameters and, if (7) is positive [negative] (zero), then (8) is negative [positive] (zero), and vice-versa. Thus, there are three possible alternatives of internal transfers in business groups that we discuss in turn.

### A Internal transfers from D to U

Internal transfers from D to U occur if and only if:

$$B^D(p_H K^U - 1) > B^U \beta (p_H K^D - 1).$$

If this condition holds, (7) is positive, (8) is negative, and the entrepreneur’s expected total income increases with $\alpha^U$ and decreases with $\alpha^D$. Three factors may contribute to this result: (a) the investment productivity of firm U, $K^U$, is higher than that of firm D, $K^D$; (b) there are fewer private benefits associated with firm U’s investment, $B^U$, than firm D’s investment, $B^D$; that is, all else equal, the minimal income that motivates the entrepreneur to behave is lower and, therefore, pledgeable income is higher in firm U vis-à-vis firm D; or (c) entrepreneur cash flow rights in firm D, $\beta$, are low enough to distort the socially efficient capital allocation.\(^8\)

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\(^8\)The capital allocation that provides the higher expected net present value is what we mean by socially efficient. Note that in our setting the NPV of an investment depends not only on its productivity but also on its ability to attract financing. Note that $\beta$ is a (inverse) measure of control leverage, the difference between voting
As the entrepreneur’s expected total income increases (decreases) with $\alpha^U$ ($\alpha^D$), the internal transfer goes from firm $D$ to firm $U$, up to the upper bound of internal transfers in which $\alpha^U = 1$ and $\alpha^D = \alpha$. In this case, the sensitivities of firm investment to its cash flow and to the other firm’s cash flow are:

\[
\begin{align*}
\frac{\partial I^U}{\partial A^U} &= M^U > 0, \\
\frac{\partial I^U}{\partial A^D} &= M^U \times \beta(1 - \alpha) > 0, \\
\frac{\partial I^D}{\partial A^U} &= 0, \\
\frac{\partial I^D}{\partial A^D} &= M^D \times \beta \alpha > 0.
\end{align*}
\]

Because of the unidirectionality of internal transfers, firm $U$’s investment increases with its cash flow and with the other firm’s cash flow and firm $D$’s investment increases with its cash flow and is insensitive to the other firm’s cash flow. In this case, the business group’s resources flow toward firm $U$, and the investment in firm $D$ is proportional to its cash flow and occurs only because there are limits to internal transfers.

Finally, as in Tirole (2006), the sensitivity of investment to the firm’s cash flow (and to the other firm’s cash flow, when applicable) is reduced with the private benefits. This happens because of the negative effect of private benefit on pledgeable income and, consequently, on the equity multiplier. Therefore, in our model, firms with low agency costs will exhibit greater investment-cash flow sensitivity.

**B Internal transfers from $U$ to $D$**

Internal transfers from $U$ to $D$ occur if and only if:

\[B^D(p_H K^U - 1) < B^U \beta (p_H K^D - 1).\]

If this condition is met, (7) is negative and (8) is positive, so entrepreneur expected total income decreases with $\alpha^U$ and increases with $\alpha^D$. Again, three factors may contribute to this result: (a) the investment productivity of firm $D$, $K^D$, is higher than that of firm $U$, $K^U$; (b) there are fewer private benefits associated with firm’s $D$ investment, $B^D$, than with firm and cash flow rights.
U’s investment, $B^U$; that is, all else being equal, the minimal income that encourages the entrepreneur to behave is lower and, therefore, the pledgeable income is higher in firm D vis-à-vis firm U; and (c) the entrepreneur’s cash flow rights in firm D, $\beta$, are high enough not to distort the socially efficient capital allocation.

As the entrepreneur expected total income decreases (increases) with $\alpha^U$ ($\alpha^D$), the internal transfer goes from firm U to firm D, up to the upper bond on internal transfers in which $\alpha^U = \alpha$ and $\alpha^D = 1$. In this case, the sensitivities of a firm’s investment to its cash flow and to the other firm’s cash flow are:

$$\frac{\partial I^U}{\partial A^U} = M^U \times \alpha > 0,$$
$$\frac{\partial I^U}{\partial A^D} = 0,$$
$$\frac{\partial I^D}{\partial A^U} = M^D \times (1 - \alpha) > 0,$$
$$\frac{\partial I^D}{\partial A^D} = M^D \times \beta > 0.$$

Firm D’s investment increases both with its cash flow and with the other firm’s cash flow. Firm U’s investment increases with its cash flow and is insensitive to the other firm’s cash flow. Now, business groups’ resources flow toward firm D, and the investment in firm U is proportional to its cash flow and occurs only because there are limits to internal transfers.

As before, the sensitivity of investment to the firm’s cash flow (and to the other firm’s cash flow, when applicable) of both firms decreases with private benefits. That happens because of the negative effect of private benefit on pledgeable income and, thus, on the equity multiplier. Again, firms with low agency cost will exhibit greater investment-cash flow sensitivity.

C No internal capital market

There is no internal capital market if and only if:

$$B^D(p_H K^U - 1) = B^U \beta(p_H K^D - 1).$$

If this condition is met, (7) and (8) are equal to zero, and the entrepreneur’s expected total income does not depend on $\alpha^U$ or $\alpha^D$. This independence of entrepreneur’s income from $\alpha^U$ and $\alpha^D$ may occur if, for example, the private benefits and the net present value per unit of
investment (in the eyes of the entrepreneur) are very similar across firms.

As the entrepreneur’s expected total income does not depend on $\alpha^U$ or $\alpha^D$, the internal transfers are undetermined; that is, any admissible values of $\alpha^U$ and $\alpha^D$ are optimal. We assume that, in this circumstance, the entrepreneur will opt for the simplest contract where there is no transfer across firms ($\alpha^U = \alpha^D = 1$). As a consequence, the investment-cash flow sensitivities are:

$$\frac{\partial I^U}{\partial A^U} = M^U > 0,$$
$$\frac{\partial I^U}{\partial A^D} = 0,$$
$$\frac{\partial I^D}{\partial A^U} = 0,$$
$$\frac{\partial I^D}{\partial A^D} = M^D \times \beta > 0.$$

Firms $U$ and $D$ investments increase with their cash flows and are insensitive to the other’s cash flow. Thus, without internal transfers, the investment in each firm is proportional to the entrepreneur’s cash flow in that firm, with the constant of proportionality equal to the equity multiplier. Finally, the sensitivity of investment to the firm’s cash flow in both firms decreases with private benefits. Again, the investments of companies with low agency costs will be more sensitive to their cash flow.

D Discussion and hypothesis development

According to our model, the direction of resources inside business groups depends on three factors: (a) the investments’ productivity differences, (b) the entrepreneur’s cash flow rights in firm $D$, and (c) the differences in private benefits or, in other words, in pledgeable income. The first two factors have been extensively studied in the internal capital markets literature.

The first factor, investments’ productivity differences, is related to the allocation efficiency in internal capital markets. For example, Williamson (1975, p. 147) argues that, in a multi-divisional firm, “the general management and its support staff can perform a further capital market function - assigning cash flows to high yield uses.” Stein (1997) develops a model in which headquarters, with the proper incentives and control rights to supervise project outcomes, engage in a winner-picking strategy, allocating scarce resources to projects with higher returns.
Empirical results, however, raise doubts about the allocation efficiency of internal capital markets in conglomerates. Shin and Stulz (1998), Rajan et al. (2000), Billett and Mauer (2003), and Ozbas and Scharfstein (2010) present evidence that internal capital markets tend to allocate resources inefficiently, investing too much (or, too little) in divisions with few (or many) investment opportunities, the so-called socialist cross-subsidization.\footnote{Scharfstein and Stein (2000) and Rajan et al. (2000) develop models that imply inefficient cross-subsidization of this type in internal capital markets. The term “socialist” cross-subsidization was introduced by Stein (2003).}

Campello (2002) examines internal transfers across small affiliate banks of multi-bank holding companies (BHCs); his findings are consistent with the inefficient (efficient) cross-subsidization hypothesis in constrained (unconstrained) BHCs. More recently, studies suggest that the allocation efficiency of internal capital markets improves during financial crises (Kuppuswamy and Villalonga, 2010) and recessions (Hovakimian, 2011), and when there is external capital markets distress (Matvos and Seru, 2014); that is, when financial constraints are more likely to be binding, and hence the winner-picking strategy is more valuable.\footnote{Gopalan and Xie (2011) present mixed results about the efficiency of internal capital markets during periods of unexpected industry distress.}

Empirical studies also report mixed results in the allocation efficiency in business groups. Shin and Park (1999) present evidence that Korean business groups \textit{(Chaebols)} better insulate the investment of high-growth firms from group-level financing constraints, which is consistent with the efficiency hypothesis outlined by Shin and Stulz (1998).\footnote{For a structural model of investment with costly external finance in business groups, see Samphantharak (2006).} Shin and Park (1999) also show that capital expenditures (as a fraction of total assets) do not differ between high- and low-growth chaebol firms, while that is not so for non-chaebol firms. This result is consistent with the “socialist” cross-subsidization view. Lee et al. (2009) demonstrate that, before the 1997 Asian crisis, chaebol’s firms with high growth opportunities took more advantage of cross-subsidization than other firms with poor opportunities in the same group; but the same was not true after the crisis.

In addition, Almeida et al. (2015) present evidence suggesting that \textit{Chaebols} engaged in winner-picking strategies in the aftermath of the Asian crisis and Gopalan et al. (2007), in a study of Indian business groups, show that net intra-group loans are insensitive to growth opportunities and that firms receiving intra-group loans underperform benchmarks in the two-year period following a loan, suggesting that efficiency is not the primary goal of Indian internal capital markets.
The second factor, the entrepreneur’s cash flow rights in affiliated firms, is related to the likelihood of the entrepreneur to divert wealth from firms she controls without holding proportional cash flow rights, known as the private benefits of control. As Morck et al. (2005, p. 676) emphasize, “By allowing cash flow rights and voting rights to diverge, control pyramids permit the same divergence of interest problems as dispersed ownership” and this divergence “[…] can lead to inefficient investment in firms in which a controlling owner has small cash flow rights.” In our model, as we assume that the entrepreneur always controls firm $D$, the lower the entrepreneur’s cash flow rights in firm $D$ (low values of $\beta$), the wider the wedge between cash flow and voting rights.

As the wedge between cash flow and voting rights (control) in firm $D$ diverges the higher the likelihood that resources inside the group flow toward firm $U$, even if firm $D$ has better investment opportunities than firm $U$ ($K^D > K^U$). Consequently, it is possible for the entrepreneur to externalize most of the costs related to value-destroying investments, creating economic incentives to divert corporate wealth at the expense of outside investors (tunneling) (Johnson et al., 2000). This divergence of interests between the entrepreneur (inside shareholder) and the outside investor (minority shareholders) arises because, from the entrepreneur’s point of view, a unit of investment in firm $U$ ($D$) has an expected value of $p_H K^U - 1 (\beta(p_H K^D - 1))$. Therefore, for low values of $\beta$, investment inefficiency in business groups and outside investor losses are more likely to be observed.12

Empirical studies have tried to identify the tunneling effect with inconclusive results. For example, examining Indian business groups, Bertrand et al. (2002) present evidence of tunneling, while Siegel and Choudhury (2012) show that internal transfers are driven by business strategies that are remarkably different across business group firms and stand-alone firms. Gopalan et al. (2007)’s analysis of intra-group loans in Indian business groups shows that net intra-group loans are positively related to insider cash flow rights and are primarily used to provide finance for impaired firms, with no evidence of tunneling. Buchuk et al. (2014) present similar evidence for Chilean firms; suggesting that, while a conclusion of tunneling could not be completely ruled out, intra-group loans are typically used to reduce financial constraints and increase investment.

Relative to the third factor, how do private benefits influence the direction of resource allocation in the internal capital market? In a business group, each firm is a legally independent

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12 What really matters is the relative size of the entrepreneur cash flow rights in firm $D$ and $U$, captured, in our model, by $\beta$. 

entity with direct access to the external capital market. To access this market, each group firm can rely only on its merits and its pledgeable income. As equation (6) shows, the surplus of an investment depends on the interaction between its marginal expected net present value (productivity) and its equity multiplier (pledgeable income). Therefore, the entrepreneur will direct resources to the firm with the higher product (in her eyes) of investment productivity and pledgeable income. That is, pledgeable income matters in financing decisions in both internal and external capital markets.

Our model implies that pledgeable income is negatively related to private benefits \( (B^U \text{ and } B^D) \); that is, the higher the private benefits, the higher the minimal income necessary for the entrepreneur to behave, and thus the lower the pledgeable income. As a consequence, low levels of private benefits increase the likelihood of financing new investment in both internal and external capital markets.

This same reasoning applies to any factor affecting pledgeable income. The entrepreneur’s cash flow rights in firm \( D, \beta \), also impact the pledgeable income of the firm. The higher the \( \beta \) is, the lower the minimal income that the entrepreneur needs to behave well in firm \( D \), and the higher is the pledgeable income, the equity multiplier, and the likelihood of accessing funding in the internal capital market.\(^{13}\) Similarly, as the investment productivity \( (K^U \text{ and } K^D) \) increases, so do the social surplus, the pledgeable income, and the equity multiplier. Thus, as investment productivity grows, so do the odds of getting internal resources from other business group firms, as well as external finance.

To show that any factor affecting the firm’s ability to raise external finance also impacts upon its chances of getting financing in the internal capital market, assume that to make one unit of investment firm \( U \) \( (D) \) needs to raise \( \tau^U \geq 1 \) \( (\tau^D \geq 1) \) units of internal or external money. We can think of \( \tau^T \) as a proxy for factors that reduce the ability of the firm to finance its projects, including low pledgeable assets (collateral), high probability of risk-shifting, and high levels of asymmetric information, to name a few. Assuming that the investment in both firms is still profitable, we can show that:

\[
I^U = \frac{\alpha^U A^U + \beta (1 - \alpha^D) A^D}{[\tau^U - p_H (K^U - B^U \Delta p)]} = M'^U \times (\alpha^U A^U + \beta (1 - \alpha^D) A^D), \tag{3'}
\]

\(^{13}\)Again, had we assumed that the entrepreneur’s cash flow rights in firm \( U \) is \( \beta^U \), this same effect will be present in firm \( U \).
\[ I^D = \frac{\beta \alpha^D A^D + (1 - \alpha^U) A^U}{\beta \left( \tau^D - p_H \left( K^D - \frac{B^D}{\beta^D} \right) \right)} = M^{ID} \times \left( \beta \alpha^D A^D + (1 - \alpha^U) A^U \right). \tag{4'} \]

Hence, under impaired access to finance, the equity multiplier of both firms is reduced, that is, if \( \tau^U > 1 \), then \( M^{ID} < M^U \), and if \( \tau^D > 1 \), then \( M^{ID} < M^D \). This is the result of a reduction in the pledgeable income of the firms and implies a lower level of investment. The direction of resources inside the business group will now depend on the inequality:

\[ B^D (p_H K^U - \tau^U) \geq B^U \beta (p_H K^D - \tau^D). \]

All else being equal, the higher the \( \tau^U (\tau^D) \), the lower the chance that internal resources will flow from firm \( D \) (\( U \)) to firm \( U \) (\( D \)). In other words, the same factors that limit a firm’s access to external finance also reduce the chance it can receive resources in the internal capital market. As far as we know, this is a novel prediction, shedding new light on our understanding of the formation and functioning of business groups.

The prediction that productivity (growth opportunities) and pledgeable income jointly determine the direction of resources in the internal capital market explains, in part, the evidence of “socialist” cross-subsidization in business groups. For example, if there is a low correlation between productivity and pledgeable income and the latter is more volatile than the former, our model predicts that pledgeable income will be the most important factor in explaining resource allocation within a business group. This model outcome implies that omitting pledgeable income in the analysis of allocation efficiency in business group’s internal capital markets can produce a biased conclusion towards the “socialist” cross-subsidization hypothesis.

The omitted variable bias is especially worrisome if the correlation between productivity and pledgeable income is negative, in which a high productive asset may increase the likelihood of private benefits, risk-shifting, and low collateral concerns. In fact, this bias may explain prior empirical results (Almeida et al., 2015; Shin and Park, 1999; Lee et al., 2009). For example, assuming that productivity and pledgeable income are highly correlated during recessions and financial crises, our model may explain Almeida et al. (2015)’s results that Korean chaebol groups engaged in winner-picking strategies in the aftermath of the 1997 Asian crisis.

The main implication of our model is, therefore, that the same factors that limit companies’ access to external finance also reduce the chance of getting internal resources in business groups.
Firms with high pledgeable income (and thus easy access to external finance) will be more likely to benefit from resource allocation within the business group. In other words, internal capital markets tend to support the financially strong firms in the group, just as outside lenders would, reproducing the same financial constraints that plague the external financial markets. This implies that financially strong firms in business groups will be able to raise more resources and, consequently, will invest more than their stand-alone counterparts. The contrary occurs with the financially weak firms. They are more likely to be lenders, supporting the internal capital market and relying on only a fraction of their wealth to finance their investments. Thus, financially weak firms will have fewer resources available and tend to invest less than their stand-alone counterparts, which does not have a related firm to finance. This reasoning leads to the following testable hypothesis:

*All else being equal, financially strong (weak) firms in the business group tend to invest more (less) than their stand-alone counterparts, because these firms tend to benefit from (support) internal capital markets.*

If true, this hypothesis raises questions about the effectiveness of internal capital markets in overcoming external capital markets’ failures, as hypothesized by Khanna and Palepu (2000) and Khanna and Yafeh (2007). Given that productivity and pledgeable income have a positive effect on the likelihood of getting resources from internal capital markets, the factors that improve a firm’s ability to get external finance, such as asset tangibility, also increase the likelihood of internal financing in business groups. Buchuk et al. (2014) show that, in Chilean business groups, capital-intensive (a proxy for pledgeable income) and small firms are more likely to receive intra-group loans, which support our hypothesis. In contrast, Gopalan et al. (2007)’s results for Indian business groups show that net intra-group loans decrease with asset tangibility and are insensitive to growth opportunities. In other words, our hypothesis fits well in Chilean firms but not in Indian firms suggesting that institutions are relevant.

Indeed, according to Buchuk et al. (2014, p. 208), “There are three features of the Chilean regulation that stand out in comparison to other markets.” First, Chilean law requires full disclosure of all related loans (in great detail), allowing investors to easily identify intra-group loans. Second, Chilean law requires that such loans be made at the prevailing market interest rate, while in India Gopalan et al. (2007) show that more than 80% of intra-group loans have no interest obligation at all. Finally, in Chile, transactions between related parties require approval
by a board committee presided by an independent director.

Our model resembles some of these institutional features, postulating that: (a) the contract with external investors should specify all internal transfers between firms in the business group; (b) the interest rate on intra-group loans is the same as competitive external markets (to simplify, this rate is assumed to be zero); and (c) while there is room for minority shareholder expropriation, productivity and pledgeable income (financial capacity) drive resources allocation in the internal capital market, and these factors are likely to satisfy the requirements of an independent director. Next, we empirically examine the hypothesis derived from our model using new data from Brazil, which resembles, in part, the Chilean institutional environment.

3 Data and Methodology

To test all the implications of our model requires detailed data from business groups and stand-alone firms, including internal transfers of financial resources between all the firms in each group. Fortunately, however, we can provide some evidence of capital allocation decisions inside business groups by examining the outcomes of this process. Specifically, by using public available accounting and financial data, we can empirically test our hypothesis, which contrasts with the extant literature on business groups financial allocation (Khanna and Palepu, 2000; Khanna and Yafeh, 2007).

A Sample selection

We draw our sample from Brazilian publicly listed companies from 1998 to 2007. Our sample combine at least three characteristics that are important to test our hypothesis. First, Brazil is an emerging economy with the typical credit and capital markets inefficiencies that may affect firms pledgeable income (La Porta et al., 1998; Levine, 1999; Leal and Saito, 2003). Second, as in emerging Asian economies, pyramidal business groups are ubiquitous in the Brazilian capital market (Aldrighi and Postali, 2010). Finally, transactions between related parties have to be disclosed, including interest rates on intra-group loans, a feature that is similar to our model structure.

Accounting and market data are collected from Economatica®, a private database covering the major economies of Latin America and the United States. Ownership data regarding business groups affiliation and pyramidal structures is drawn upon a comprehensive research
To map the ownership structure of the Brazilian business groups, this author compiled data from the annual reports available at the Stock Exchange Commission (e.g., CVM is the Brazilian acronym) of each company with shares traded in São Paulo’s Stock Exchange (BM&FBovespa) for the period from 1998 to 2007. For each company in the sample, he identified the direct shareholders. If the direct shareholders were other companies, he verified the shareholders of these companies, and so on, until he identified the ultimate shareholder.

Figure 2: Braskem S.A. ownership structure, Source: Adapted from Aldrighi(2014).

In Figure 2, we show an example of a typical Brazilian business group, Odebrecht, and its affiliated firms, including “Braskem S.A”, listed on BM&FBovespa. Braskem’s ownership structure provides a complete picture of different ownership mechanisms by which “entrepreneurs” enhance their controlling position. Besides the pyramidal structure, Braskem controlling shareholders have two shareholder agreements, one between Odebrecht and Petroquisa and another between Odebrecht and BNDES Participações (Aldrighi, 2014, p. 109). Despite the existence of these agreements, the Odebrecht family is the ultimate controlling shareholder of Braskem, as

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14 We thank Professor Dante Aldrighi for providing the ownership data of Brazilian business groups.
they own - indirectly - more than 50% of the company’s voting rights. The shareholders’ agreements serve only as a mechanism to strengthen the control position of the Odebrecht family. As a consequence of the use of these control enhancing mechanisms (pyramidal structure and shareholder agreements), the Odebrecht family owns 20.68% of the cash flow rights of “Braskem S.A” while controlling 93.97% of voting rights.

We cross-checked Aldrighi (2014)’s business group and stand-alone classification by a manual inspection of the yearbook “Valor Grandes Grupos” of the “Valor Econômico” Newspaper. For robustness purposes, we also adopt a more stringent classification in which only groups with a pyramidal structure are recognized as business groups. It is worth noting that our model does not differentiate pyramidal groups from other business group structures, and so we do not expect differences in results when we restrict our sample to pyramidal business groups. In addition, we analyze just the publicly listed firms from which we have access to accounting, market, and ownership data.

Our sample selection procedure follows common practices in the investment and financial constraints literature (Fazzari et al., 1988; Gilchrist and Himmelberg, 1995; Kaplan and Zingales, 1997; Almeida and Campello, 2007; Almeida et al., 2015). We restrict our analysis to manufacturing firms to ensure data comparability and a homogeneous sample regarding investments and operations. Our initial sample consists of 254 firms and 1,942 observations (firm-year). We excluded observations for which assets or sales growth are greater than 100% (405 obs.), those with book value of equity less than zero (255 obs.), and those with missing values for any variable used in the analysis (188 obs.). These criteria serve to eliminate firms with drastic changes in operations, through mergers and acquisitions, for example, and firms near bankruptcy. Finally, our model assumes that business groups affiliates are controlled by a common shareholder (“entrepreneur”) and so we exclude from the sample those business groups affiliates in which control is not well defined (147 obs.). Our final sample consists of 175 firms and 947 firm-year observations.

B Empirical methods: matching and regression procedures

Our empirical strategy consists of two steps: first, we separate firms in two classes – financially weak (low pledgeable income) and financially strong (high pledgeable income) – and then, we compare the investments of business groups affiliates (treated group) and stand-alone firms

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15 We thank Maria Serrano for excellent research assistance.
(control group) for each of these two classes. According to the view that internal capital markets overcome the failures of external financial markets (Khanna and Palepu, 2000; Khanna and Yafeh, 2007), we should expect business group affiliates invest more than stand-alone firms, especially in the case of financially weak firms. Our model challenges this hypothesis and posits that: i) within the financially weak class, business group affiliates invest less than stand-alone firms; and ii) within the financially strong class, business group affiliates invest more than stand-alone firms.

We draw on Almeida and Campello (2007) and Campello and Hackbarth (2012) and use tangibility of assets, the ratio of fixed-to-total assets, as a proxy for pledgeable income. In general, fixed assets can serve as collateral in debt agreements and so increase a firm’s ability to raise external capital. In countries with low levels of financial development, such as Brazil, collateral requirements tend to be higher and to target non-specific assets (Liberti and Mian, 2010), supporting the use of tangibility as a proxy for pledgeable income. Thus, we use the tangibility of assets to split (yearly) firms into two classes: financially weak, those firms with below median tangibility, and financially strong, those firms with above median tangibility.

For business group affiliates the ideal would be to rank firms according to tangibility of assets within a business group, since in our model what matters is the financial condition of a member relative to other affiliates of the same business group. As we explained above, we do not have information about all the firms in a group, so we use the overall median to classify business group affiliates into financial conditions classes (weak and strong). If Brazilian business groups are as diversified as the entire manufacturing sector, we would expect that the overall median will do a good job of classifying business group affiliates (relatively to their unobserved peers). If this is not the case, the failure to correctly classify those firms should make it harder to find evidences consistent with our hypothesis.

To evaluate the effect of internal capital markets in business groups on investment of financially weak and financially strong firms, we begin by comparing means and medians of investment levels in a two-way matrix using business groups vs. stand-alone and financially weak vs. financially strong dichotomies. We follow a standard procedure in empirical corporate finance literature and define Investment as capital expenditures divided by total assets.

Then, to control for other observable variables that may affect firm’s investment and business groups membership, we estimate average treatment effect (ATE) and average treatment effect on the treated (ATT) of financially weak and financially strong firms using two methods:
nearest-neighbor matching and regression adjustment. As for Almeida and Campello (2007) and Almeida et al. (2015), the covariates are those determinants of firm’s investment that appear in the empirical literature on financial constraints: Tobin’s Q is defined as total assets minus book value of equity plus market value of equity divided by total assets; Cash Flow is earnings before interest, taxes, and depreciation (EBITDA) divided by total assets; Tangibility is the ratio of fixed-to-total assets; Size equals the natural logarithm of inflation adjusted total assets; Cash Holdings is defined as cash and cash equivalents over total assets; and Debt is the sum of short and long term debt divided by total assets. We also require exact match on year when we use the nearest-neighbor matching estimator and we include year fixed effects when we use the regression adjustment estimator. To correct for large-sample bias when matching on two or more continuous covariates, we apply the bias-corrected nearest-neighbor matching estimator (Abadie and Imbens, 2011). Finally, because of outliers, we winsorize the variables Investment and Cash Flow at the top and bottom 1%.

Business group membership is not a random choice and it may be related to unobservable variables in our empirical model (Almeida and Wolfenzon, 2006b; Almeida et al., 2015), that is, our treatment variable may be endogenous. For example, if investment opportunities of business groups differ in an unobserved fashion from those of stand-alone firms\footnote{Because of their relative weight in the emerging economies and their political connections, business group firms may have investment and financial opportunities privileges not captured by Tobin’s Q. Almeida et al. (2015) made a similar point for the case of Chaebols in Korea.}, our ATEs and ATTs estimates will capture this effect thereby biasing our results. To mitigate endogeneity concerns, we employ a linear regression with endogenous treatment effects, estimated by the control-function estimator as suggested by Wooldridge (2010). To do so, beyond some distributional assumptions, we need an instrument for our (possibly) endogenous treatment, that is, a variable that is (partially) correlated with business groups membership and unrelated to unobservable variables in our empirical model (exclusion restriction).

It is hard to find a good instrument for business groups, for which data availability is very restrictive. One potential candidate to be a valid instrument is Family Control, a binary variable that indicates when a family is the ultimate controlling shareholder of the firm. We hope that, after controlling for determinants of firms’ investment, family control has no effect on investment decision (exclusion restriction). We believe and empirical evidence seems to confirm that family control is related to the business group membership decision. Indeed, prior literature has shown that, in several countries, families not only control a large number of firms, but also define
ownership mechanisms to enhance their controlling position (such as those that separate cash flow and voting rights; e.g., pyramidal structures, dual-class shares, shareholders’ agreements, etc.) (Gompers et al., 1999; La Porta et al., 1999); and, in emerging markets, firms are typically organized in family business groups (Colpan et al., 2010). In the next section, we present and discuss the results of our empirical analyses of investment behavior in business groups.

4 Empirical Results

In Table 1, we present summary statistics of our variables. In the final sample, 67.6% of firm-year observations are business groups’ affiliated firms and from these observations 88.75% come from groups with a pyramidal structure. Our data uncover the predominance of pyramidal business groups in Brazil and confirms prior evidence of this organizational form in emerging economies with low capital market development (Masulis et al., 2011). The average (median) firm in our sample invests 5.9% (4.7%) of total assets, has a Tobin’s Q of 1.081 (0.946), generates $0.123 ($0.127) of cash flows per unit of total asset, has a ratio of fixed-to-total assets of 38.7% (38.3%), holds 8.1% (4.1%) of total assets in cash, and owes to debt-holders $0.248 ($0.242) per unit of assets.

To provide some evidence on the relevance of internal capital markets in business groups, we measure the size of debt and credit within related-party transactions. As shown in Table 1, the average business group affiliated firm holds $0.050 ($0.047) per unit of assets in debt (credit) from (to) other group’s firm, which represent about 1/5 of ordinary debt. While these related-party transactions account for a significant portion of debt, they are a conservative measure of internal capital markets as internal transfers across business group affiliates include other mechanisms such as equity financing and price-transfers, to name a few.

Next, we compare means and medians of investment rates between business groups (treated) and stand-alone (control) firms. As argued before, we expect differences in investment behavior between financially weak and financially strong firms; thus, we split our sample accordingly. Tables 2 and 3 show means (Panel A) and medians (Panel B) of our variables for treated, non-treated\(^\text{17}\), and control firms for the two subsamples (i.e., financially weak and strong firms).\(^\text{18}\).

\(^\text{17}\)Non-treated are all stand-alone firm-year observations, including those not selected as control by our matching procedures.

\(^\text{18}\)The results presented in Tables 2 and 3 are based on the less stringent definition of a business group. Results for a more restrictive definition in which only groups with a pyramidal structure are recognized as business groups are very similar and are available upon request.
To have a meaningful comparison of investment rates across groups, we need to ensure that the groups are comparable in other measures that are potentially correlated to the outcome variable. Table 2 shows that treated and control firms in the financially weak subsample are very similar in cash flow, size, tangibility, cash holdings, and debt; but, there is a statistically significant difference in Tobin’s Q. A business group’s members tend to have more growth-opportunities than stand-alone firms. Because of this difference, one may expect that, contrary to our hypothesis, a business group’s affiliated firm invests more than stand-alone firms in this subsample.

Table 3 uses the financially strong firms subsample and shows that treated and control firms are very similar in cash flow, tangibility, and debt; but they are statistically different in Tobin’s Q, size, and cash holdings. Moreover, business groups’ affiliated firms tend to have more growth-opportunities, size, and cash than stand-alone firms. These differences may produce a positive difference in investment rates between business group members and stand-alone firms for the financially strong subsample, the same difference that is implied by our model. Therefore, we can have difficulties to separate our internal capital market effect from these other effects.

As suggested by Imbens and Rubin (2015) (see also Wooldridge, 2010), we calculate the normalized difference for each covariate to examine the overlap assumption embedded in average treatment effect estimations. According to these authors, normalized differences (in absolute terms) above 25% are potential cause for concern. In the financially weak subsample, the normalized differences are all below this threshold, suggesting that lack of overlap is not a problem. Regarding financially strong firms, Tobin’s Q and size exhibit normalized differences above the 25% threshold; thus, our results should be interpreted with caution in these cases.

Turning to investment behavior, in the financially weak subsample (Table 2), a business
group’s firms tend to invest less than their stand-alone counterparts. The difference in means (medians) is -0.006 (-0.009) between treated and non-treated firms, approximately 14% (26%) of the mean (median) investment rate of business group firms; and is -0.004 (-0.009) between treated and control firms, approximately 9% (26%) of the mean (median) investment rate of business group firms.

The differences in medians are statistically significant at the 5% level and economically relevant, showing that the median financially weak stand-alone firm invest 26% more than its business group affiliated counterpart. This evidence is in sharp contrast with the traditional view that internal capital markets can mitigate external financial markets inefficiencies (Khanna and Palepu, 2000; Khanna and Yafeh, 2007) and confirms our hypothesis that financially weak business group firms tend to support business group’s internal capital markets and, thus, invest less than stand-alone firms with similar characteristics (growth opportunities, cash flow, size, tangibility, cash holdings, and debt).

In the financially strong subsample (Table 3) business group firms tend to invest more than their stand-alone counterparts. The difference in means (medians) is 0.012 (0.004) between treated and non-treated firms, approximately 16% (7%) of the mean (median) investment rate of business group firms; and, the difference is 0.018 (0.008) between treated and control firms, approximately 24% (13%) of the mean (median) investment rate of business group firms. The differences in means are statistically significant at the 5% and 1% levels, respectively, and economically expressive, since the typical stand-alone firm in the financially strong subsample invest 24% less than its business group member counterpart. This result confirms our hypothesis that financially strong business group affiliates tend to benefit from their internal capital markets and, consequently, invest more than stand-alone firms with similar characteristics, but we need to be cautious because of remaining differences in Tobin’s Q and size between groups and the (possible) violation of the overlap assumption discussed above.
Table 2: Comparison of Treated, Nontreated, and Control Firms: Financially Weak Subsample

Panel A: Means for Treated, Nontreated, and Control Firms

<table>
<thead>
<tr>
<th></th>
<th>Investment</th>
<th>Q</th>
<th>Cash Flow</th>
<th>Size</th>
<th>Tangibility</th>
<th>Cash</th>
<th>Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated</td>
<td>0.043</td>
<td>1.212</td>
<td>0.119</td>
<td>13.394</td>
<td>0.240</td>
<td>0.107</td>
<td>0.213</td>
</tr>
<tr>
<td>Nontreated</td>
<td>0.049</td>
<td>1.038</td>
<td>0.121</td>
<td>13.737</td>
<td>0.246</td>
<td>0.092</td>
<td>0.227</td>
</tr>
<tr>
<td>Difference</td>
<td>-0.006</td>
<td>0.175</td>
<td>-0.002</td>
<td>-0.343</td>
<td>-0.006</td>
<td>0.014</td>
<td>-0.014</td>
</tr>
<tr>
<td>p-value</td>
<td>0.166</td>
<td>0.006</td>
<td>0.827</td>
<td>0.010</td>
<td>0.531</td>
<td>0.192</td>
<td>0.395</td>
</tr>
<tr>
<td>Norm. Diff.</td>
<td>-0.091</td>
<td>0.172</td>
<td>-0.015</td>
<td>-0.175</td>
<td>-0.042</td>
<td>0.087</td>
<td>-0.057</td>
</tr>
<tr>
<td>Treated</td>
<td>0.043</td>
<td>1.212</td>
<td>0.119</td>
<td>13.394</td>
<td>0.240</td>
<td>0.107</td>
<td>0.213</td>
</tr>
<tr>
<td>Control</td>
<td>0.048</td>
<td>0.993</td>
<td>0.111</td>
<td>13.602</td>
<td>0.253</td>
<td>0.088</td>
<td>0.210</td>
</tr>
<tr>
<td>Difference</td>
<td>-0.004</td>
<td>0.219</td>
<td>0.008</td>
<td>-0.208</td>
<td>-0.013</td>
<td>0.018</td>
<td>0.002</td>
</tr>
<tr>
<td>p-value</td>
<td>0.316</td>
<td>0.001</td>
<td>0.448</td>
<td>0.132</td>
<td>0.215</td>
<td>0.119</td>
<td>0.894</td>
</tr>
<tr>
<td>Norm. Diff.</td>
<td>-0.073</td>
<td>0.223</td>
<td>-0.057</td>
<td>-0.094</td>
<td>-0.094</td>
<td>0.115</td>
<td>0.010</td>
</tr>
</tbody>
</table>

In Panel A, p-value is the two-sided p-value of the t test on the equality of means.

Panel B: Medians for Treated, Nontreated, and Control Firms

<table>
<thead>
<tr>
<th></th>
<th>Investment</th>
<th>Q</th>
<th>Cash Flow</th>
<th>Size</th>
<th>Tangibility</th>
<th>Cash</th>
<th>Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated</td>
<td>0.034</td>
<td>0.997</td>
<td>0.122</td>
<td>13.313</td>
<td>0.251</td>
<td>0.062</td>
<td>0.195</td>
</tr>
<tr>
<td>Nontreated</td>
<td>0.043</td>
<td>0.941</td>
<td>0.113</td>
<td>13.741</td>
<td>0.253</td>
<td>0.037</td>
<td>0.209</td>
</tr>
<tr>
<td>Difference</td>
<td>-0.009</td>
<td>0.056</td>
<td>0.008</td>
<td>-0.429</td>
<td>-0.001</td>
<td>0.025</td>
<td>-0.014</td>
</tr>
<tr>
<td>p-value</td>
<td>0.028</td>
<td>0.105</td>
<td>0.775</td>
<td>0.070</td>
<td>0.924</td>
<td>0.070</td>
<td>0.391</td>
</tr>
<tr>
<td>Treated</td>
<td>0.034</td>
<td>0.997</td>
<td>0.122</td>
<td>13.313</td>
<td>0.251</td>
<td>0.062</td>
<td>0.195</td>
</tr>
<tr>
<td>Control</td>
<td>0.043</td>
<td>0.922</td>
<td>0.100</td>
<td>13.450</td>
<td>0.259</td>
<td>0.038</td>
<td>0.195</td>
</tr>
<tr>
<td>Difference</td>
<td>-0.009</td>
<td>0.075</td>
<td>0.021</td>
<td>-0.137</td>
<td>-0.008</td>
<td>0.024</td>
<td>-0.000</td>
</tr>
<tr>
<td>p-value</td>
<td>0.038</td>
<td>0.064</td>
<td>0.445</td>
<td>0.326</td>
<td>0.585</td>
<td>0.230</td>
<td>0.913</td>
</tr>
</tbody>
</table>

In Panel B, p-value is the continuity-corrected p-value of the nonparametric test on the equality of medians.

Norm. Diff. is the normalized difference suggested by Imbens and Rubin (2015).
Table 3: Comparison of Treated, Nontreated, and Control Firms: Financially Strong Subsample

Panel A: Means for Treated, Nontreated, and Control Firms

<table>
<thead>
<tr>
<th></th>
<th>Investment</th>
<th>Q</th>
<th>Cash Flow</th>
<th>Size</th>
<th>Tangibility</th>
<th>Cash</th>
<th>Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated</td>
<td>0.076</td>
<td>1.052</td>
<td>0.130</td>
<td>14.389</td>
<td>0.538</td>
<td>0.065</td>
<td>0.270</td>
</tr>
<tr>
<td>Nontreated</td>
<td>0.064</td>
<td>0.914</td>
<td>0.117</td>
<td>13.550</td>
<td>0.524</td>
<td>0.048</td>
<td>0.302</td>
</tr>
<tr>
<td>Difference</td>
<td>0.012</td>
<td>0.138</td>
<td>0.013</td>
<td>0.839</td>
<td>0.014</td>
<td>0.017</td>
<td>-0.032</td>
</tr>
<tr>
<td>p-value</td>
<td>0.038</td>
<td>0.001</td>
<td>0.163</td>
<td>0.000</td>
<td>0.171</td>
<td>0.007</td>
<td>0.034</td>
</tr>
<tr>
<td>Norm. Diff.</td>
<td>0.144</td>
<td>0.232</td>
<td>0.100</td>
<td>0.382</td>
<td>0.093</td>
<td>0.187</td>
<td>-0.151</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Investment</th>
<th>Q</th>
<th>Cash Flow</th>
<th>Size</th>
<th>Tangibility</th>
<th>Cash</th>
<th>Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated</td>
<td>0.076</td>
<td>1.052</td>
<td>0.130</td>
<td>14.389</td>
<td>0.538</td>
<td>0.065</td>
<td>0.270</td>
</tr>
<tr>
<td>Control</td>
<td>0.058</td>
<td>0.896</td>
<td>0.119</td>
<td>13.680</td>
<td>0.534</td>
<td>0.045</td>
<td>0.295</td>
</tr>
<tr>
<td>Difference</td>
<td>0.018</td>
<td>0.156</td>
<td>0.011</td>
<td>0.709</td>
<td>0.004</td>
<td>0.020</td>
<td>-0.025</td>
</tr>
<tr>
<td>p-value</td>
<td>0.006</td>
<td>0.000</td>
<td>0.256</td>
<td>0.000</td>
<td>0.741</td>
<td>0.003</td>
<td>0.124</td>
</tr>
<tr>
<td>Norm. Diff.</td>
<td>0.207</td>
<td>0.281</td>
<td>0.090</td>
<td>0.327</td>
<td>0.024</td>
<td>0.225</td>
<td>-0.119</td>
</tr>
</tbody>
</table>

Panel B: Medians for Treated, Nontreated, and Control Firms

<table>
<thead>
<tr>
<th></th>
<th>Investment</th>
<th>Q</th>
<th>Cash Flow</th>
<th>Size</th>
<th>Tangibility</th>
<th>Cash</th>
<th>Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated</td>
<td>0.060</td>
<td>0.947</td>
<td>0.131</td>
<td>14.427</td>
<td>0.521</td>
<td>0.037</td>
<td>0.269</td>
</tr>
<tr>
<td>Nontreated</td>
<td>0.057</td>
<td>0.899</td>
<td>0.131</td>
<td>13.427</td>
<td>0.513</td>
<td>0.024</td>
<td>0.330</td>
</tr>
<tr>
<td>Difference</td>
<td>0.004</td>
<td>0.048</td>
<td>0.000</td>
<td>0.999</td>
<td>0.008</td>
<td>0.013</td>
<td>-0.061</td>
</tr>
<tr>
<td>p-value</td>
<td>0.560</td>
<td>0.016</td>
<td>0.977</td>
<td>0.001</td>
<td>0.322</td>
<td>0.045</td>
<td>0.007</td>
</tr>
<tr>
<td>Treated</td>
<td>0.060</td>
<td>0.947</td>
<td>0.131</td>
<td>14.427</td>
<td>0.521</td>
<td>0.037</td>
<td>0.269</td>
</tr>
<tr>
<td>Control</td>
<td>0.052</td>
<td>0.897</td>
<td>0.129</td>
<td>13.450</td>
<td>0.518</td>
<td>0.024</td>
<td>0.314</td>
</tr>
<tr>
<td>Difference</td>
<td>0.008</td>
<td>0.051</td>
<td>0.002</td>
<td>0.976</td>
<td>0.004</td>
<td>0.013</td>
<td>-0.045</td>
</tr>
<tr>
<td>p-value</td>
<td>0.378</td>
<td>0.014</td>
<td>0.841</td>
<td>0.044</td>
<td>0.841</td>
<td>0.074</td>
<td>0.006</td>
</tr>
</tbody>
</table>

In Panel A, p-value is the two-sided p-value of the $t$ test on the equality of means.
In Panel B, p-value is the continuity-corrected p-value of the nonparametric test on the equality of medians.
Norm. Diff. is the normalized difference suggested by Imbens and Rubin (2015).
One final remark regarding the summary statistics presented in Tables 2 and 3 is that firms classified as financially strong tend to invest more than firms classified as financially weak regardless of their organization structure – business group or stand-alone (differences are statistically significant at the 1% level). This result is consistent with an environment in which financial constraints play a role in determining firm’s investment decisions.

We now examine the average treatment effects (ATEs and ATTs) in both subsamples. These estimations effectively control for observable differences between business group and stand-alone firms using both non-parametric (nearest-neighbor matching) and parametric (regression adjustment) techniques. In addition to our conventional classification of firms as belonging to business groups or as stand-alone firms, we also present results under a strict definition in which only groups with a pyramidal structure are classified as business groups. The results for the conventional classification are presented under the label “Business Group” and those for the narrow definition are presented under the label “Pyramidal Groups”. Table 4 shows ATEs and ATTs estimates using the nearest-neighbor matching method (Panel A) and the regression adjustment method (Panel B). Since the results between these two definitions of business groups are very similar, our analyses is restricted to our conventional classification.

Table 4, Panel A, shows that the average treatment effect (ATE) for firms classified as financially weak is -0.011. This result is statistically significant at the 1% level and the economic significance of this effect is also relevant: the typical financially weak stand-alone firm invests 26% (0.011/0.043) more than its business group pair. It is hard to reconcile this evidence with the traditional view of business groups’ internal capital markets, in which these markets can mitigate external market inefficiencies (Khanna and Palepu, 2000; Khanna and Yafeh, 2007). If the traditional view is correct, we should observe business group affiliates investing more (not less) than their stand-alone firms counterparts; especially in financially weak firms, that are more affected by financial constraints.

This empirical evidence supports our hypothesis that financially weak business group affiliates tend to support their internal capital markets, providing funds to other group members and, thus, relying only on a fraction of their cash flows to finance their investments. Accordingly, these firms should invest less than stand-alone firms with similar characteristics that can rely on their entire cash flows to finance their investments. The average treatment effect on the treated (ATT) is a little bit higher (in absolute terms), statistically significant at the 5% level, leading to the same conclusion discussed above.
Table 4, Panel B, shows that, using regression adjustment estimator for firms classified as financially weak, both ATE and ATT are statistical and economic significant. The typical financially weak stand-alone firm invests 19% (0.008/0.043) more than its business group member counterpart. Again, this result contrasts with the traditional view of internal capital markets in business groups and corroborates our hypothesis.

When we examine the financially strong firms, the nearest-neighbor estimate (Table 4, Panel A) of the ATE is 0.014, statistically significant at the 5% level. This result suggests that the typical financially strong stand-alone firm invests 18% (0.014/0.076) less than its business group member counterpart. Although this can not rule out the traditional view, it confirms our hypothesis that internal capital markets in business groups tend to favor the financially strong firms (as the external markets do) and, consequently, these firms are able to raise more resources (internally and externally) and invest more than stand-alone firms with similar characteristics. The nearest-neighbor estimate of the ATT is 0.017, statistically significant at the 5% level, and it indicates that the treatment effect is higher for business group firms. The regression adjustment estimator decrease in magnitude and in statistical significance for both ATE and ATT, which is (possibly) a consequence of the lack of overlap that we identified in this subsample.

Our empirical results so far corroborate our hypothesis and challenges the traditional view of business groups’ internal capital markets (Khanna and Palepu, 2000; Khanna and Yafeh, 2007). Although the difference in investment rates between business group affiliates and stand-alone firms in the financially strong subsample does not completely contradict the traditional view, the difference in investment rates between business group affiliates and stand-alone firms in the financially weak subsample clearly dispute this view. These differences, however, are exactly in line with our hypothesis.

We can also analyze the differences between our predictions and the traditional view from another (closely related) perspective. In both cases external capital markets fail (at least in part) to channel resources toward the more productive uses of capital. Moral hazard and adverse selection problems, for example, lead lenders to provide credit to firms with high pledgeable income. Hence, investment rates may vary substantially for firms with similar growth-opportunities and cash flows but different pledgeable income. On the one hand, in the traditional view, internal capital markets in business groups can overcome this failure, alleviating the resource allocation problem for financially constrained firms. If this is true, we should not observe much difference in investment rates of business groups affiliates with similar growth-opportunities and cash flows.
Table 4: Investment and Business Group Membership: Average Treatment Effects

Panel A: Nearest-Neighbor Matching

<table>
<thead>
<tr>
<th></th>
<th>Financially</th>
<th>Pyramidal Groups</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Strong</td>
</tr>
<tr>
<td>ATE</td>
<td>-0.011</td>
<td>0.014</td>
<td>-0.011</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>0.009</td>
<td>0.036</td>
<td>0.010</td>
<td>0.050</td>
</tr>
<tr>
<td>ATT</td>
<td>-0.012</td>
<td>0.017</td>
<td>-0.011</td>
<td>0.017</td>
</tr>
<tr>
<td></td>
<td>0.024</td>
<td>0.014</td>
<td>0.030</td>
<td>0.018</td>
</tr>
</tbody>
</table>

Panel B: Regression Adjustment

<table>
<thead>
<tr>
<th></th>
<th>Financially</th>
<th>Pyramidal Groups</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Strong</td>
</tr>
<tr>
<td>ATE</td>
<td>-0.008</td>
<td>0.009</td>
<td>-0.009</td>
<td>0.010</td>
</tr>
<tr>
<td></td>
<td>0.034</td>
<td>0.153</td>
<td>0.028</td>
<td>0.137</td>
</tr>
<tr>
<td>ATT</td>
<td>-0.008</td>
<td>0.010</td>
<td>-0.007</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td>0.062</td>
<td>0.150</td>
<td>0.098</td>
<td>0.128</td>
</tr>
</tbody>
</table>

Coefficients in the first row, p-value in the second.

ATE is the Average Treatment Effect and ATT is the Average Treatment Effect on the Treated.

Nearest-Neighbor Matching based on the following covariates: Tobin’s Q, Cash Flow, Size, Tangibility, Cash, and Debt. We also request exact match on year.

Regression Adjustment Matching based on an outcome model linear in the following covariates: Tobin’s Q, Cash Flow, Size, Tangibility, Cash, Debt, and Year (dummies).
but different pledgeable income. On the other, our model makes the opposite prediction, that is, internal capital markets works similarly to external capital markets and so will magnify the difference in investment rates of business groups affiliates with similar growth-opportunities and cash flows but different pledgeable income.

We can provide empirical evidence to this alternative perspective by comparing differences in investment rates between financially strong and financially weak firms for business group affiliates and stand-alone firms. To do so, we estimate ATEs and ATTs using financially strong firms as the treatment group and the financially weak as the control group, for our subsamples of business group affiliates and stand-alone firms (separately). Since now the tangibility variable is used to classify firms into treatment and control groups, we exclude it from the covariates. According to the traditional view, the new ATEs and ATTs estimates should be lower in the business group affiliates subsample than in the stand-alone subsample. Our model, however, predicts the opposite.

Table 5 presents the results of these estimations. All ATEs and ATTs are positive and statistically significant at the 5% level, suggesting that the financial condition (pledgeable income) is an important driver for resource allocation and investments. In Table 5, Panel A, using the nearest-neighbor matching estimator, the ATEs and ATTs of business group affiliates are almost twice those of stand-alone firms. The one-side $t$-test rejects the hypothesis that ATEs and ATTs of business groups affiliates and stand-alone firms are equal at the 10% level. This evidence, again, supports our hypothesis and is inconsistent with the traditional view. In Panel B, we run the regression adjustment estimator and the differences between business groups affiliates and stand-alone firms decreases, but are still consistent with our model and incompatible with the traditional view.

Finally, we control for the possibility that our treatment (i.e., business group affiliation) is endogenous. One could argue, for example, that growth-opportunities differ between business group affiliates and stand-alone firms in an unobserved fashion and, consequently, our ATEs and ATTs estimates would capture this effect. Before going further, we should make it clear that such alternative explanations can hold only if these unobserved variables have a positive effect on the investment rate of financially strong business group affiliates and a negative effect on the investment rate of financially weak business group affiliates. We believe that it is difficult to observe this scenario, but we cannot discard this possibility. Therefore, as described in the previous section, we employ a linear regression with endogenous treatment effects, estimated
Table 5: Investment and Financial Strength: Average Treatment Effects

Panel A: Nearest-Neighbor Matching

<table>
<thead>
<tr>
<th></th>
<th>Business Groups</th>
<th>Pyramidal Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stand-Alone</td>
<td>Business Group</td>
</tr>
<tr>
<td>ATE</td>
<td>0.015</td>
<td>0.028</td>
</tr>
<tr>
<td></td>
<td>0.017</td>
<td>0.000</td>
</tr>
<tr>
<td>ATT</td>
<td>0.015</td>
<td>0.028</td>
</tr>
<tr>
<td></td>
<td>0.028</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Panel B: Regression Adjustment

<table>
<thead>
<tr>
<th></th>
<th>Business Groups</th>
<th>Pyramidal Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stand-Alone</td>
<td>Business Group</td>
</tr>
<tr>
<td>ATE</td>
<td>0.018</td>
<td>0.024</td>
</tr>
<tr>
<td></td>
<td>0.012</td>
<td>0.000</td>
</tr>
<tr>
<td>ATT</td>
<td>0.017</td>
<td>0.026</td>
</tr>
<tr>
<td></td>
<td>0.005</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Coefficients in the first row, p-value in the second.
ATE is the Average Treatment Effect and ATT is the Average Treatment Effect on the Treated.
Nearest Neighbor Matching based on the following covariates: Q, Cash Flow, Size, Cash, and Debt. We also request exact match on year.
Regression Adjustment Matching based on an outcome model linear in the following covariates: Q, Cash Flow, Size, Cash, Debt, and Year (dummies).
by the control-function estimator, using family control as an instrument.

Table 6 shows the results of probit regressions in which business group affiliation is the dependent variable and family control and the covariates that we have used before are the explanatory variables\(^{19}\). We ran the probit regression separately for financially weak and financially strong firms subsamples and we also report the marginal effects\(^{20}\). The likelihood of being a business group affiliate is 0.259 (0.279) higher for a firm controlled by a family in the financially weak (strong) subsample. The regression coefficients and marginal effects of the family control variable are all statistically significant at the 1% level, attenuating potential concerns about the quality of our instrument. For the financially weak firms subsample, no other variable has a statistically significant coefficient and the pseudo R square is 22.8%. For the financially strong firms subsample, Tobin’s Q, size, and debt have coefficients and marginal effects statistically significant at the 5% level. In this subsample, a change in one standard deviation of Tobin’s Q, size, and debt change the likelihood of being a business group affiliate in 0.098 (0.209 \(\times\) 0.467), 0.144 (0.09 \(\times\) 1.597), and -0.092 (−0.609 \(\times\) 0.151), respectively. The pseudo R square in this subsample is 25.3%.

In Table 7, we show the results of our linear regressions with endogenous treatment effects for financially weak and financially strong firms subsamples. As in the probit regressions, we add industry and time fixed-effects. The coefficients associated with the business group variable are the average treatment effects (ATEs). Results are very similar if we use our conventional classification of business groups or the narrower one (\textit{i.e.}, pyramidal business groups) and so we limit our analysis to the first set of results. For the financially weak firms the ATE is -0.017, suggesting that business group affiliates invest less than stand-alone firms with similar characteristics. While this evidence supports our model predictions and rejects those of the traditional view, the effect is not statistically significant at the usual levels and so we should accept it with caution. For the financially strong firms the ATE is 0.08, statistically significant at the 1% level, suggesting that financially strong business group affiliates invest more than their stand-alone firms counterparts. This evidence is consistent with our model predictions, but cannot rule out the traditional view. As suggested by Almeida and Campello (2007), cash flow and tangibility have a positive effect on the investment rate of financially weak firms. Finally, debt does have a statistically significant effect on the investment rate of financially

\(^{19}\)We also add industry fixed-effect in these regressions.

\(^{20}\)Covariates are fixed at their means in the case of continuous variables and at observed values in the case of factor variables.
Table 6: **Probability of Business Group: Probit Estimates**

<table>
<thead>
<tr>
<th></th>
<th>Financially Weak</th>
<th>Financially Strong</th>
<th>Coefficient</th>
<th>Marginal Effect</th>
<th>Coefficient</th>
<th>Marginal Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Control</td>
<td>0.902***</td>
<td>0.259***</td>
<td>0.938***</td>
<td>0.279***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[2.99]</td>
<td>[3.45]</td>
<td>[3.40]</td>
<td>[3.80]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tobin’s Q</td>
<td>−0.013</td>
<td>−0.004</td>
<td>0.703**</td>
<td>0.209**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[−0.10]</td>
<td>[−0.10]</td>
<td>[1.99]</td>
<td>[1.97]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash Flow</td>
<td>−0.294</td>
<td>−0.084</td>
<td>−0.111</td>
<td>−0.033</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[−0.29]</td>
<td>[−0.28]</td>
<td>[−0.08]</td>
<td>[−0.08]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tangibility</td>
<td>1.678</td>
<td>0.482</td>
<td>1.866</td>
<td>0.555</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1.17]</td>
<td>[1.17]</td>
<td>[1.44]</td>
<td>[1.44]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm Size</td>
<td>−0.129</td>
<td>−0.037</td>
<td>0.303**</td>
<td>0.090**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[−1.02]</td>
<td>[−1.01]</td>
<td>[2.32]</td>
<td>[2.33]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash Holdings</td>
<td>1.417</td>
<td>0.407</td>
<td>0.556</td>
<td>0.165</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1.40]</td>
<td>[1.36]</td>
<td>[0.28]</td>
<td>[0.28]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt</td>
<td>−0.021</td>
<td>−0.006</td>
<td>−2.047**</td>
<td>−0.609**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[−0.03]</td>
<td>[−0.03]</td>
<td>[−2.35]</td>
<td>[−2.35]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.418</td>
<td>−5.300**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.22]</td>
<td>[−2.54]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Year Dummies        | Yes              | Yes                | Yes         | Yes             | Yes         |
| Industry Effect     | Yes              | Yes                | Yes         | Yes             | Yes         |
| Pseudo R2           | 0.228            |                    | 0.253       |                 |             |
| # Obs.              | 463              | 463                | 392         | 392             |             |

*Dependent variable: Business Group. Probit regression with Robust Standard Errors (clustered at the firm level).

*t statistic in brackets. ***, **, and * indicate statistical significance at 1%, 5%, and 10% level, respectively.*
strong firms.

In sum, our results indicate that financially weak business group affiliates invest less *(the same, at most, in the IV results)* than stand-alone firms with similar characteristics. This is in sharp contrast with the traditional view of internal capital markets in business groups postulating that they can overcome the external markets inefficiencies (*Khanna and Palepu, 2000; Khanna and Yafeh, 2007*). According to this traditional view, business group affiliates should invest *more* than stand-alone firms, especially in the case of financially weak firms, that is, those more sensitive to capital allocation problems that characterize financial markets in developing countries. Our results, however, are fully consistent with our hypothesis, claiming that financially weak business group affiliates tend to support their internal capital markets, relying on only a fraction of their wealth to finance their investments, and thus tend to invest less than their stand-alone counterparts. Regarding the financially strong firms, our results suggest that business group affiliates invest *more* than stand-alone firms. This is exactly what our model predicts and is also consistent with the traditional view of the role of internal capital markets.
Table 7: **Average Treatment Effect: Endogenous Treatment**

<table>
<thead>
<tr>
<th></th>
<th>Business Groups</th>
<th>Pyramidal Groups</th>
<th>Financially</th>
<th>Financially</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Strong</td>
</tr>
<tr>
<td>Business Group</td>
<td>−0.017</td>
<td>0.088***</td>
<td>−0.011</td>
<td>0.076***</td>
</tr>
<tr>
<td></td>
<td>[−1.16]</td>
<td>[3.31]</td>
<td>[−0.85]</td>
<td>[3.28]</td>
</tr>
<tr>
<td>Tobin’s Q</td>
<td>0.004</td>
<td>−0.001</td>
<td>0.003</td>
<td>−0.002</td>
</tr>
<tr>
<td></td>
<td>[1.63]</td>
<td>[−0.05]</td>
<td>[1.29]</td>
<td>[−0.15]</td>
</tr>
<tr>
<td>Cash Flow</td>
<td>0.080***</td>
<td>0.062</td>
<td>0.056**</td>
<td>0.057</td>
</tr>
<tr>
<td></td>
<td>[3.20]</td>
<td>[1.46]</td>
<td>[2.22]</td>
<td>[1.23]</td>
</tr>
<tr>
<td>Tangibility</td>
<td>0.158***</td>
<td>−0.056</td>
<td>0.162***</td>
<td>−0.063</td>
</tr>
<tr>
<td></td>
<td>[5.65]</td>
<td>[−1.33]</td>
<td>[5.35]</td>
<td>[−1.42]</td>
</tr>
<tr>
<td>Firm Size</td>
<td>−0.000</td>
<td>−0.002</td>
<td>−0.000</td>
<td>−0.002</td>
</tr>
<tr>
<td></td>
<td>[−0.02]</td>
<td>[−0.40]</td>
<td>[−0.11]</td>
<td>[−0.46]</td>
</tr>
<tr>
<td>Cash Holdings</td>
<td>0.007</td>
<td>−0.027</td>
<td>0.008</td>
<td>−0.020</td>
</tr>
<tr>
<td></td>
<td>[0.39]</td>
<td>[−0.40]</td>
<td>[0.39]</td>
<td>[−0.30]</td>
</tr>
<tr>
<td>Debt</td>
<td>0.024</td>
<td>0.059**</td>
<td>0.032</td>
<td>0.047*</td>
</tr>
<tr>
<td></td>
<td>[1.31]</td>
<td>[2.04]</td>
<td>[1.60]</td>
<td>[1.80]</td>
</tr>
<tr>
<td>Constant</td>
<td>0.002</td>
<td>0.035</td>
<td>0.004</td>
<td>0.060</td>
</tr>
<tr>
<td></td>
<td>[0.05]</td>
<td>[0.68]</td>
<td>[0.11]</td>
<td>[1.16]</td>
</tr>
</tbody>
</table>

Year Dummies | Yes | Yes | Yes | Yes |
| Industry Effect | Yes | Yes | Yes | Yes |

N | 463 | 392 | 424 | 365 |

*Dependent variable: Investment. Linear regression with endogenous treatment effect (control function approach).

*a* t statistic in brackets. ***, **, and * indicate statistical significance at 1%, 5%, and 10% level, respectively.
5 Concluding Remarks

We provide a new rationale for investment in business groups subject to moral hazard to answer two related questions: (1) How do business groups allocate resources in internal capital markets? and (2) Do these internal transfers alleviate the financial constraints of group firms with limited access to external finance?

On the first question, our model suggests that productivity and pledgeable income jointly determine the allocation of resources in business group internal capital markets. That is, funds within groups tend to flow in the direction of firms with high productivity and high pledgeable income. This means that, if productivity varies little relative to the pledgeable income across firms within a group, pledgeable income will be the key driver of resources.

On the second question, our model predicts that internal capital markets in business groups tend to favor financially strong firms over financially weak firms. This result casts some doubt on the ability of internal capital markets to alleviate financial constraints of group firms that have limited access to external finance, as hypothesized by Khanna and Palepu (2000) and Khanna and Yafeh (2007).

Our model’s primary predictions are consistent with evidence on intra-group loans in Chilean business groups (Buchuk et al., 2014), but inconsistent with Gopalan et al. (2007)’s results for Indian business groups. Institutions, therefore, may play a major role in explaining cross-country variation in business groups financial allocation. In several aspects our model assumptions resemble the Chilean institutional environment. Our model can also be used to gain a better understanding of the efficiency of internal capital markets in business groups (Shin and Park, 1999; Gopalan et al., 2007; Almeida et al., 2015). We propose that efficiency in capital allocation is driven by productivity and pledgeable income. So our model may explain in terms of efficiency extant evidence suggesting a “socialist” cross-subsidization in business groups.

Empirically, we use a sample of Brazilian publicly listed firms from 1998 to 2007 to examine how internal capital markets help affiliated firms to invest and, ultimately, differentiate their investment behavior from stand-alone firms. We find that Brazilian business groups favor financially strong firm just as external capital markets do. This result is consistent with our model central hypothesis and suggest that internal capital markets do not necessarily alleviate financially weak firms’ restrictions. That is, our model contrasts the traditional view of business groups (Khanna and Palepu, 2000; Khanna and Yafeh, 2007).
Our work is not without limitations. First, similar to prior literature studying efficient capital allocation in internal capital markets, we cannot claim that there is an optimal allocation of resources in Brazilian internal capital markets. Our model predictions and empirical evidence suggest that under some conditions, the workings of internal capital markets in business groups function with the same logic as the external capital markets, which tend to favor firms with high productivity and pledgeable income, improving financial resources and allowing further investment.

Second, because of data availability restrictions, we were not able to examine additional testable implications of our model, but we do briefly present them, aiming to provide potential avenues for future research.

Implication (a). Investment-cash flow sensitivity is positive and increases with pledgeable income (e.g., firms with high productivity, low private benefits, high controlling shareholders’ cash flow rights, and high tangibility of assets, will show a higher investment-cash flow sensitivity).

This implication is not particularly new. Theoretically, it has been derived from Tirole (2006) models. Empirically, several authors, including Fazzari et al. (1988), Hoshi et al. (1991), and Kaplan and Zingales (1997), have documented the positive effect of cash flow on firm investment. The cross-sectional variation in the sensitivity of investment to cash flow, however, has been the subject of debate in the corporate finance literature. While Fazzari et al. (1988) present evidence that investment-cash flow sensitivity increases with the degree of financial constraints, Kaplan and Zingales (1997) challenge this view, both theoretically and empirically.

We suggest that investment becomes less sensitive to cash flow with the degree of financial constraints, in accordance with Kaplan and Zingales (1997). For example, if firms with few private benefits and considerable asset tangibility are less financially constrained, then our model implies that their investment-cash flow sensitivity will be high.

The model’s implication is also consistent with Almeida and Campello (2007)’s results. These authors propose that tangible (pledgeable) assets support more borrowing, allowing for further investment in tangible assets, giving rise to a “credit multiplier”. They show that the sensitivity of investment to cash flow increases with tangibility of assets for financially constrained firms, as suggested by the credit multiplier rationale.

In the business group literature, to the best of our knowledge, there is no evidence on how financial and agency factors (tangibility of assets and entrepreneurs’ private benefits) jointly
affect the investment-cash flow sensitivity of group affiliated firms. We propose a theoretical model that explicitly recognizes the role of group firms’ pledgeable income in internal and external capital markets, calling for future empirical evidence.

Implication (b). The sensitivity of investment to other group firms’ cash flow is positive (null) for receivers (providers) of intra-group loans and increases with its level of pledgeable income.

According to our model, the sensitivity of investment to other group firms’ cash flow is the outcome of an active internal capital market in business groups. Lamont (1997), Shin and Stulz (1998), Shin and Park (1999), and Lee et al. (2009) use this logic to motivate their empirical analyses and to interpret their results.\(^\text{21}\) These studies report that the cash flow of other segments (firms) in the same conglomerate (business group) positively affects the firms’ investment. This evidence supports the internal capital markets hypothesis.

As far as we know, however, there is no study that differentiates the investment-cash flow sensitivity between receivers and providers of capital within business groups. Our model explicitly makes this singular distinction and predicts that only the receivers’ investment is positively affected by the cash flow of other firms in the business group.

The extent of the effect of other group firms’ cash flow on investment depends on the receivers’ equity multiplier or, from another perspective, pledgeable income. Receivers with high pledgeable income can leverage internal wealth to a greater degree (higher multiplier) and so their investment responds more to other firms’ cash flow than the investment of receivers with low pledgeable income. Thus, our model suggests that the investment of receivers who have high productivity, low private benefits, high cash flow rights of controlling shareholders, and high tangibility of assets will be more sensitive to other group firms’ cash flow.

Moreover, the corporate finance literature presents mixed evidence about the effect of productivity on the sensitivity of investment to other group firms’ cash flow. On the one hand, the Shin and Stulz (1998) results suggest that the sensitivity of a segment’s investment to the cash flow of other segments does not depend on whether its investment opportunities are better than those of the other segments. For business groups, Shin and Park (1999) suggest less investment sensitivity to other group firms’ cash flow for firms with high-growth opportunities. On the other hand, Lee et al. (2009) find the opposite in the period preceding the 1997 Asian crisis. Our model also accounts for the sensitivity of investment to other firms’ cash flow varying with private benefits, controlling shareholder cash flow rights, or tangibility of assets, opening a new

\(^{21}\) The first two studies deal with conglomerates, while the last two deal with business groups.
avenue for future research empirical research.

Finally, we believe that examining the welfare effects of internal capital markets in business groups provide a unique contribution to the corporate finance literature in emerging economies where capital markets are less developed and business groups are ubiquitous. Along with the insights of Almeida and Wolfenzon (2006a,b), our study testable implications can inspire further theoretical and empirical work with the objective of gaining a better understanding of the equilibrium effects of business groups and the policies needed to improve the efficiency of economy-wide capital allocation.

References


Samphantharak, Krislert, 2006, Internal capital markets in business groups, *Unpublished working paper* Available at SSRN.


A Appendix

In this appendix we develop a more general model than the one presented in the main text. Specifically, we assume now that the investment cash flow at date 1 in case of success is $f_U(I_U)$ for firm $U$ and $f_D(I_D)$ for firm $D$. Except for some adjustments in the assumptions (A1) and (A2), everything else in the model setup remain like before. Regarding the production technology we will assume the following:

\[ f_U(0) = 0, \quad f_U'(\cdot) > 0, \quad f_U''(\cdot) \leq 0, \quad \text{and} \quad p_H f_U'(0) > 1, \]
\[ f_D(0) = 0, \quad f_D'(\cdot) > 0, \quad f_D''(\cdot) \leq 0, \quad \text{and} \quad p_H f_D'(0) > 1. \]

(A0)
In the case of decreasing returns to scale, namely, \( f_T^T(-) < 0 \) for \( T \in \{U, D\} \), we define the first-best investments as the ones that satisfy \( p_H f_T^U(I^{U,FB}) = 1 \) for firm \( U \) and \( p_H f_T^D(I^{D,FB}) = 1 \) for firm \( D \). For \( I^U < I^{U,FB} \) and \( I^D < I^{D,FB} \), \( p_H f_T^U(I^U) > 1 \) and \( p_H f_T^D(I^D) > 1 \) under (A0). With these definitions and changes, assumption (A1) needs to be replaced by:

\[
\begin{align*}
    p_L f_T^U(I^U) + B^U &< 1, \\
    p_L f_T^D(I^D) + B^D &< 1 \beta < 1.
\end{align*}
\]

Assumption (A2) also requires modifications being replaced by:

\[
\begin{align*}
    p_H \left( f_T^U(0) - \frac{B^U}{\Delta_p} \right) &< 1, \\
    p_H \left( f_T^D(0) - \frac{B^D}{\beta \Delta_p} \right) &< 1.
\end{align*}
\]

The investment of firm \( U \) (\( D \)) will be financed by a fraction \( \alpha^U \) (\( \alpha^D \)) of its cash flow \( A^U \) (\( A^D \)), by a fraction \( (1 - \alpha^D) \) (\( (1 - \alpha^U) \)) of the cash flow of firm \( D \) (\( U \)), and the remaining by external finance. Under direct loan, the borrowing firm, say \( U \), needs to promise an amount of \( (1 - \alpha^D) A^D / p_H \) in the case of success at date 1 in exchange of a loan of \( (1 - \alpha^D) A^D \) at date 0. The incentive compatibility constraint of the entrepreneur in the case of firm \( U \) is:

\[
\begin{align*}
    p_H \left( R^U_S - (1 - \beta) \frac{(1 - \alpha^D) A^D}{p_H} \right) + (1 - p_H) R^U_F &\geq 0, \\
    p_L \left( R^U_S - (1 - \beta) \frac{(1 - \alpha^D) A^D}{p_H} \right) + (1 - p_L) R^U_F + B^U I^U &\geq 0.
\end{align*}
\]

Simplifying:

\[
\Delta_p \left( R^U_S - R^U_F \right) - (1 - \beta) \frac{(1 - \alpha^D) A^D}{p_H} \geq B^U I^U. \quad (IC^U)
\]

The incentive compatibility constraint of the entrepreneur in the case of firm \( D \) is:
\[ p_H \left( \beta R_S^D + (1 - \beta) \frac{(1 - \alpha^U)A^U}{p_H} \right) + (1 - p_H)\beta R_F^D \geq \]
\[ p_L \left( \beta R_S^D + (1 - \beta) \frac{(1 - \alpha^U)A^U}{p_H} \right) + (1 - p_L)\beta R_F^D + B^D I^D. \]

Simplifying:

\[ \Delta_p \left( \beta (R_S^D - R_F^D) + (1 - \beta) \frac{(1 - \alpha^U)A^U}{p_H} \right) \geq B^D I^D. \quad (IC^D) \]

The investors rationale constraint in the case of firm U is:

\[ p_H \left( f^U(I_U^D) - R_F^D \right) - (1 - p_H)R_F^U \geq I^D - \alpha^D A^D - (1 - \alpha^U)A^D. \quad (IR^U) \]

The investors rationale constraint in the case of firm D is:

\[ p_H \left( f^D(I_D^D) - R_S^D \right) - (1 - p_H)R_F^D \geq I^D - \alpha^D A^D - (1 - \alpha^U)A^U. \quad (IR^D) \]

Finally, the objective of the entrepreneur is to maximize its expected total income:

\[ p_H \left( R_S^D - (1 - \beta) \frac{(1 - \alpha^D)A^D}{p_H} \right) + (1 - p_H)R_F^U + \]
\[ p_H \left( \beta R_S^D + (1 - \beta) \frac{(1 - \alpha^U)A^U}{p_H} \right) + (1 - p_H)\beta R_F^D. \]

The Lagrangian of the problem:
\[ L = p_H \left( R^U_S - (1 - \beta) \frac{(1 - \alpha^D) A^D}{p_H} \right) + (1 - p_H) R^U_F + \]

\[
p_H \left( \beta R^D_S + (1 - \beta) \frac{(1 - \alpha^U) A^U}{p_H} \right) + (1 - p_H) \beta R^D_F - \]

\[ \lambda^U \left[ B^U I^U - \Delta_p \left( (R^U_S - R^U_F) - (1 - \beta) \frac{(1 - \alpha^D) A^D}{p_H} \right) \right] - \]

\[ \lambda^D \left[ B^D I^D - \Delta_p \left( \beta (R^D_S - R^D_F) + (1 - \beta) \frac{(1 - \alpha^U) A^U}{p_H} \right) \right] - \]

\[ \theta^U \left[ I^U - \alpha^U A^U - (1 - \alpha^D) A^D - p_H \left( f^U(I^U) - R^U_S \right) + (1 - p_H) R^U_F \right] - \]

\[ \theta^D \left[ I^D - \alpha^D A^D - (1 - \alpha^U) A^U - p_H \left( f^D(I^D) - R^D_S \right) + (1 - p_H) R^D_F \right] + \]

\[ \pi^U_S R^U_S + \pi^U_F R^U_F + \pi^D_S R^D_S + \pi^D_F R^D_F + \psi^U I^U + \psi^D I^D - \]

\[ \delta^U (\alpha - \alpha^U) - \delta^D (\alpha - \alpha^D) - \phi^U (\alpha^U - 1) - \phi^D (\alpha^D - 1). \]

The First-Order Conditions (FOCs):

\[ p_H + \lambda^U \Delta_p - \theta^U p_H + \pi^U_S = 0, \quad (A.1) \]

\[ (1 - p_H) - \lambda^U \Delta_p - \theta^U (1 - p_H) + \pi^U_F = 0, \quad (A.2) \]

\[ p_H \beta + \lambda^D \Delta_p \beta - \theta^D p_H + \pi^D_S = 0, \quad (A.3) \]

\[ (1 - p_H) \beta - \lambda^D \Delta_p \beta - \theta^D (1 - p_H) + \pi^D_F = 0, \quad (A.4) \]

\[ -\lambda^U B^U - \theta^U (1 - p_H f^U(I^U)) + \psi^U = 0, \quad (A.5) \]

\[ -\lambda^D B^D - \theta^D (1 - p_H f^D(I^D)) + \psi^D = 0, \quad (A.6) \]

\[ - (1 - \beta) A^U - \frac{\lambda^D \Delta_p (1 - \beta) A^U}{p_H} + \theta^U A^U - \theta^D A^U + \delta^U - \phi^U = 0, \quad (A.7) \]
\[(1 - \beta)A^D + \frac{\lambda^U \Delta_p (1 - \beta)A^D}{p_H} - \theta^U A^D + \theta^D A^D + \delta^D - \delta^D = 0. \tag{A.8} \]

Since the lender sector is competitive, firms will earn the entire surplus. Under our assumptions, this means that both firms invest up to their first-best levels, \(0 < I^U \leq I^{U,FB} \) and \(0 < I^D \leq I^{D,FB} \), and that the investor’s rationality constraints are binding at the optimum. Regarding the firms payoffs in each state (success of failure) there is four possible cases: 1) \(R^U_S = R^D_F = 0 \), 2) \(R^U_S > 0 \) and \(R^D_F > 0 \), 3) \(R^U_S = 0 \) and \(R^D_F > 0 \), and 4) \(R^U_S > 0 \) and \(R^D_F = 0 \), \(T \in \{U, D\} \). The first case is clearly not optimal. If we make the additional assumption that both firms are financial constrained, that is, internal wealth \((A^U + A^D)\) and external finance are low enough to not allow firms to invest at the first-best levels\(^{22}\), we can show that the second and third cases are also ruled out. If \(R^U_S > (=) 0 \) and \(R^D_F > 0 \), then \(\pi^U_S = (\geq) 0 \) and \(\pi^U_D = 0 \). Hence, from (A.1) and (A.2):

\[
\begin{align*}
\quad p_H \left(\theta^U - 1\right) &= (\geq) \lambda^U \Delta_p 
\quad (1 - p_H) \left(\theta^U - 1\right) &= -\lambda^U \Delta_p 
\end{align*}
\]

These conditions can only be satisfied if \(\lambda^U = 0 \), that is, if the incentive compatibility constraint \((IC^U)\) is not binding. As we will show below, this only happens when firm \(U\) is financial unconstrained. In the more interesting scenario of financial constraints (and even more realistic!), \(\lambda^U > 0 \) implying that \(R^U_S > 0 \) and \(R^D_F = 0 \) (the forth case above). The same applies to firm \(D\). If \(R^D_S > (=) 0 \) and \(R^D_F > 0 \), then \(\pi^D_S = (\geq) 0 \) and \(\pi^D_F = 0 \). Hence, from (A.3) and (A.4):

\[
\begin{align*}
\quad p_H \left(\theta^D - \beta\right) &= (\geq) \lambda^D \Delta_p \beta 
\quad (1 - p_H) \left(\theta^D - \beta\right) &= -\lambda^D \Delta_p \beta 
\end{align*}
\]

Again, if firm \(D\) is financial constrained then \(\lambda^D > 0 \) implying that \(R^D_S > 0 \) and \(R^D_F = 0 \). That is, if firms are financial constrained they are reward only in the case of success, providing the right incentives for the entrepreneur to behave. From now on we will assume that this is the case. Knowing that \(\psi^U = \psi^D = \pi^U_S = \pi^D_S = 0 \), we can use the first order-conditions (A.1)-(A.6)

\(^{22}\)In the constant returns to scale case (main text) firms are always financial constrained.
to solve for $\theta^U$, $\theta^D$, $\lambda^U$, $\lambda^D$, $\pi_F^U$, and $\pi_F^D$:

$$\theta^U = \frac{p_H B^U / \Delta_p}{1 - p_H \left[ f^U(I^U) - \frac{B^U}{\Delta_p} \right]}$$  \hspace{1cm} (A.9)$$

$$\theta^D = \frac{p_H B^D / \Delta_p}{1 - p_H \left[ f^D(I^D) - \frac{B^D}{\Delta_p} \right]}$$  \hspace{1cm} (A.10)$$

$$\lambda^U = \frac{p_H}{\Delta_p} \times \frac{p_H f^U(I^U) - 1}{1 - p_H \left[ f^U(I^U) - \frac{B^U}{\Delta_p} \right]}$$  \hspace{1cm} (A.11)$$

$$\lambda^D = \frac{p_H}{\Delta_p} \times \frac{p_H f^D(I^D) - 1}{1 - p_H \left[ f^D(I^D) - \frac{B^D}{\Delta_p} \right]}$$  \hspace{1cm} (A.12)$$

$$\pi_F^U = \frac{p_H f^U(I^U) - 1}{1 - p_H \left[ f^U(I^U) - \frac{B^U}{\Delta_p} \right]}$$  \hspace{1cm} (A.13)$$

$$\pi_F^D = \frac{\beta \left[ p_H f^D(I^D) - 1 \right]}{1 - p_H \left[ f^D(I^D) - \frac{B^D}{\Delta_p} \right]}$$  \hspace{1cm} (A.14)$$

The incentive compatibility constraints, ($IC^U$) and ($IC^D$), are binding at the optimal solution and determine the firms payoffs in case of success:

$$R^U_S = \frac{B^U I^U}{\Delta_p} + \frac{(1 - \beta)(1 - \alpha^D)A^D}{p_H}$$  \hspace{1cm} (A.15)$$

$$R^D_S = \frac{B^D I^D}{\beta \Delta_p} - \frac{(1 - \beta)(1 - \alpha^U)A^U}{\beta p_H}$$  \hspace{1cm} (A.16)$$

After replacing $R^U_S$ and $R^D_S$ by the values given in (A.15) and (A.16), respectively, the investor rationality constraints, ($IR^U$) and ($IR^D$), determine (implicitly) the firms investment levels:

$$I^U - p_H \left[ f^U(I^U) - \frac{B^U I^U}{\Delta_p} \right] = \alpha^U A^U + \beta (1 - \alpha^D)A^D$$  \hspace{1cm} (A.17)$$

$$\beta \left[ I^D - p_H \left[ f^D(I^D) - \frac{B^D I^D}{\beta \Delta_p} \right] \right] = \beta \alpha^D A^D + (1 - \alpha^U)A^U$$  \hspace{1cm} (A.18)$$

At this point is worth to make some comments about the Lagrange multipliers of our prob-
lem (see equations (A.9)-(A.14)). As we know, they measure the increase in the entrepreneur expected total income if we could violate (relax) their respective constraints by a unit (in other words, the shadow values of the constraints). Thus, for example, \( \pi^U_F \) measure (approx.) the value to the entrepreneur if we could set the firm \( U \) payoff in case of failure, \( R^U_U \), to the value minus one (instead of zero). More interesting to our analysis are the values of the Lagrange multipliers associated with the investor rationality constraints: \( \theta^U \) and \( \theta^D \). It is easy to show that if the entrepreneur wealth \( (A^U + \beta A^D) \) is increased by a unit and this amount is allocated in firm \( U \) \( (D) \) then the entrepreneur expected total income will increase by \( \theta^U (\theta^D \div \beta) \). The value added by this marginal wealth allocated in firm \( U \) or in firm \( D \) (henceforth, value added) is, respectively:

\[
\theta^U - 1 = (p_H f^U_I (I^U) - 1) \times \frac{1}{1 - p_H \left[ f^U_I (I^U) - \frac{R^U_U}{\Delta p} \right]}, \tag{A.19}
\]

\[
\frac{\theta^D}{\beta} - 1 = \beta (p_H f^D_I (I^D) - 1) \times \frac{1}{\beta \left[ 1 - p_H \left[ f^D_I (I^D) - \frac{B^D_D}{\beta \Delta p} \right] \right]}, \tag{A.20}
\]

Thus, the value added is the product of two factors: the first is the expected NPV per unit of investment (at the entrepreneur eyes) and the second is the firm incremental investment per unit of additional entrepreneur wealth allocated to it (the equity multiplier in the language of Tirole (2006)). As the firms are constrained, their investments are restricted to the amounts of internal and external wealth they can attract. So, this last factor depends positively on the pledgeable income of the firm, that is, the amount it can raise in the external capital market per unit of entrepreneur wealth allocated to it. With this in mind, the value added is the result of the interaction between productivity (expected NPV) and pledgeable income. As we will see below, the resources in the internal capital market flow to the firm with higher value added.

Now, we need to pin down the optimal values of \( \alpha^U \) and \( \alpha^D \). The first-order conditions (A.7) and (A.8) show us how internal transfers impact the entrepreneur expected total income. To see this more clearly, we rewrite these first-order conditions as follows:

\[
A^U \times \left[ \theta^U - \frac{\theta^D}{\beta} \right] = \phi^U - \delta^U, \tag{A.21}
\]

\[
\beta A^D \times \left[ \frac{\theta^D}{\beta} - \theta^U \right] = \phi^D - \delta^D. \tag{A.22}
\]
The left sides of these equations measure the increase in the entrepreneur expected total income if we augment $\alpha^U$ and $\alpha^D$, respectively, by one unit. Suppose that with no internal transfers ($\alpha^U = \alpha^D = 1$) the value added is higher in firm $U$ than in firm $D$, that is, $\theta^U > \theta^D \div \beta$. Then equations (A.21) and (A.22) tell us that is worth (in the entrepreneur eyes) transferring some wealth from firm $D$ to firm $U$, that is, to decrease $\alpha^D$. As we can see from (A.17) and (A.18), as $\alpha^D$ decreases firm $U$ investment increases, firm $D$ investment decreases, and so the gap between $\theta^U$ and $\theta^D \div \beta$ shrinks (see equations (A.9) and (A.10)). The entrepreneur will continue to transfer internal resources from firm $D$ to firm $U$ until this gap vanishes or until the limit to internal transfers is reached (whichever happens first). In this last case, $\delta^U = \phi^D = 0$ and equations (A.21) and (A.22) determine the values of $\phi^U$ and $\delta^D$, respectively.

Now, suppose that with no internal transfers $\theta^U < \theta^D \div \beta$. Then the direction of resources will be reversed, namely, from firm $U$ to firm $D$. If the limit to internal transfers is reached before the gap between $\theta^U$ and $\theta^D \div \beta$ vanishes, then $\phi^U = \delta^D = 0$ and equations (A.21) and (A.22) determine the values of $\delta^U$ and $\phi^D$, respectively. Finally, suppose that with no internal transfers $\theta^U = \theta^D \div \beta$. Then the entrepreneur expected total income cannot be increased by internal transfers and the simplest contract is the one with $\alpha^U = \alpha^D = 1$. It is easy to see that in this case $\phi^U = \delta^U = \phi^D = \delta^D = 0$. Therefore, as in the main text, productivity and pledgeable income jointly determine the allocation of resources in the internal capital markets.

All of our empirical implications remain valid in this more general context.

To better compare the expression used here and the one used in the main text to determine the direction of resources in the internal capital market, it is interesting to note that the expression in brackets on the left side of (A.21) has the same sign as the following expression:

$$B^D \left[ p_H I^U_I (I^U) - 1 \right] - B^U \beta \left[ p_H I^D_I (I^D) - 1 \right].$$

In the case of linear technology (constant returns to scale), the expression above is exactly the same as the one used in the main text. Lastly, we check the second-order conditions for a local maximum. If the limit of internal transfers is reached at the optimal solution (no matter the direction of resources), only one condition must be satisfied: the determinant of the (respective) bordered Hessian matrix is positive, that is:
\[
\left( \Delta_p \left( 1 - p_H \left[ f_I^U(I^U) - \frac{B^U}{\Delta} \right] \right) \right)^2 \times \left( \beta \Delta_p \left( 1 - p_H \left[ f_I^D(I^D) - \frac{B^D}{\beta \Delta_p} \right] \right) \right)^2 > 0.
\]

One can see that this condition is satisfied. If the limit of internal transfers is not reached at the optimal solution, then two conditions must be satisfied: the determinant of the (respective) bordered Hessian matrix is positive and the second last leading principal minor is negative. The first condition is not satisfied since this determinant is null. As we can see in the following expression, the second condition is met.

\[
p_H(\Delta_p^2 A^U)^2 \left[ \theta^U f_{II}^U(I^U) \left( \beta \left( 1 - p_H \left[ f_I^D(I^D) - \frac{B^D}{\beta \Delta_p} \right] \right) \right)^2 + \theta^D f_{II}^D(I^D) \left( 1 - p_H \left[ f_I^U(I^U) - \frac{B^U}{\Delta_p} \right] \right)^2 < 0.
\]

Hence, there is not a single optimal solution in the sense that once the value added of both firms are equated, changes to \( \alpha^U \) and \( \alpha^D \) that do not alter firms investment, and neither therefore, the entrepreneur expected total income, are also optimal solutions. We opt for the simplest solution, that is, the one in which the flow of resources is unidirectional.