The Cost of Diversity: The Diversification Discount and Inefficient Investment

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ABSTRACT

We model the distortions that internal power struggles can generate in the allocation of resources between divisions of a diversified firm. The model predicts that if divisions are similar in the level of their resources and opportunities, funds will be transferred from divisions with poor opportunities to divisions with good opportunities. When diversity in resources and opportunities increases, however, resources can flow toward the most inefficient division, leading to more inefficient investment and less valuable firms. We test these predictions on a panel of diversified U.S. firms during the period from 1980 to 1993 and find evidence consistent with them.

THE FUNDAMENTAL QUESTION IN THE THEORY of the firm, raised by Coase (1937) more than 60 years ago, is how decisions taken inside a hierarchy differ from those taken in the marketplace. Coase suggested that decisions within a hierarchy are determined by power considerations rather than relative prices. If this is indeed the case, why, and when, does the hierarchy dominate the market?

A major obstacle to progress in this area has been the lack of data. Data on internal decisions made by firms are generally proprietary. Even when they are available to researchers, it is difficult to find a comparable group of decisions taken in the market. A notable exception is the capital allocation decision in diversified firms. Since 1978, public U.S. companies have been forced to disclose their data on sales, profitability, and investments by major lines of business (segments). An analysis of a small sample of multisegment firms reveals that segments correspond, by and large, to distinct internal

units of the firm. Since the investment decision is perhaps the most important of corporate decisions, these data allow researchers an opportunity to compare decisions taken by units within hierarchies with decisions taken by independent units in the same industry, and thus obtain insights on how hierarchies and markets differ.

Previous research (Lamont (1997) and Shin and Stulz (1998)) has shown that resource allocation in diversified firms does appear different from that in focused firms and seems to ignore traditional market indicators of the value of investment such as Tobin's q. Moreover, there seems to be a connection between resource (mis)allocation and the value of diversified firms. Berger and Ofek (1995) find that investment by diversified firms in segments that have low q is correlated with the discount at which these firms trade. So perhaps such misallocation explains why diversified firms trade, on average, at a discount relative to a portfolio of single-segment firms in the same industries (Lang and Stulz (1994), Berger and Ofek (1995), Servaes (1996), Lins and Servaes (1999)). But these facts simply heighten the puzzle. What is it in a hierarchy that makes diversified firms misallocate funds? Moreover, what accounts for the wide dispersion in diversified firm values, with fully 39.3 percent trading at a premium in 1990?[1]

To answer these questions, we first need a theoretical framework to understand the phenomenon. At least three kinds of models have been proposed to explain how the divisions of diversified firms behave differently from stand-alone firms. Efficient Internal Capital Market models typically suggest that diversification creates value. By forming an internal capital market where the internally generated cash flows can be pooled, diversified firms can allocate resources to their best use (e.g., see Li and Li (1996), Matsusaka and Nanda (1997), Stein (1997), Weston (1970), and Williamson (1975)).[2] Clearly, these models do not explain the misallocation of resources to divisions with poor opportunities.

Agency cost models have sometimes been offered as explanations for the potential investment distortions in diversified firms. Because top management in the diversified firm has greater opportunities to undertake projects, and potentially greater resources to do so if diversification relaxes constraints imposed by imperfect external capital markets, it might overinvest

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[1] Also, the evidence on the value of diversification, as indicated by the stock price reaction to the decision to diversify, is decidedly mixed. Morck, Shleifer, and Vishny (1990) show that acquiring firms in the 1980s experience negative returns when they announce unrelated acquisitions. John and Ofek (1995) find that announcement returns are greater when diversified firms in the late 1980s announce asset sales that increase focus. By contrast, Schipper and Thompson (1983) document positive announcement period returns when conglomerates announced acquisition programs in the 1960s, and Matsusaka (1993) and Hubbard and Palia (1999) find positive returns to announcements of diversifying acquisitions in the 1960s and 1970s during the conglomerate merger wave.

[2] Also see Billett and Mauer (1997), Denis and Thothadri (1999), Gertner, Scharfstein, and Stein (1994), Milbourn and Thakor (1996), and Harris and Raviv (1996, 1997) for other recent papers on the costs, benefits, and workings of internal capital markets.

resources (e.g., see Stulz (1990) and Matsusaka and Nanda (1997)). Though we believe that agency theories could explain generic overinvestment—for example, the decision to diversify could be viewed as an attempt by the CEO to entrench herself (e.g., Shleifer and Vishny (1989))—it is more difficult to see how these theories could explain the internal misallocation of funds; the CEO should exploit all potential sources of value inside the firm, skimming her agency rents only from the overall pie.

Influence cost models are a third class of models that attempt to explain the decisions of diversified firms. In Meyer, Milgrom, and Roberts (1992), managers of divisions that have a bleak future have an incentive to attempt to influence the top management of the firm to channel resources in their direction. Of course, in the spirit of influence cost models, top management sees through these lobbying efforts. Thus, no resources are, in fact, misallocated to the divisions, though costs are incurred in lobbying activities. As a result, it is again hard to explain the evidence on misallocation with these models.[3]

Since existing theories need substantial embellishment to explain the misallocation of funds in diversified firms and the cross-sectional variation in value, Occam's Razor suggests a different approach. We develop a model of capital allocation under two basic assumptions. First, headquarters has limited power over its divisions: it can redistribute resources ex ante, but it cannot commit to a future distribution of surplus. Second, surplus is distributed among divisions through negotiations, and divisions can affect the share of surplus they receive through their choice of investment.[4] Questions of how the power to take decisions, or capture surplus, is distributed within the firm then become central to determining whether the firm does better or worse than the market.

A brief description of our model may help fix ideas. We assume that the diversified firm consists of two divisions, each led by a divisional manager. Each manager starts with an endowment of resources that the headquarters can either transfer to the other division or leave in place. The retained resources can be invested in one of two projects: an "efficient" investment and a "defensive" investment. The former is the optimal investment for the firm in a world where all contracts can be perfectly enforced. The latter offers lower returns, but protects the investing division better against poaching by the other division.[5]

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[3] Hard, though not impossible. The prospect of enhanced influence costs can lead to changes, ex ante, in real decisions like allocations or organizational structure. These ideas have been separately explored in Fulghieri and Hodrick (1997), Scharfstein and Stein (1997), and Wulf (1997). As we will argue later, the precise nature of the misallocation we document is hard to reconcile with influence cost models.

[4] Our model is best characterized as a model of power-seeking, and is most related to papers by Shleifer and Vishny (1989), Skaperdas (1992), Hirshleifer (1995), and Rajan and Zingales (2000).

[5] That managers have a choice between investments that alter their power is well recognized in the literature; see Shleifer and Vishny (1989) and Stole and Zwiebel (1996).

Divisional managers have autonomy in choosing investments and are self interested. Even though the efficient investment maximizes firm value, a divisional manager may prefer the defensive investment that would benefit her more directly, especially when her resources and opportunities are much better than the other division's. The reason is quite simple. Once the divisional manager makes the unprotected, albeit efficient, investment, she will have to share some of the surplus created with the other division. Of course, if the other division also makes the efficient investment, our manager will get a piece of the surplus created by the other division. If the surplus created by the other division is not too small relative to what she is giving up, the divisional manager will prefer the efficient investment. Thus appropriate incentives are created for both divisions only when they do not differ too much in the surplus—which is the product of resources and opportunities—they create. Diversity in resources and opportunities is costly for investment incentives.

Clearly, the investment distortions would not arise if headquarters could design precise rules to share ex post surplus. In practice, sharing rules are likely to be determined by factors other than considerations of ex ante optimality—such as the ex post bargaining power of the divisions.

Although headquarters cannot contract on how divisions will share the surplus ex post, it can transfer funds ex ante. Some transfers will certainly be made because one division has better opportunities than the other. If stand-alone divisions face imperfect capital markets and cannot borrow as much as they need, the transfers to deserving divisions ("winner-picking" in Stein's (1997) felicitous language) is one way the diversified firm adds value.

But transfers will also be made so as to improve the incentives to undertake the efficient investment. Since incentives are distorted away from the optimal because of diversity (of opportunities and resources), transfers will be made in a direction that makes divisions less diverse—from divisions that are large and have good opportunities to divisions that are small and have poor investment opportunities. Thus, the diversified firm may misallocate some funds at the margin (relative to the first-best) to prevent greater average investment distortions. The more diverse a firm's divisions are, the greater the need to reallocate funds in this way. Thus corporate redistribution may be a rational second-best attempt to head off a third-best outcome.

We are not the first to argue that politics influences investment decisions in firms.[6] However, our simple model of internal capital allocation based on power considerations has the advantage of identifying a clear proxy for what

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[6] For example, Chandler (1966, p. 166) describes the capital budgeting process at General Motors under Durand's management in the following way: "When one of them [Division Managers] had a project why he would vote for his fellow members; if they would vote for his project, he would vote for theirs. It was a sort of horse trading."

drives inefficient allocations: the diversity of investment opportunities and resources among the divisions of the firm. Moreover, it offers detailed testable implications on the direction of flows between divisions.

We test the implications of the theory for a panel of diversified U.S. firms during the period 1980 to 1993 using the segment data on COMPUSTAT. Our theory suggests that whether a segment receives or makes transfers in a diversified firm depends not so much on its opportunities (proxied for by Tobin's q) as on its size-weighted opportunities, and the way these are dispersed across segments in that firm. We show that our theory has a greater ability to predict internal capital allocation than the Efficient Internal Market theory. Moreover, allocations toward the relatively low q segments of a diversified firm, on average, outweigh allocations to its relatively high q segments as the dispersion in weighted opportunities (which we call diversity) increases.

Of course, this may simply reflect the channeling of funds to low q segments that are inefficiently being rationed by the market. For this reason, we test the relationship between diversity and value. We find the greater the diversity, the lower the diversified firm's value relative to a portfolio of single-segment firms. This effect persists even after we correct for the extent to which the diversified firm is focused in specific industries, so our measure of diversity captures something different from traditional measures of diversification.

The empirical results, taken together, provide striking evidence that diversity in investment opportunities between segments *within* firms leads to distorted investment allocations and hence value differences *between* diversified firms. Diversified firms can trade at a premium if their diversity is low. As a case in point, General Electric, perhaps the most admired U.S. conglomerate, is at the 8th percentile of our sample over the entire sample period in terms of diversity, and at the 75th percentile in terms of relative value.

More generally, we believe that our evidence sheds light on how decisions within firms can differ from decisions made in markets. A firm is a collection of commonly held, and mutually specialized critical resources.[7] Though the common control of key resources gives certain agents in the firm the power to shape transactions that would otherwise not be possible in the marketplace (such as the transfer of resources), the absence of a clear demarcation to property rights within the firm can create inefficient power struggles (also see Rajan and Zingales (1998a)). Thus, our finding that a measure of the distortions created by power (i.e., diversity) relates to the discount diversified firms trade at suggests, first, that the use of power may indeed explain why transactions within firms are different from transactions in markets and, second, that neither hierarchies nor markets need dominate. Coase's emphasis on power is far from empty!

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[7] See Kumar, Rajan, and Zingales (1999) for a more detailed exposition of Critical Resource theories of the firm.

The rest of the paper is organized as follows. In Section I we present the framework of our simple stripped-down model. In Section II we derive some testable implications from the model. Section III describes the sample, the tests, and the results. Conclusions follow.

I. The Model

We want to analyze resource allocation in diversified firms. Therefore, we focus on firms operating in different lines of business. For the purposes of our analysis, the distinction between vertically integrated divisions and un-related divisions is unimportant. In fact, the distortions we want to study may arise whenever different organizational units operate within the same hierarchy, so long as at least one dimension of their operations (e.g., raising and allocating resources) is integrated. Our model, therefore, does not apply to a leveraged buyout fund, where each subunit is a firm that operates separately from the other subunits on every dimension, including financing (see Jensen (1989)).

A. Timing

Consider a world with four dates, 0, 1, 2, and 3. A firm is composed of two divisions, *A* and *B*, each of which is headed by a manager who, for simplicity, will be thought of as representing the entire human capital of her division. Each manager wants to maximize the surplus that accrues to her division at date 2. We assume, by contrast, that headquarters maximizes the surplus created by the entire firm.[8]

The two divisions interact on three dimensions. At date 0, the headquarters can reallocate resources between the two divisions. At date 1, divisions choose investments. The type of investment chosen affects the "property right" a division has on the cash flow produced because, depending on it, a division may have the opportunity to poach on the surplus created by the other division. At date 2, the divisions split the total surplus according to their relative power. Everything is predetermined at date 3: Production takes place and surplus is shared according to the date 2 contract. So date 3 is only for completeness. To summarize, the sequence of events is presented in Figure 1.

We now detail the interactions on the previous three dates.

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[8] In Rajan, Servaes, and Zingales (1997), we model this more precisely by assuming that headquarters controls the physical assets of the firm (which are crucial for production), and thus gets a share of the total surplus in bargaining with the divisions. If we assume that headquarters first bargains with the divisions after which the divisions further subdivide the surplus, headquarters will always get a constant share of the surplus, and hence has an incentive to maximize the surplus created by the firm.
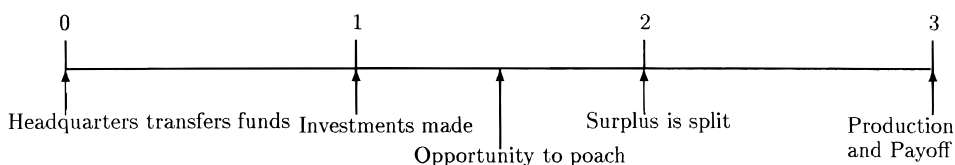
Figure 1. Timing of the events.

B. Resources and Transfers

Each division j starts with an initial endowment of resources, λ_0^j, that can be invested. We assume that these resources include any potential borrowing from outside. The initial level of resources could also be thought of as the resources the division would be able to invest if it were a stand-alone firm. The quantity of these resources are assumed to be limited despite unlimited investment opportunities (see later) because external capital markets are imperfect.

For simplicity, we assume that headquarters can transfer all of a division's resources to the other, though we will see that in equilibrium it will not always choose to do so. The total resources division A has available for investment at date 1 is then $\lambda_1^A = \lambda_0^A - t$, and division B has $\lambda_1^B = \lambda_0^B + t$.

C. Investment

Each division can allocate its date 1 resources, λ_1^j, to one of two kinds of investments. One investment is *technologically efficient* in that it maximizes returns; however, it leaves the surplus exposed to potential expropriation by the other division. Alternatively, the division could make a *defensive* investment, which protects the surplus created at the cost of lower returns.

Some examples are useful to fix ideas. The protective investment could be overly specialized (as in Shleifer and Vishny (1989)) so that only the division knows how to run it. This prevents the project from ever being turned over to the other division. Moreover, the durable resources employed on the project, such as employees, would also become so specialized that they could never be poached by the other division. Of course, the excess specialization would reduce the returns of such a project relative to a more general investment that could be subject to interference by the other division.

The protective investment could reduce a division's dependence on the other division. One of the authors once worked in a commercial bank with three subunits. One subunit had leased dedicated long-distance telephone lines to connect its representatives in each of the bank's branches. The lines were barely used and since the subunits shared space in the branches, it would have been a simple matter for the other subunits to share access to the lines and also connect their representatives. Rather than spending resources to

augment the common usage of the existing lines (efficient), the other sub-units decided to lease their own lines (protective) because they felt their dependence on the first subunit would compromise their ability to bargain over issues such as transfer prices for funds.

The protective investment could be one that stays within the well-defined turf of a division, even though it is efficient for the division to venture out. Bertelsmann, the German conglomerate, had separate divisions for publishing and new media. The development of book sales through the Internet provided a wonderful opportunity to the book division, as well as a substantial threat to its existing business. Yet the book division ignored the opportunity, preferring to focus on book sales through traditional channels, which were clearly its protected turf, and ignoring the efficient Internet investment that could well become part of the new media division's empire.[9]

Let the gross return at date 3 per dollar invested in efficient investment at date 1 be α^j. Since defensive investments are wasteful of resources, the gross return to them is then $\alpha^j - \gamma$, where γ is a positive quantity.

To tie our hands, we assume that there are no savings or diseconomies from joint production. We only assume that if two divisions are under common ownership, resources can be reshuffled between the two. As we shall show, this reshuffling has a positive side (the possibility that resources can be reallocated to their highest value use as in Stein (1997)) and a negative side (that a division may distort its investment in order to obtain "property rights" in the surplus it creates). Thus, both the benefits and costs of a diversified firm spring from the same source: the use of power rather than arm's length contracts to govern transactions within the firm.

D. Contractibility

Accounting controls can ensure that the funds transferred to a division are invested, but a division (and the headquarters) cannot contract on the type of investment that is to be made by the other division. Myers (1977) has a detailed discussion as to why it is difficult to contract on investment; the nature of the "right" physical investment is based on the division's judgment about the state, which is hard to specify ex ante or verify ex post. Also, much of the investment may not be in physical assets but may enhance the division's human capital which, again, is hard to contract upon.

We also make another assumption that is standard in the incomplete contract literature (see Grossman and Hart (1986)): The surplus that is to be produced at the final date cannot be contracted on before date 2 because the state will be realized then and the state-contingent surplus that will be pro-

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[9] See the survey in *The Economist*, November 21 1998, p. 10.

duced may be hard to specify up front. As shown by Hart and Moore (1999), this incompleteness of long-term contracts can be rationalized in a world where all contracts can be renegotiated.

At date 2, however, after the uncertainty about the state that will prevail is resolved, it is possible to strike deals, after bargaining, over the division of date 3 cash flow. Date 3 is separated from date 2 only for expositional convenience, and these dates could be thought of as very close together so that the deals could be thought of as enforceable spot deals.

E. Date 2 Payoffs

A divisional manager who chooses the defensive investment ensures that the surplus his division creates is well protected against any actions by the other division. Moreover, since the investment does not consume all his time and resources, he can attempt to poach on the surplus created by the other division if the other division made the efficient, albeit unprotected, investment.

Thus, if each divisional manager chooses the defensive investment, there is no room for power seeking inside the firm and each division will retain its product—that is, $(\alpha^j - \gamma)\lambda_1^j$.

If one divisional manager, say A, chooses the defensive investment and B does not, then A will have the opportunity of trying to grab some of B's surplus. If A attempts such a grab, B can defend himself, but at substantially greater cost than if he had chosen the defensive investment up front. Specifically, a fraction of the surplus produced by B is dissipated in ex post jockeying for advantage. The payoff B gets is then $(\alpha^B - \theta)\lambda_1^B$ where $\theta > \gamma$. For simplicity, we assume that the surplus division A grabs is almost fully matched by its cost of poaching, and it gets $(\alpha^A - \gamma)\lambda_1^A + \epsilon$ where ϵ is a small number.

Finally, if both divisional managers choose the technologically efficient investment, both are fully involved in productive activity, and neither has the time to poach. Of course, knowing this, neither bothers to defend. Thus, when both divisions choose the efficient investment, dissipation will be avoided and we assume the total surplus $(\alpha^A\lambda_1^A + \alpha^B\lambda_1^B)$ is split equally between the two divisions.[10] The assumption of equal split is not crucial. We will discuss the robustness of the result to changes in this assumption in Section II.D.[11]

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[10] That headquarters does not get any of the surplus is only for simplicity. None of our results would be changed if headquarters gets a constant fraction of the surplus because of its control of the firm's physical assets (see footnote 7).

[11] It is possible to formalize all this. For example, let poaching consume real resources. Skaperdas (1992) shows that when the opportunity cost of poaching is high, cooperation (i.e., no poaching) is an equilibrium. When division A makes the defensive investment and division B does not, A's opportunity cost of poaching is low since the defensive investment has low returns. By contrast, when A makes the efficient investment, the opportunity cost of poaching is high, and both divisions would be content not to poach.

F. First Best

Ideally, all the resources should be transferred to the division with the highest return α^j.[12] This division should allocate all the resources to the efficient investment. As we will show, resources may not all be transferred to the division with the highest use for them because such a transfer can destroy the division's incentive to make the efficient investment. In what follows, we will examine how transfers and allocations are distorted away from the first-best.

II. Equilibrium Implications

Given the anticipated payoffs from date 2 bargaining, at date 1 division j ($j \in A, B$) has the incentive to make the efficient investment if division k is expected to do so, and

$$\tfrac{1}{2}[\alpha^j \lambda_1^j + \alpha^k \lambda_1^k] \geq (\alpha_1^j - \gamma)\lambda_1^j. \tag{1}$$

Since a similar inequality should hold for division k also, both divisions have the requisite incentives if

$$\tfrac{1}{2}[\alpha^j \lambda_1^j + \alpha^k \lambda_1^k] \geq \text{Max}[(\alpha_1^j - \gamma)\lambda_1^j, (\alpha_1^k - \gamma)\lambda_1^k]. \tag{2}$$

It is easily checked that this is a necessary and sufficient condition for the efficient investment to be an equilibrium at date 1. Now let us effect a simple change of variables so that $\beta^j = \alpha^j - \gamma$. Furthermore, without loss of generality, let $\beta^j \lambda_1^j \geq \beta^k \lambda_1^k$. Then the right-hand side of inequality (2) simplifies to $\beta^j \lambda_1^j$ and the whole expression can be rewritten as

$$\gamma(\lambda_1^j + \lambda_1^k) \geq (\beta^j \lambda_1^j - \beta^k \lambda_1^k). \tag{3}$$

For a fixed total amount of resources, $(\lambda_1^A + \lambda_1^B)$, this inequality implies that the product of resources and potential returns cannot be too diverse across divisions.

The intuition is straightforward. Division j (which is the division that can contribute the most to surplus in the following period) will choose the efficient investment only if division k contributes enough surplus to make it worthwhile. Division k will not be able to contribute enough if its resource-weighted opportunities, $\beta^k \lambda_1^k$, are small relative to j's. If so, division j will not make the efficient investment, and neither will k. Therefore, too much diversity in potential contributions to the common pool will lead to a break-

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[12] Of course, in practice, returns will not be constant with scale. Some resources will be retained by the division with lower α^j so as to undertake essential investments such as maintenance.

down in investment incentives, and to each one making defensive investments. In other words, the problem is that division j with the best resource-weighted opportunities has to share the joint surplus, ex post. Unless the other division makes a sufficient contribution, division j will want to forgo cooperation and protect its surplus via defensive investment.

A. Transfers

Before investments are made (date 1), the headquarters can transfer resources from one division to the other (date 0). Interestingly, there are two possible motives for transfers. When both divisions are expected to make the efficient investment, the headquarters will want to reallocate resources from the division with the worse investment opportunities to the division with better investment opportunities.

By contrast, if the two divisions are not going to choose the efficient investment under the initial allocation of resources, then a transfer of resources which tends to equalize the resource-weighted opportunities across divisions may alter incentives and improve efficiency. In this case, the headquarters may transfer resources to the division with worse opportunities. Intuitively, ex ante transfers enhance a division's ex post contribution to the common pool, and improve investment incentives for the other division.

To analyze the direction of transfers, we assume, without loss of generality, that A's potential resource-weighted opportunities at date 0 are greater than B's, so that $\beta^A \lambda_0^A \geq \beta^B \lambda_0^B$. Now $\lambda_1^A = \lambda_0^A - t$ and $\lambda_1^B = \lambda_0^B + t$, with t being the transfer.

Case 1: $\beta^B > \beta^A$. Since B has better opportunities than A, A's resources should be transferred to B so as to improve the efficiency of investment. In addition, since A's potential resource-weighted opportunities are better than B's, resources transferred to B will (weakly) improve A's incentive to make the efficient investment. Will the headquarters transfer all A's resources to B? The answer is no; beyond some level of transfer, $\beta^B \lambda_1^B \geq \beta^A \lambda_1^A$, even if $\beta^A \lambda_0^A \geq \beta^B \lambda_0^B$. At this point, the more restrictive constraint is B's, which, from inequality (3), is

$$\gamma(\lambda_1^A + \lambda_1^B) \geq (\beta^B \lambda_1^B - \beta^A \lambda_1^A). \tag{4}$$

Thus, the transfer will take place until the point that constraint (4) is just binding, that is, when the transfer t is such that

$$\beta^B(\lambda_0^B + t) = \beta^A(\lambda_0^A - t) + \gamma(\lambda_0^A + \lambda_0^B). \tag{5}$$

Solving for t, we get

$$t = \frac{\beta^A \lambda_0^A - \beta^B \lambda_0^B}{\beta^A + \beta^B} + \gamma \frac{\lambda_0^A + \lambda_0^B}{\beta^A + \beta^B}. \tag{6}$$

Therefore for a mean level of opportunities $\beta^A + \beta^B$, and a given level of total resources, $\lambda_0^A + \lambda_0^B$, the transfer from A to B increases in the disparity between A's initial resource-weighted opportunities and B's. Note that the transfer here goes in the "right" direction, so that the bigger it is, the better the allocation to investment. The effect here is similar to that in Efficient Internal Market Theories: the internal capital market allocates resources to their best use. What is new here is that incentives pose a limit to such reallocation even if technology does not.

Case 2: $\beta^B \leq \beta^A$. Since $\beta^A \lambda_0^A \geq \beta^B \lambda_0^B$, before any transfers are made, the more restrictive incentive constraint is A's, which (by inequality (3) is

$$\gamma(\lambda_1^A + \lambda_1^B) \geq (\beta^A \lambda_1^A - \beta^B \lambda_1^B). \tag{7}$$

If

$$\gamma(\lambda_0^A + \lambda_0^B) \geq (\beta^A \lambda_0^A - \beta^B \lambda_0^B), \tag{8}$$

A's incentive constraint is met even without a transfer and, thus, the headquarters has some room to transfer resources so as to improve the allocative efficiency, that is from B to A. This transfer will continue until equation (7) holds with an equality; that is

$$\beta^A(\lambda_0^A - t) = \beta^B(\lambda_0^B + t) + \gamma(\lambda_0^A + \lambda_0^B). \tag{9}$$

For high levels of initial diversity, however, inequality (8) does not hold, and the headquarters will have to transfer resources from A to B so as to reduce disparities in resource-weighted opportunities and ensure that A's incentive constraint is met. But this is at a cost, because B does not utilize resources as well. So the headquarters will transfer the minimum resources consistent with A's incentive constraint being met. The transfer t, then, will be such that equation (9) holds.

In both cases, solving for t, we get

$$t = \frac{\beta^A \lambda_0^A - \beta^B \lambda_0^B}{\beta^A + \beta^B} - \gamma \frac{\lambda_0^A + \lambda_0^B}{\beta^A + \beta^B}. \tag{10}$$

Again, for a mean level of opportunities $\beta^A + \beta^B$, and a given level of total resources, $\lambda_0^A + \lambda_0^B$, the transfer from A to B increases in the disparity between A's initial resource-weighted opportunities and B's. Note that the transfer is toward the division with better opportunities only at low levels of diversity, but it is toward the division with inferior opportunities at high levels of diversity.

Of course, even though the transfer to the division with low opportunities can improve incentives, it has a cost. Headquarters will make the transfer only if the gain through the improvement in incentives outweighs the loss through the misallocation of funds. In other words, we also have to check

that total surplus is more when the transfer is made in the "wrong" direction than when resources are entirely allocated to the division with better opportunities so that

$$(\beta^A + \gamma)(\lambda_0^A - t) + (\beta^B + \gamma)(\lambda_0^B + t) \geq \beta^A(\lambda_0^A + \lambda_0^B). \tag{11}$$

Simplifying, we get the necessary and sufficient condition to be

$$t \leq \gamma \frac{\lambda_0^A + \lambda_0^B}{\beta^A - \beta^B} - \lambda_0^B. \tag{12}$$

Further, since t is determined by equation (10), we can show by substitution and simplification in equation (12) that headquarters has the incentive to make the transfer if

$$\gamma \geq \frac{\beta^A - \beta^B}{2}. \tag{13}$$

In other words, if either the cost of the defensive investment is high in terms of foregone returns, or if the opportunities of division A are not much better than those of division B, headquarters will make the transfer; otherwise headquarters will find transfers too costly relative to the benefits of improved incentives.

Recall that a transfer in the "wrong" direction is necessary to improve incentives if inequality (8) is not satisfied. Taken together with inequality (13), the transfer will be made in the "wrong" direction iff

$$\frac{\beta^A - \beta^B}{2} \leq \gamma < \frac{\beta^A \lambda_0^A - \beta^B \lambda_0^B}{(\lambda_0^A + \lambda_0^B)}. \tag{14}$$

Summarizing this case, when A's resource-weighted opportunities, $\beta^A \lambda_0^A$, are not much higher than B's to start with, transfers may flow toward A since the right incentives are in place. When, ceteris paribus, diversity increases, the transfer toward the division with worse investment opportunities has to increase to improve incentives. Such a transfer will be made so long as the difference in opportunities ($\beta^A - \beta^B$) is not too extreme. Of course, if the difference in opportunities is extreme, then any improvements in investment incentives will be outweighed by the loss in allocative efficiency. As a result, headquarters will simply allocate all resources to the most productive division.[13]

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[13] Even in case 1, equation (6) is derived under the condition that headquarters finds the benefits of improved investment outweigh the costs of the loss of allocative efficiency. For headquarters not to want to transfer everything to division B in that case, a similar condition to inequality (13) can be derived. Headquarters will not transfer everything if γ is high or $\beta^B - \beta^A$ is not too high.

B. Empirical Implications

Our model predicts both a positive and a negative side to diversification. First, there are circumstances when resources will flow toward divisions with superior opportunities—when the interests of improving investment incentives within divisions and allocative efficiency between divisions are jointly served by transfers. The internal capital market in the diversified firm then works well. But, in a second set of circumstances, the ex post sharing rule the diversified firm imposes can also change divisional investment incentives to the point that allocations between divisions will have to be distorted away from first-best to prevent worse investment decisions. The internal capital market still plays a role, but it now channels funds in the "wrong" direction—toward divisions with worse opportunities—in order to head off even worse decisions by divisions.[14]

Our theory enables us to identify these circumstances. Let us term $(\beta^A \lambda_0^A - \beta^B \lambda_0^B)/(\beta^A + \beta^B)$ diversity. Provided headquarters wants to preserve incentives to make the efficient investment, equation (6) suggests:

EMPIRICAL CONJECTURE 1A: *Transfers* from *divisions with relatively high resource-weighted opportunities (high $\beta_0^A \lambda_0^A$) and relatively low opportunities (low β_0^A)* to *divisions with relatively low resource-weighted opportunities and relatively high opportunities will increase in diversity.*

Transfers here enhance overall surplus, so headquarters always wants to make them provided the incentive constraint is met. Greater initial diversity allows for more transfers to take place before the incentive constraint becomes binding.

Provided headquarters wants to preserve incentives to make the efficient investment, equation (10) suggests the following conjecture.

EMPIRICAL CONJECTURE 1B: *Transfers* from *divisions that have relatively high resource-weighted opportunities and relatively high opportunities* to *divisions that have relatively low resource-weighted opportunities and relatively low opportunities will increase in diversity.*

There is a caveat, however. If diversity is extremely high, and the difference in opportunities between divisions is large, headquarters may find that the opportunity cost of transferring resources to the division with poor opportunities outweighs the gains from improved investment incentives. It may no longer find it rational to make those transfers. Let us plot transfers against diversity for an example (see Figure 2, later).

Division A has better opportunities, and better resource-weighted opportunities. Diversity is increased by increasing $\alpha^A - \alpha^B$. For low levels of diversity, transfers from A are negative (i.e., it receives transfers). As di-

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[14] For reasons of space, we have modeled a firm with two segments. The thrust of the results hold when we examine firms with multiple segments. Greater diversity will necessitate transfers in the "wrong" direction to preserve incentives.

versity increases, transfers increase and become positive (they flow toward B, the division with worse opportunities). At very high levels of diversity, however, they become negative again since headquarters allocates all resources back to A. Since we do not know when this point occurs empirically, we will also estimate the relationship between diversity and transfers nonparametrically.

We offer these implications as conjectures guided by the theory rather than the only implications of the theory because there is always a "bad" equilibrium where neither division makes the efficient investment. However, if firms end up in the different equilibria at random, our empirical implications still hold.

C. Model's Implications for the Diversification Discount

In a world where all contracts could be written at no cost, two separate companies could achieve no less and no more than two divisions of the same company. Thus, the relative value of a diversified firm versus a portfolio of single-segment firms in the same industry is a meaningful concept only if we accept frictions that prevent the writing and enforcement of complete state contingent contracts.

The form of contractual incompleteness that is generally used in this literature is the difficulty in writing state-contingent contracts to transfer resources between cash-rich and cash-poor firms. This is the source of the benefit of diversification emphasized by Williamson (1975), Stein (1997), and Matsusaka and Nanda (1997): Resources within a firm can be more easily reallocated from divisions with lower opportunities to divisions with higher opportunities. Of course, for this to be value enhancing there must be some frictions in the external capital market which prevent a division with good opportunities from borrowing all it wants if it were stand-alone.

Even though internal capital markets may not suffer from frictions, the ease of transferring resources has a cost. Since property rights within a firm are not enforced, in a multidivisional firm there are more opportunities for poaching across divisions and resources will be wasted in trying to protect property rights. This is the novel part of the trade-off that we emphasize.

Since our model contains both the negative and the positive aspects of having two divisions in the same firm, it has no direct implications on the average difference between a diversified firm and a portfolio of single-segment firms. There can be either a premium or a discount. As a result, in our empirical analysis we will control for a fixed, firm-specific, effect that captures the average discount, and focus on the relationship between changes in diversity and changes in the discount.

If the division with better resource-weighted opportunities also has better opportunities, our model has implications on how the discount will change as a function of diversity. When diversity is low, transfers are in the right direction and the firm trades at a premium (positive excess value in Figure 2) relative to single-segment firms that cannot reallocate in the same
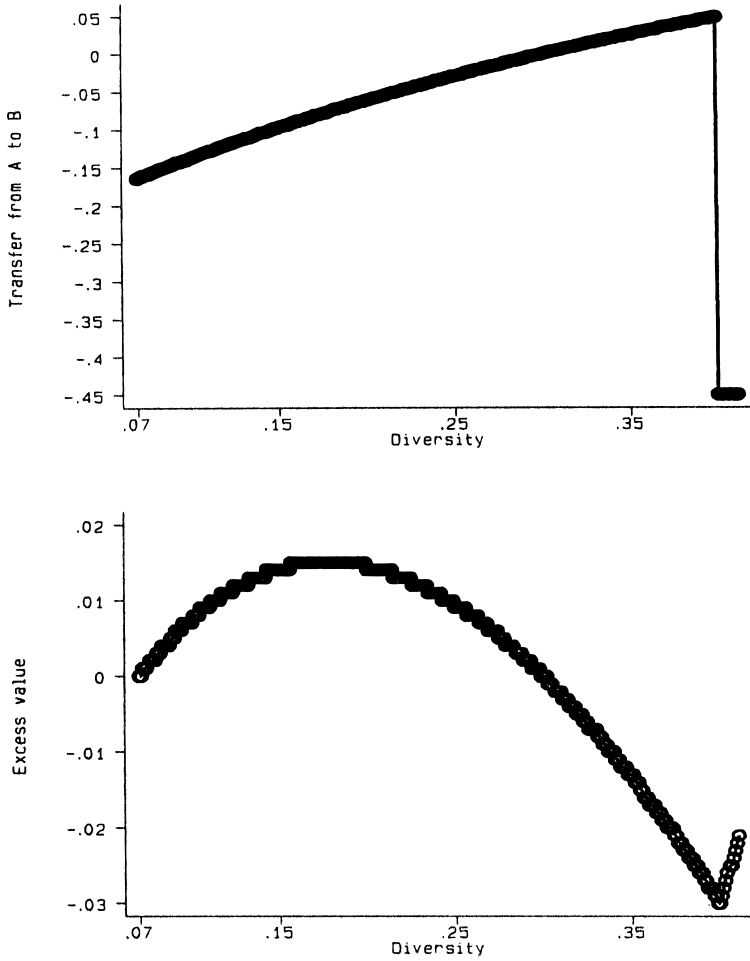
Figure 2. Numerical example of the effects of diversity. This figure presents a numerical example of the effects of diversity on the amount of interdivisional transfers and on the relative value of a diversified firm vis-à-vis a portfolio of single-segment firms. In this example $\lambda_0^A = 0.55$, $\lambda_0^B = 0.45$, $\gamma = 0.3$, $\alpha^B = 1$, and $\alpha^A - \alpha^B$ varies between 0 and 0.62.

way. When diversity increases, the firm starts trading at a discount, which deepens with diversity. Transfers are made to head off a third-best outcome—the defensive investment. Of course, at some point, headquarters no longer finds transfers in the "wrong" direction worthwhile, and all resources are transferred to A, which makes the defensive investment. This is the third-best solution. Thus, we can generate both diversification premia and discounts based on the extent of diversity.

D. Robustness

To simplify the model we have made a number of strong assumptions. The ultimate validity of these assumptions must be judged in terms of predictive power of the model (an issue we will tackle momentarily), but it is useful here to discuss how sensitive our results are.

The most "ad hoc" assumption is probably the equal split of the surplus when both divisions make the efficient investment. This equal split, which gives the large division (where "large" should be interpreted in terms of asset-weighted opportunities) a disproportionately small share of the cash flow produced, appears to drive the results. It does not!

Suppose, by contrast, that the split is unequal and the large division gets a disproportionately large fraction of the cash flow produced. In such a case, it is obvious that, unlike in our model, the incentive compatibility constraint of the large division is not binding. We do not need ex ante transfers to induce it to make the efficient investment. However, in this case, the share the small division expects to receive is likely to be less than what it can secure through a defensive investment. The small division will not want to make the efficient investment, and a transfer will be needed to satisfy its incentive constraint. Interestingly, the transfer will be from the large division to the small division—exactly in the same direction as predicted by our model.

There is, of course, a sharing rule that depends on ex ante resources and endowments, which will satisfy the IC constraints for both divisions and eliminate the problem—it is the rule that gives each division back what it produces. But this is tantamount to assuming that future cash flow is contractible (or that property rights within the firm are inviolate). Thus, the crucial assumption in our model is that future cash flow cannot be assigned contractually ex ante, not the equal split. More generally, in a dynamic framework, the inability of the headquarters to commit to not make (potentially efficient) reallocations of resources ex post, could lead to ex ante incentives for divisions to defend their resources through distorted investment which, in turn, could lead to ex ante inefficient allocations.

E. Caveats

Throughout the empirical analysis we take the firm's ex ante choice about how diversified it should be as given. Since Baumol (1959) and Williamson (1964), a number of papers have suggested that CEOs may have the desire to build empires, and others have documented that diversifying takeovers are typically value decreasing. Thus, the presence of multiple divisions may be a result of agency problems at the headquarters (see Denis, Denis, and Sarin (1997)), and need not be value maximizing. However, we do not need to appeal to this to justify the existence of potentially value-destroying diversified firms. The firm could have been formed at a date when the expected benefits of internal transfers outweighed the expected costs. At any

subsequent point in time, the diversity may become more extreme and the distortions substantial, yet exit costs and the chance that diversity will narrow—both because of the current allocation of funds and because of anticipated mean-reversion in opportunities—could keep the firm together. This is another reason for controlling for firm-specific effects in the analysis.

F. Related Work

It is useful to relate our model to the literature. Our formulation bears some resemblance to Holmstrom and Milgrom (1991) or Holmstrom and Tirole (1991) in the sense that managers have a choice between tasks that are differentially rewarded. These papers, however, do not focus on the role of capital budgeting, or ex ante mechanisms such as capital allocation, in changing the reward system. More directly related is Scharfstein and Stein (1997) who, following the rent-seeking model of Meyer et al. (1992), ask why the headquarters of the diversified firm does not directly bribe the managers of inefficient divisions in return for their refraining from rent seeking. They conclude that if shareholders can control funds spent on investment better than funds spent in bribes, the self-interested headquarters effectively has two currencies with which to bribe managers—investment funds (which by assumption have little value to headquarters because shareholders control them tightly) and discretionary funds (which have high value because shareholders do not control them). Clearly, headquarters chooses the lower cost funds with which to bribe. With further assumptions, they establish that bribes flow to the division that has fewer productive assets in place.

Scharfstein and Stein (1997) ask the right question, but their answer is not without problems. Why can shareholders control investment allocations any better than discretionary allocations? As Myers (1977) argues, almost all investment is discretionary and hard to contract on. Furthermore, their explanation raises the question of whether headquarters would misallocate hundreds of millions of dollars in capital budgets to save a few hundred thousands in the discretionary budget.

By contrast, we assume that investment is hard to contract on. So, all allocations are discretionary. Furthermore, instead of having a divisional manager trying to curry favor with top management in the spirit of rent-seeking models like Meyer et al. (1992) and Scharfstein and Stein (1997), we choose to focus on the manager trying to keep a share of the surplus through self-serving investment. This follows the work by Shleifer and Vishny (1989). The difference in assumptions helps us explain the puzzle posed by Scharfstein and Stein. Headquarters cannot bribe the managers privately to take the right investment because investment cannot be contracted on. Also, headquarters is willing to channel large capital budgets to divisions with poor opportunities simply to avoid even larger costs from divisions choosing worse investments.

Finally, both Meyer et al. (1992) and Scharfstein and Stein (1997) suggest that inefficiency stems directly from the presence of divisions with low opportunities. This is consistent with what Berger and Ofek (1995) find. By

contrast, our model has a specific prediction about how diversity in resources and opportunities across a firm's divisions leads to cross-subsidies that can enhance or reduce value. Other than in previous theoretical work by Rajan and Zingales (2000), we do not think this prediction is found elsewhere, nor has it been directly tested.

III. The Sample and Tests

Since 1976, the Statement of Financial Accounting Standards 14 (SFAS 14) requires publicly traded firms to break down their activities in major lines of business. Specifically, distinct segments that account for more than 10 percent of consolidated profits, sales, or assets should be separately reported. Since June 1997, SFAS 131 requires the primary breakdown used by management in defining segments to be the enterprise's operating segments. The intent is to follow the *management approach* of reporting, which implies that management should report segment information according to how the firm internally organizes business activity for purposes of allocating resources and assessing performance (see Danaher and Francis (1997)). Clearly, the divisions in our model are meant to be distinct operating segments, and this is the kind of data we need. Unfortunately, SFAS 131 comes too late for our study.

To get a sense of the correspondence between segments and divisions, we chose 10 firms in alphabetical order from the list of COMPUSTAT firms that report multiple segments. We then compared the segment description in the 1993 Annual Report with the *Corporate Yellow Book of Who's Who at Leading U.S. Companies*, which lists organizational structure. For eight of the 10 firms, the segments represent distinct organizational units (divisions, groups, or separately incorporated subsidiaries) or the aggregation of such units in similar industries. For example, with Allied Signal the three segments reported are Aerospace, Automotive, and Engineered Materials. They correspond to three major subsidiaries of the company: Allied Signal Aerospace, Allied Signal Automotive, and Allied Signal Engineered Materials. Of course, not all diversified firms had such distinct and readily identifiable divisions. The two exceptions in our small sample were Alberto-Culver and Agway. Alberto-Culver reports three segments: one is identifiable with a separately incorporated subsidiary, the second with a division having as a head a senior vice-president, and the third could not be identified. The only firm with a reported segment structure bearing no correspondence to the organizational structure is Agway, which is a cooperative. However, to the extent that the cooperative consists of distinct firms/producers in different industries, it should be amenable to our analysis.

In sum, apart from adding noise, there is no reason why this imperfect correspondence between organizational structure and segment structure should bias our tests.

An additional problem of business-segment data is the lack of consistency in reporting from year to year. SFAS 14 leaves some discretion in how to break down a company's activities. Firms can use this discretion strategi-

cally. We address this problem in three ways. First, models of strategic reporting typically have firms manipulating numbers such as earnings and sales rather than assets. Therefore, for much of the analysis, the only data items reported by segment that we use are the segment's assets and capital expenditures. Second, we ensure that no data item is calculated from data spread over multiple years. Therefore, we compute beginning-of-period assets as end-of-period assets minus capital expenditures plus depreciation, rather than as previous period end-of-period assets. While this does not account for asset disposals, we verify that our analysis is robust to dropping observations where disposals are likely to be large. Finally, differences in segment reporting between firms are absorbed in the firm-specific fixed effects that we include in much of our analysis.

A. The Sample

Segment data are obtained from the COMPUSTAT Business Segment Information database over the 1979 to 1993 period. Both the active and research files are employed. The segment files contain detailed information on 156,598 firm-segment-years.[15]

To test our implications we need to construct proxies for a segment's β^j, its resources λ^j, the relative value of diversified firms, and the transfers t. In what follows we describe how they are calculated. Summary statistics are in Table I.

B. Proxy for β^j

We have $\beta^j = \alpha^j - \gamma$, where γ is a constant, and α^j is a measure of the investment opportunities faced by the segment. We cannot measure a segment's investment opportunities directly. But we can determine Tobin's q, a good proxy for investment opportunities, for single-segment firms in the industry. Since Wernerfelt and Montgomery (1988) find that industry effects account for much of the variation in Tobin's q, a reasonable proxy for β^j is the Tobin's q of single-segment firms in the same industry.[16]

We compute q ratios for each firm using the Lindenberg and Ross (1981) methodology and the specific assumptions of Hall et al. (1988). Because q ratios cannot be computed for firms with operations in the financial services industries (SIC code starting with 6), firms with any segments in these industries are excluded from our analysis (see Houston, James, and Marcus (1997) for an analysis of internal capital markets in banks). The q ratio we assign to a segment as a proxy for opportunities is the beginning-of-year

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[15] We compute the single segment's Tobin's q at the beginning of a period as the end-of-period value in the previous year. Thus, we lose one year of data. All the regressions, then, are for the period 1980 to 1993.

[16] More precisely, under our assumption of no synergies, the Tobin's q of single-segment firms is a measure of α_j. But under our assumption of a constant γ (since there is no reason for the cost of defensive investment, γ, to be correlated with α_j), it is a reasonable proxy for β_j also.

asset-weighted average ratio for single-segment firms that operate in the same 3-digit SIC code as the segment.[17] To avoid potential problems with outliers, this variable, as all the other variables we compute, are winsorized at the 1st and 99th percentiles of their distributions.

C. Proxy for λ_0^j

Unlike for investment opportunities, there are no immediate proxies for the initial resources a division has at its command. There are some problems in using the free cash flow that a division generates. First, as a number of studies have shown (e.g., see Harris (1993)), strategic reporting of segment income is common. Second, even if the free cash flow the segment generates is reported accurately, we would be understating the resources at its command, since the segment would have the ability to borrow, or obtain trade credit. We therefore prefer to use segment assets as a measure of its resources. Segment assets are less likely to be reported strategically. Furthermore, a segment's assets, while being correlated with the size of the cash flows it generates, also partly reflect its borrowing capacity.

The size of total resources in the firm is constant in our model. To be consistent with this in the cross-sectional analysis, we divide a segment's assets by the firm's assets, and use the segment's beginning-of-year share of total assets as a measure of its resources.

D. Proxy for the Relative Value of Diversified Firm

To measure the relative value of a diversified firm vis-à-vis a portfolio of single-segment firms, we use the excess-value measure introduced by Lang and Stulz (1994). This is computed as the difference between the market value of a diversified firm and a portfolio of single-segment firms in the same three-digit SIC code.

Formally,

$$Excess\ Value = \frac{MV_d}{RVA_d} - \sum_{j=1}^{n} q_j \frac{BA_j}{BA_d}, \tag{15}$$

where MV_d is the the end-of-the-year market value of assets, RVA_d is the replacement value of the assets of the diversified firm, q_j is the end-of-the-year asset-weighted average Tobin's q of single-segment firms that operate in the three-digit industry of segment j, and BA is the book value of assets. Our procedure mimics the valuation method employed by Lang and Stulz (1994) but for the fact that in our computation of industry averages we use the asset-weighted average, rather than the equally weighted average To-

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[17] Alternatively, we could define the industry q ratio as the median ratio for single-segment firms that operate in the same 3-digit SIC code. All the results are unchanged.

Table I

Summary Statistics

Tobin's q is the ratio of the market value of the firm to the replacement value of its assets. Market-to-sales ratio is the ratio of the market value of the firm to net sales, for firms with sales in excess of $20 million. Average of segment qs is the asset-weighted average of segment qs. Segment q is defined as the asset-weighted average q of single-segment firms that operate in the same three-digit SIC code as the segment. Excess value measured using q is $EV = (MV/RVA) - \sum_{j=1}^{n} q_j (BA_j/BA)$, where MV is the market value of assets, RVA the replacement value of the assets, BA the book value of assets, subscript j refers to segment j, n is the total number of segments, and q_j is the asset-weighted average Tobin's q of single-segment firms that operate in the three-digit industry of segment j. Excess value measured using market-to-sales is $EV' = (MV/S) - \sum_{j=1}^{n}(MV/S)_j(S_j/S)$, where MV is the market value of assets, S is the value of sales, n is the number of segments in the diversified firm, $(MV/S)_j$ is the sales-weighted average market-to-sales ratio of single-segment firms in the same three-digit industry, and subscript j refers to segment j. Adjusted investment is the industry-adjusted investment in a segment less the weighted average industry-adjusted investment across all the segments of a firm. This is defined as

$$\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}} - \sum_{j=1}^{n} w_j\left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}}\right),$$

where I_j is capital expenditure of segment j (item #4 of the COMPUSTAT segment file), BA_j is the book value of assets of segment j, (I_j^{ss}/BA_j^{ss}) is the asset-weighted average capital expenditure to assets ratio for the single-segment firms in the corresponding industry, and w_j is the ratio of segment assets to firm assets. The relative value added by allocation is

$$\frac{\sum_{j=1}^{n} BA_j(q_j - \bar{q})\left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}} - \sum_{j=1}^{n} w_j\left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}}\right)\right)}{BA},$$

where $\bar{q}$ is the asset-weighted average of segment q's for the firm. The absolute value added by allocation is

$$\frac{\sum_{j=1}^{n} BA_j(q_j - 1)\left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}}\right)}{BA}.$$

Standard deviation of weighted segment qs is the standard deviation of the asset-weighted qs of the segments in which the firm operates. The inverse of average q equals $1/qe$, where qe is the equally weighted average q across segments in the firm. Diversity is the standard deviation of a firm's asset-weighted q divided by the equally weighted average q. Number of segments is the number of business-segments as reported by COMPUSTAT. The Herfindahl index of segment's size is based on the segment's share of total assets of the firm. Coefficient of variation of segment qs is the standard deviation of segment qs divided by the mean of segment qs. Similarly, the coefficient of variation of segment size is the standard deviation of segment's share of total firm assets divided by the average segment share. All the data are for the period 1980 to 1993.

Variable	Mean	Median	Std. Dev.	Min	Max	N
Tobin's q	1.158	0.994	0.730	0.100	9.853	13,947
Market-to-sales ratio	1.249	0.915	1.062	0.195	7.005	12,847
Average of segment qs	1.279	1.205	0.511	0.039	6.111	13,868
Average of segment market-to-sales	1.363	1.189	0.792	0.025	6.663	13,125
Excess value (using q)	−0.120	−0.156	0.713	−2.194	5.423	13,868
Excess value (using market-to-sales)	−0.113	−0.184	0.794	−2.028	3.799	12,169
Adjusted investments in segments						
Above firm's average q and weighted $q \times 100$	−0.160	0.000	1.831	−10.250	6.705	13,947
Above firm's average q but below weighted $q \times 100$	0.067	0.000	1.304	−4.223	8.161	13,947
Below firm's average q but above weighted $q \times 100$	−0.046	0.000	1.455	−7.885	5.329	13,947
Below firm's average q and weighted $q \times 100$	0.129	0.000	1.646	−5.810	9.825	13,947
Value added by allocation (relative)* 100	−0.120	−0.001	1.478	−8.160	6.194	13,946
Value added by allocation (absolute)* 100	−0.068	−0.115	4.341	−16.818	27.518	13,946
Std. deviation of segment qs	0.372	0.286	0.296	0.017	1.600	13,947
Average of segment q (equally weighted)	1.264	1.202	0.443	0.494	2.868	13,947
Inverse of average q	0.891	0.832	0.316	0.349	2.023	13,947
Diversity	0.295	0.251	0.191	0.015	0.865	13,947
Number of segments	2.904	3.000	1.113	2.000	10.000	13,947
Herfindahl index of segment's size	0.547	0.527	0.185	0.212	0.958	13,947
Firm's size (log of total sales)	5.861	5.752	1.722	2.996	11.641	13,947
Coefficient of variation of segment qs	0.192	0.156	0.160	0.000	0.700	13,947
Coefficient of variation of segment size	0.763	0.764	0.369	0.032	1.539	13,947

bin's q of single-segment firms. We choose the asset-weighted average because of concerns about the possible bias created by small single-segment firms with large growth opportunities and, thus, very large Tobin's q.[18]

E. Proxy for Transfer t

We need a measure of the funds transferred to/from a division. Since we do not have direct data on this, we have to use indirect measures. In our model all the transfers made/received correspond to a decrease/increase in investments. Thus, the difference between the investment a segment makes when it is part of a diversified firm and the investment it would have made had it been on its own represents a good proxy for transfers made (if negative) or received (if positive). We approximate the investment a segment would have made on its own by the *investment ratio* of single-segment firms in the same industry (which is the weighted average of the ratio of capital expenditures to beginning-of-period assets).

It is possible, however, that diversified firms have more funds overall, perhaps because their cost of capital is lower. By measuring transfers as the difference between the investment of a segment and the investment of single-segment firms in the same industry, we would incorrectly treat these additional funds as a transfer between segments, rather than as a net addition to all segments. To correct for this, we further subtract the industry-adjusted investment ratio averaged across the segments of the firm from the segment's industry-adjusted investment ratio. The industry- and firm-adjusted investment ratio, which we will call *the adjusted investment ratio* in what follows, is our best proxy for the transfers the segment makes (if negative) or receives (if positive). It is computed as

$$\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}} - \sum_{j=1}^{n} w_j \left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}} \right), \tag{16}$$

where ss refers to single-segment firms and w_j is segment j's share of total firm assets. To get a sense of this measure, and the adjustments we make in reaching it, in Table II we compute the above measures for segments in low q industries and high q industries. Since our model is about the relative

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[18] In the literature there are two main explanations of the average discount of diversified firms. Berger and Ofek (1995, 1996) suggest that the discount is an indication of a real loss in value produced by diversification. Others (Hyland (1996) and Matsusaka (1997)) suggest that the discount is a purely statistical artifact. For example, Matsusaka (1997) has a matching model where firms diversify to find a good match between their organizational capabilities and their line of business. Focused firms are firms that have been successful in finding a suitable match in the past, and hence have a higher value, on average. We think that both explanations are, a priori, plausible. This is another reason why, in all our analyses, we correct for firm-specific effects, so that the firm-specific component of the discount, which is more likely to be explained by sample selection, is eliminated.

Allocation of Funds in a Diversified Firm

The level of investments in business segments are compared with an industry q above the firm's average and that in business segments with an industry q below the firm's average. We use three definitions of investments: Investment ratio is the capital expenditure to beginning-of-the-period asset ratio, I_j/BA_j, where BA is book value of assets, I is capital expenditures, and subscript j refers to segment j. Industry-adjusted investment ratio is the segment investment ratio less the average industry investment ratio: $(I_j/BA_j) - (I_j^{ss}/BA_j^{ss})$, where (I_j^{ss}/BA_j^{ss}) is the asset-weighted capital expenditure to assets ratio for the single-segment firms in the corresponding industry. Firm and industry-adjusted investment ratio is the industry-adjusted investment ratio in a segment less the weighted average industry-adjusted investment ratio across all the segments of the firm. This is defined as

$$\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}} - \sum_{j=1}^{n} w_j \left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}} \right),$$

where w_j is the segment's share of total assets. All the data are for the period 1980–1993.

Funds Allocated	Segments with $q > \bar{q}$	Segments with $q < \bar{q}$	Difference
Investment ratio	0.101	0.096	0.005
Industry adjusted	0.008	0.013	−0.005
Firm and industry adjusted	−0.002	0.004	−0.006
Number of segments	23,604	22,600	

level of opportunities, segments are defined to be low q if the industry q for that segment is below the asset-weighted mean q for the firm. Correspondingly, segments with q above the mean are classified as high q.

On average, diversified firms invest more as a fraction of assets in segments with good opportunities than in segments with poor opportunities (0.101 versus 0.096, the difference is statistically significant at the 1 percent level).

Correcting for the industry level of investment, we obtain our crude measure of the transfers a segment receives or makes. Now, low q segments receive more than high q segments (0.013 versus 0.008, the difference is statistically significant at the 1 percent level). Finally, our preferred measure for the transfer, the adjusted investment ratio, corrects for both industry and firm and this measure also shows that low q segments receive transfers, on average, while high q segments make them (0.004 versus −0.002, the difference is statistically significant at the 1 percent level).

In summary, diversified firms transfer more to divisions with poor opportunities. This, by itself, is in contrast to Efficient Internal Market models, which predict that diversified firms should channel funds to divisions with good opportunities. Our model, however, makes predictions about how the transfer varies with diversity.

<div align="center">

Table III

**Effect of Diversity of Opportunities on Internal Transfers:
Theoretical Predictions**

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This table summarizes the predictions of the main theories in terms of investments in different segments. Segments are divided according to whether they have better opportunities than the firm's average ($q > \bar{q}$) and more resources-weighted opportunities than the firm's average ($\lambda q > \bar{\lambda q}$). The predictions of "our theory" hold only as long as the headquarters wants to preserve the incentives to make efficient investments.

	Adjusted Investment in Segments with			
	$q > \bar{q}$ $\lambda q > \bar{\lambda q}$	$q > \bar{q}$ $\lambda q < \bar{\lambda q}$	$q < \bar{q}$ $\lambda q > \bar{\lambda q}$	$q < \bar{q}$ $\lambda q < \bar{\lambda q}$
Efficient internal capital market	+	+	−	−
Our theory	−	+	−	+
Scharfstein and Stein	−	−	+	+

F. Proxy for Diversity

We use equations (6) and (10) to guide the specifications for the regressions. So the explanatory variables are the inverse of the equally weighted q (corresponding to the second term in equations (6) and (10)) and our measure of diversity—the standard deviation of segment asset-weighted q's for the firm divided by the equally weighted average q of segments in the firm:

$$Diversity = \frac{\sqrt{\sum_{j=1}^{n} \frac{(w_j q_j - \overline{wq})^2}{n-1}}}{\frac{\sum_{j=1}^{n} q_j}{n}}, \tag{17}$$

where both w_j and q_j are beginning-of-the-period values.

G. The Effect of Diversity on Segment Investments

Table III summarizes the predictions of our model for the effect of diversity on transfers assuming headquarters wants to preserve incentives to make efficient investments. We contrast these with the implications of the Efficient Internal Market models and the implications of Scharfstein and Stein (1997). Efficient Internal Market models emphasize the positive aspects of internal capital markets: headquarters has the option to reallocate resources from divisions with low investment opportunities to divisions with high investment opportunities. An increase in the diversity increases the value of this option and, thus, should increase the amount of resources trans-

ferred to segments with better investment opportunities. By contrast, Scharfstein and Stein's arguments imply that the least productive divisions receive transfers from the most productive divisions. Again, an increase in diversity will lead to an increase in this transfer.

Our model, on the other hand, is more nuanced. It predicts that an increase in diversity should lead to an increase in the transfers *from* segments that have asset-weighted investment opportunities above the firm average, and an increase in transfers *to* segments below the firm average. In other words, the dividing line between those divisions that receive and those divisions that make transfers that increase with diversity, is not so much opportunities (as in Efficient Internal Market models) as size-weighted opportunities. As a result, while our Empirical Conjecture 1a is not any different from that predicted by EIM models, Empirical Conjecture 1b is exactly the opposite.[19]

Table IV presents a direct test of the main implications of the model. We place a segment in one of four groups, depending on whether the segment's asset-weighted investment opportunities are above or below the firm average, and whether the segment q is above or below the firm's average q. For each firm year, we compute the adjusted investment ratios (our measure of transfers) for segments that fall in the group of interest. We multiply this by the weight of each segment and sum across all segments in the group. The dependent variable thus is the transfer in a particular year in a particular firm to segments that belong to the particular group. Thus, the dependent variable is different for each of the four columns, though the number of observations is the number of firm-years, and is the same in all columns.[20] The explanatory variables are the inverse of the equally weighted q, and diversity. Our specification also includes firm fixed effects, calendar-year dummies, and firm size, measured as logarithm of total sales. The inclusion of a separate dummy variable for each firm (fixed effects) allows us to control for unobserved heterogeneity, as long as this is constant over time. Thus, our findings are not affected by cross-sectional differences in organizational structure or segment reporting, as long as these firm characteristics are fairly stable over time. Table IV, Panel A, summarizes the results.

In all the four regressions, the estimated coefficient on diversity has the sign predicted by our model and the coefficient is statistically different from zero at the 1 percent level. Though regressions in columns 2 and 3 do not distinguish between our theory and Efficient Internal Market theories, the regressions in columns 1 and 4 do. In these regressions, diversity has the effect of increasing transfers *to* segments with below-average opportunities (or increasing transfers *from* segments with above-average opportunities),

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[19] Strictly speaking, Efficient Internal Market models refer to the dispersion in investment opportunities, not our measure of diversity. The results are not any more favorable for EIM models if we use measures of dispersion of investment opportunities instead of the diversity of size-weighted opportunities. Results are available on request.

[20] If a firm does not have a segment in a particular group, we set the transfer to zero. The results are qualitatively similar if we set the transfer to missing in these cases.

Table IV

Segment Investment and Diversity in Investment Opportunities

Firm- and industry-adjusted investment is the industry-adjusted investment in a segment less the weighted average industry-adjusted investments across all the segments of a firm. This is defined as

$$\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}} - \sum_{j=1}^{n} w_j \left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}} \right),$$

where w_j is the asset weight of the segment. The inverse of average q equals $1/qe$, where qe is the equally weighted average q. Diversity is the standard deviation of a firm's asset-weighted q $\left(\sqrt{\sum_{j=1}^{n}[(w_j q_j - \overline{wq})^2/(n-1)]} \right)$ divided by the equally weighted average q). Size is the logarithm of total sales. Coefficient of variation of segment qs is the standard deviation of segment qs divided by the mean of segment qs. Coefficient of variation of segment size is the standard deviation of segment shares in a diversified firm divided by mean segment share. All regressions contain firm fixed effects and calendar-year dummies. Heteroskedasticity robust t-statistics are reported in parentheses. All the data are for the period 1980 to 1993.

	Adjusted Investment in Segments with			
	$q > \bar{q}$ $\lambda q > \overline{\lambda q}$	$q > \bar{q}$ $\lambda q < \overline{\lambda q}$	$q < \bar{q}$ $\lambda q > \overline{\lambda q}$	$q < \bar{q}$ $\lambda q < \overline{\lambda q}$
Panel A: Basic Specification				
Inverse of average q	0.005	−0.001	−0.001	−0.004
	(5.383)	(−0.896)	(−0.726)	(−4.289)
Diversity	−0.014	0.004	−0.004	0.014
	(−9.059)	(3.637)	(−4.004)	(9.547)
Firm size	0.000	0.000	−0.001	0.001
	(−0.192)	(0.249)	(−1.342)	(1.054)
R^2	0.321	0.332	0.326	0.318
N	13,947	13,947	13,947	13,947
Panel B: The Effect of Focus				
Inverse of average q	0.006	−0.001	0.000	−0.004
	(5.610)	(−1.043)	(−0.600)	(−4.506)
Diversity	−0.025	0.008	−0.009	0.024
	(−12.036)	(6.743)	(−6.786)	(12.125)
Firm size	0.001	0.000	0.000	0.000
	(1.394)	(−0.794)	(−0.413)	(−0.617)
Herfindahl index of segment size	0.025	−0.011	0.011	−0.023
	(9.653)	(−6.472)	(5.633)	(−9.602)
R^2	0.329	0.335	0.328	0.326
N	13,947	13,947	13,947	13,947

Table IV—*Continued*

Panel C: The Effect of the Coefficient of Variation of Segment q				
Inverse of average q	0.005	−0.001	0.000	−0.003
	(4.357)	(−1.210)	(−0.258)	(−3.414)
Diversity	−0.015	0.003	−0.004	0.015
	(−9.316)	(3.454)	(−3.759)	(9.687)
Coeff. variation of q	−0.006	−0.002	0.002	0.005
	(−3.797)	(−1.554)	(1.932)	(3.572)
Firm size	0.000	0.000	−0.001	0.000
	(0.072)	(0.353)	(−1.475)	(0.793)
R^2	0.322	0.332	0.326	0.319
N	13,947	13,947	13,947	13,947
Panel D: The Effect of the Coefficient of Variation of Segment Size				
Inverse of average q	0.005	0.000	−0.001	−0.004
	(5.367)	(−0.592)	(−1.052)	(−4.247)
Diversity	−0.015	0.000	0.000	0.014
	(−8.010)	(−0.026)	(−0.055)	(8.167)
Coeff. variation of segment size	0.000	0.004	−0.005	0.000
	(0.383)	(5.685)	(−5.961)	(0.039)
Firm size	0.000	0.000	0.000	0.001
	(−0.221)	(−0.199)	(−0.852)	(1.045)
R^2	0.321	0.335	0.328	0.318
N	13,947	13,947	13,947	13,947

an effect that is the opposite of that predicted by EIM models. The economic magnitude of the effect is also large. For example, the estimates in column 1 indicate that a one-standard deviation increase in diversity decreases transfers to segments with above-average weighted opportunities and above-average opportunities by 0.0027, which is more than 1.5 times the average level of the dependent variable.

It is possible that even after controlling for firm-specific effects, observations arising in any single year are not independent (the variance-covariance matrix of the residuals is not diagonal) and, thus, the standard errors computed in the usual way are biased downward. Fama and MacBeth (1973) provide a way to correct for this problem. It consists of estimating a series of cross-sectional regressions and then computing the statistical significance by using the time series average and standard deviation of the estimated coefficients.

To compute fixed-effects Fama–MacBeth (or FEFM) t-statistics, we first subtract the time series average for each variable and each firm. Then, we estimate a series of cross-sectional regressions with the demeaned variables.

Finally, we use the time series standard deviation of the estimated coefficients to compute statistical significance.[21] The coefficient estimates (not reported) are almost identical to the ones in Table IV, Panel A, and they are all highly statistically significant (*t*-statistics between 2.8 and 8).

In summary, it is especially interesting that segments with identical opportunities can make or receive transfers depending on their size-weighted opportunities relative to the rest of the firm. If these correlations are not spurious (a possibility we will examine shortly), our work confirms earlier theory and empirical work (e.g., Shin and Stulz (1998)) that decisions made in a hierarchy are affected by the rest of the hierarchy. Moreover, our work suggests that funds are allocated in a diversified firm not simply as a blind cross-subsidy to poorly performing divisions, but something more complex. Furthermore, it gives hope that simple models of the allocation of power and bargaining within firms can add substantially to our understanding of this process.

H. Robustness

One could think of other potential explanations for our findings. For one, we rely on investment by single-segment firms as a benchmark. But Tobin's *q* may be a noisy measure of investment opportunities and, at the same time, it may affect the amount of funds the market provides to single-segment firms (a hypothesis consistent with the findings of Lang, Ofek, and Stulz (1996)). If the diversified firm rectifies these errors, we should expect high *q* segments to invest less than their industry average and low *q* segments to invest more. Moreover, an increase in diversity would accentuate these effects. This explanation is certainly consistent with two of our correlations, however it is not consistent with the other two. For instance, it does not explain the increase in transfer with diversity to segments with below-average asset-weighted *q* and above-average *q*. This alternative explanation also predicts that transfers should increase value, a prediction rejected in Section J.

A number of papers (see, e.g., Berger and Ofek (1995), Bhagat, Shleifer, and Vishny (1990), Comment and Jarrell (1995), and John and Ofek (1995)) have observed that firms become more efficient when they increase focus. Thus, an alternative explanation is that our results are driven by the distribution of segment size (firm focus) rather than anything to do with opportunities.

To check that our diversity measure does not simply capture differences in focus, we reestimate our basic regression by inserting a measure of focus as an explanatory variable. Following Berger and Ofek (1995), we measure focus by the Herfindahl index of segment asset size. A higher Herfindahl index corresponds to a higher concentration of the firm's activities in a particular industry and, thus, a more focused firm. To test our theory against the "focus" alternative we hypothesize that focus leads to greater investment effi-

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[21] We thank Gene Fama for suggesting this two-step procedure.

ciency. Thus, a higher Herfindahl index should increase the amount of funds allocated to segments with q above the firm's average q and reduce the amount allocated to segments with q below the firm's average q. Furthermore, if focus is the major reason for our previous findings, the introduction of the Herfindahl index should reduce or eliminate the effect of diversity.

In Table IV, Panel B, we reestimate the four regressions in Panel A, including the Herfindahl index as an additional explanatory variable. As Panel B shows, the Herfindahl index is always statistically significant, but only two out of four times does it have the sign predicted by the "focus" theory. For instance, column 2 indicates that focused firms invest less in segments with a Tobin's q above the average, when these segments are small. Most important, from our point of view, the inclusion of the Herfindahl index, far from weakening our effect, increases both the magnitude and the statistical significance of the effect of diversity on the funds transferred.

We also examine whether the effect of diversity (in asset-weighted opportunities) persists after controlling for variation in investment opportunities across divisions (Table IV, Panel C) and variation in size across divisions (Table IV, Panel D). As illustrated in Panel C, including the coefficient of variation of segment q's has little effect on the coefficient or the significance of our measure of diversity. On the other hand, including the coefficient of variation of segment size does affect the coefficient on diversity in two of the four models. In particular, transfers to segments with above-average opportunities, but below-average asset-weighted opportunities are positively related to the coefficient of variation in size, but not to diversity when both are included. Similarly, transfers to segments with below-average opportunities, but above-average weighted opportunities are negatively related to the coefficient of variation in size, but not to diversity when both are included. Since the coefficient of variation in size is a component of diversity, the results in Panel D suggest that it sometimes captures the effect we are trying to measure, but there are aspects of diversity it does not capture.

I. Individual Rationality Constraint

The predictions of our model about transfers in the wrong direction (Table III, columns 1 and 4) hold only if headquarters wants to preserve the incentives to make efficient investments; that is, the individual rationality (IR) constraint for a transfer, inequality (11), is satisfied. But nothing assures us of this.

Since we do not know when the IR constraint binds (i.e., when the kink in Figure 2 occurs), we estimate nonparametrically the relationship between transfers and diversity for the two groups of segments for which the constraint might be binding. We use a kernel estimation method (see Scott (1992)). The method essentially consists of estimating a weighted average response of the dependent variable in a small neighborhood around a specific value of the explanatory variable, and repeating this many times over the range of realizations of the explanatory variable to trace out the em-

pirical relationship. Before estimating the relationship, we partial out firm-specific effects as well as the calendar-year dummies and the inverse of the equally weighted q.

In Figures 3a and b, we plot the fitted values from the kernel regression and the corresponding grid points.[22] Figure 3a shows the fitted values from the kernel regression when the dependent variable is the transfer to segments that have above-average opportunities, and above-average size-weighted opportunities. There is no sign of a weakening of the relation for high values of diversity. A similar relationship (though with opposite sign) can be seen for segments that are below average on both dimensions (see Figure 3b). Thus, the IR constraint does not seem to bind, on average, over the range of diversity represented in the sample.

J. Overall Efficiency of Transfers

Although the estimates in Table IV support the main predictions of the theory, they do not directly indicate whether, taken together, greater diversity improves or decreases the efficiency of internal allocation. Columns 1 and 4 imply a decrease, columns 2 and 3 suggest the opposite. Since the magnitude of the estimated coefficients when diversity decreases efficiency is three times as large as when diversity increases efficiency (see Table IV), it is likely that, on average, an increase in diversity reduces the efficiency of allocation.[23] To verify this, however, we have to collapse the four separate indicators of transfers into one measure of the efficiency of allocations.
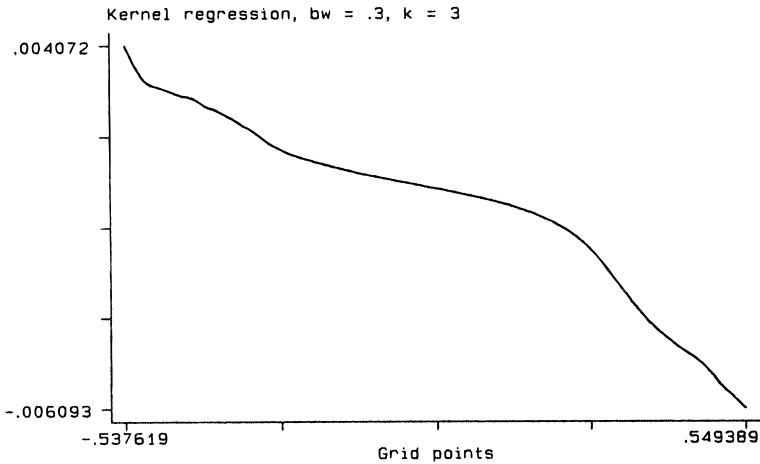
To do so, we weight the transfer to a segment by the difference between a segment's q and the average q in the firm. Under the assumption that the average industry q is a good proxy for the marginal q of a segment in that industry, this weighting attributes an incremental market value to each transfer. We add the weighted transfer across all the segments of a firm in a year, and call the sum the relative *value added by allocation*, because it represents a measure of the overall value consequences of the allocation policy of a diversified firm. It is given by

$$\frac{\sum_{j=1}^{n} BA_j(q_j - \bar{q})\left(\dfrac{I_j}{BA_j} - \dfrac{I_j^{ss}}{BA_j^{ss}} - \sum_{j=1}^{n} w_j\left(\dfrac{I_j}{BA_j} - \dfrac{I_j^{ss}}{BA_j^{ss}}\right)\right)}{BA}. \tag{18}$$
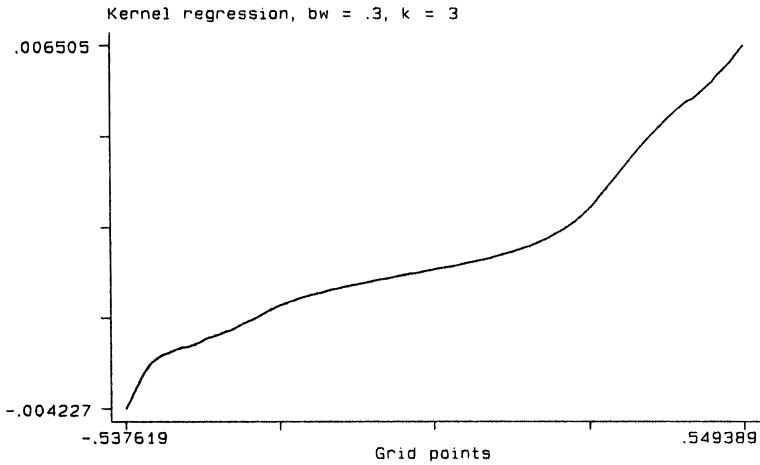
Table V, column 1, reports the estimates obtained by regressing the value added by allocation for each diversified firm on the inverse of the equally weighted q of its segments and the diversity of its segments. As usual, we

[22] The kernel density is estimated using the Epanechnikov kernel with a bandwith of 0.3 and a grid of 100 points.

[23] Intuitively, the likelihood of transfers in the "wrong" direction will also go up when diversity increases if opportunities and resources are independently distributed. Conditional on $\lambda_0^A \beta^A \gg \lambda_0^B \beta^B$, a situation with $\beta^B \leq \beta^A$ is more likely than the reverse.

Kernel regression, bw = .3, k = 3

.004072

-.006093

-.537619 .549389

Grid points

(a)

Kernel regression, bw = .3, k = 3

.006505

-.004227

-.537619 .549389

Grid points

(b)

Figure 3. Kernel regression of adjusted investment on diversity. Plots of the fitted values from the kernel regression of adjusted investments against diversity. Before estimating the relationship, we partial out the inverse of the equally weighted q, firm size (logarithm of total sales), firm-specific effects as well as the calendar-year dummies. The kernel density is estimated using the Epanechnikov kernel with a bandwith of 0.3 and a grid of 100 points. The y-axis contains the fitted values from the kernel regression and the x-axis the corresponding grid points. The top plot shows the fitted values from the kernel regression for the sample of segments that are above the firm's average q and above the firm's asset-weighted opportunities. The bottom plot shows the fitted values from the kernel regression for the sample of segments that are below the firm's average q and below the firm's asset-weighted opportunities.

also include firm fixed effects to control for any heterogeneity across firms, calendar-year dummies, and firm size (logarithm of total sales). An increase in diversity decreases the relative value added by allocation and this effect

Value Added by Allocation and Diversity in Investment Opportunities

This table estimates the empirical link between different measures of the efficiency of the investment policy of a diversified firm and diversity across segments. In the first column the dependent variable is the relative value added by allocation, defined as

$$\frac{\sum_{j=1}^{n} BA_j(q_j - \bar{q})\left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}} - \sum_{j=1}^{n} w_j\left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}} \right) \right)}{BA},$$

where $\bar{q}$ is the asset-weighted average of segment qs for the firm, q_j is the asset-weighted q ratio of single-segment firms that operates exclusively in segment j, I_j is the capital expenditure of segment j (item #4 of the COMPUSTAT segment file), BA_j is the book value of assets of segment j, and (I_j^{ss}/BA_j^{ss}) is the asset-weighted average capital expenditure to assets ratio for single-segment firms in the corresponding industry. The dependent variable in the second column is the absolute value added by allocation, defined as

$$\frac{\sum_{j=1}^{n} BA_j(q_j - 1)\left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}} \right)}{BA}.$$

The inverse of q equals $1/qe$, where qe is the equally weighted average q over segments in the firm. Diversity is the standard deviation of a firm's asset-weighted q $\left(\sqrt{\sum_{j=1}^{n}[(w_j q_j - \overline{wq})^2/(n-1)]} \right)$ divided by the equally weighted average q. Size is the logarithm of total sales. All regressions contain firm fixed effects and calendar-year dummies. Heteroskedasticity robust t-statistics are reported in parentheses. All the data are for the period 1980 to 1993.

	1	2
Inverse of average q	0.007	−0.004
	(7.532)	(−1.439)
Diversity	−0.008	−0.010
	(−5.543)	(−2.372)
Firm size	0.000	0.004
	(−0.059)	(3.220)
R^2	0.325	0.394
N	13,946	13,946

is statistically significant at the 1 percent level. A one–standard deviation increase in diversity reduces the value added by allocation by an amount equal to 10 percent of its standard deviation.

The computation of value added by allocation employed in column 1 uses the firm's average q ratio to determine whether a segment has excellent or poor investment opportunities relative to the other segments of the firm. Furthermore, we subtract from each segment's investment the average excess investment of a diversified firm vis-à-vis single-segment firms. In doing so, we tend to underestimate the value a diversified firm adds by reallocating funds. If, for instance, a more diverse firm can raise more funds and thus invest more on average across all segments, we would not capture this

effect. For this reason, we recompute the value added by allocation by measuring the transfer as the difference between actual segment investment and single-segment firm investments and weighting it by the difference between the segment's q ratio and one. This measure, called the absolute value added by allocation, is the dependent variable in column 2. The results are similar to those of column 1.

To summarize, even though some transfers in the right direction increase with diversity, on average, diversity reduces the transfers to segments with above-average opportunities and increases transfers to segments with below-average opportunities.

K. The Effect of Value Added by Allocation on Firm Value

Up to this point, we have used "right" and "wrong" within quotes because we had no evidence that the flow of resources toward segments with relatively low q subtracts value. In fact, one could argue that one of the reasons why firms exist is to allocate resources differently from markets. In order to remove the quotes, we need to show that flows in the "wrong" direction do indeed reduce the relative value of a diversified firm.[24]

We therefore estimate the relation between the excess value of a diversified firm (see Section D) and the value added by allocation. These results are reported in Table VI. Again we include firm size, firm fixed effects, and calendar-year dummies in each specification. In the first column we use the relative value added by allocation as an explanatory variable. This is the measure employed in the first column of Table V. Value added by allocation has a positive effect on firm value, significant at the 1 percent level. A one standard deviation increase in the value added by allocation increases the excess value of a diversified firm by about two percentage points, thereby reducing the average discount from approximately 12 percent to 10 percent. This is consistent with our claim that a lower than average investment in segments with a better than average q is inefficient, and inconsistent with the hypothesis that internal capital allocations rectify errors in the allocation of resources made by the market.

A better measure of how a diversified firm improves the allocation of funds of single-segment firms is probably represented by the absolute value added by allocation described above. Thus, in column 2 we use this measure as an explanatory variable. The result is similar to that of column 1: There is a positive relationship between firm value and the value added by allocation.[25]

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[24] The firm is valued as a constant fraction of the size of the overall pie produced if the headquarters also gets its share of the joint surplus and passes on a constant fraction to investors. Headquarters gets a constant fraction in the ex post bargaining if, for instance, headquarters has control over the assets and therefore becomes indispensable in the ex post production (see Rajan et al. (1997)).

[25] The components of excess market value are measured at the end of the year; the components of diversity are measured at the beginning of the year. Arguably, an end-of-year measure of diversity is more appropriate in this regression since it is current diversity that drives the market's prognosis of investment allocation. Consistent with this view, the results are stronger.

<div align="center">

Table VI

Excess Value and Efficiency of Investments

</div>

This table estimates the relation between excess value of a diversified firm and efficiency of investments. The dependent variable is the excess value of a diversified firm vis-à-vis a single-segment firm. In the first two columns this is measured as

$$EV = \frac{MV}{RVA} - \sum_{j=1}^{n} q_j \frac{BA_j}{BA},$$

where MV is the market value of assets, RVA the replacement value of the assets, BA the book value of assets, subscript j refers to segment j, n is the total number of segments, and q_j is the asset-weighted average Tobin's q of single-segment firms that operate in the three-digit industry of segment j. In the last two columns this is measured using market-to-sales as

$$EV' = \frac{MV}{S} - \sum_{j=1}^{n} \left(\frac{MV}{S}\right)_j \frac{S_j}{S},$$

where MV is the market value of assets, S is the value of sales, n is the number of segments in the diversified firm, $(MV/S)_j$ is the sales-weighted average market-to-sales ratio of single-segment firms in the same three-digit industry, and subscript j refers to segment j. The relative value added by allocation is

$$\frac{\sum_{j=1}^{n} BA_j(q_j - \bar{q})\left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}} - \sum_{j=1}^{n} w_j\left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}}\right)\right)}{BA},$$

where $\bar{q}$ is the asset-weighted average of segment qs for the firm, q_j is the asset weighted q ratio of single-segment firms that operates exclusively in segment j, I_j is capital expenditure of segment j (item #4 of the COMPUSTAT segment file), BA_j is the book value of assets of segment j, and (I_j^{ss}/BA_j^{ss}) is the asset-weighted average capital expenditure to assets ratio for single-segment firms in the corresponding industry. The absolute value added by allocation is

$$\frac{\sum_{j=1}^{n} BA_j(q_j - 1)\left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{ss}}\right)}{BA}.$$

Standard deviation of segment qs is the standard deviation of the asset-weighted qs of the segments in which the firm operates. Size is the logarithm of total sales. All regressions contain firm fixed effects and calendar-year dummies. Heteroskedasticity robust t-statistics are reported in parentheses. All the data are for the period 1980 to 1993.

	1	2	3	4
Relative value added by allocation	1.077		0.995	
	(2.674)		(2.171)	
Absolute value added by allocation		0.814		1.330
		(4.943)		(6.592)
Firm size	0.022	0.019	−0.210	−0.217
	(1.216)	(1.013)	(−7.902)	(−8.149)
R^2	0.633	0.634	0.698	0.701
N	13,868	13,868	12,169	12,169

Thus far, we have used a measure of excess value based on assets because segment assets are less likely to be affected by strategic reporting. There is, however, a potential problem. Since the industry Tobin's q appears on both sides of the regression, we may be inducing some spurious correlation. We have conducted simulation exercises for all the regressions reported thus far which suggest that spurious correlation does not drive our results (results are available on request); however, another way to address this concern is to compute the excess value of a diversified firm using a methodology that does not rely on the use of Tobin's q. Berger and Ofek (1995) provide two alternative valuation approaches: one based on market-to-sales multiples, the other based on earnings multiples. We prefer the first one, because it is less likely to be affected by strategic reporting. We define excess value as the difference in the market-to-sales ratio of a diversified firm from the market-to-sales ratio of a weighted portfolio of single-segment firms.[26] Formally,

$$EV' = \frac{MV}{S} - \sum_{j=1}^{n} \left(\frac{MV}{S} \right)_j \frac{S_j}{S},$$ (19)

where MV is the market value of assets, S is the value of sales, n is the number of segments in the diversified firm, $(MV/S)_j$ is the sales-weighted-mean market-to-sales ratio of single-segment firms in the same three-digit industry, and subscript j refers to segment j.

Using this alternative measure of excess value we reestimate the two previous specifications, and report the findings in columns 3 and 4 of Table VI. Our results are essentially unchanged.

L. The Effect of Diversity on Value

We can also directly estimate the effect of diversity on value rather than seeing the indirect effect through allocations. In the first column of Table VII, we estimate the relationship between excess value measured as described in Section D above (the industry-adjusted q ratio) and our measure of diversity. An increase in diversity reduces the value of a diversified firm, and this effect is statistically significant at the 1 percent level. A one–standard deviation increase in diversity reduces the excess value of a diversified firm by five percentage points.[27] In the second column, we include the Herfindahl index of division size. More focused diversified firms are indeed more valuable, but diversity has an independent effect in reducing value. Also, in this and all previous regressions, the estimates are qualitatively unchanged when we leave out the inverse in average q.

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[26] As Berger and Ofek (1995) do, we drop all the firms with total sales less than $20 million.

[27] As Figure 2 shows, beyond a certain level of diversity, transfers may no longer be cost effective in avoiding the third-best solution. The discount will then bottom out. We do not have any evidence that this region is empirically important.

<div align="center">

Table VII

Excess Value of a Diversified Firm and Diversity

</div>

This table estimates the relation between excess value of a diversified firm and the diversity of investment opportunities in its segments. The dependent variable is the excess value of a diversified firm vis-à-vis a portfolio of single-segment firms in the same three-digit industries. In the first two columns, excess value is

$$EV = \frac{MV}{RVA} - \sum_{j=1}^{n} q_j \frac{BA_j}{BA},$$

where MV is the market value of assets, RVA is the replacement value of the assets, n is the number of segments in the diversified firm, BA is the book value of assets of the whole firm, subscript j refers to segment j. In the last two columns, excess value is

$$EV' = \frac{MV}{S} - \sum_{j=1}^{n} \left(\frac{MV}{S} \right)_j \frac{S_j}{S},$$

where MV is the market value of assets, S is the value of sales, n is the number of segments in the diversified firm, $(MV/S)_j$ is the sales-weighted average market-to-sales ratio of single-segment firms in the same three-digit industry, subscript j refers to segment j. The inverse of equally weighted q equals $1/qe$, where qe is the equally weighted average q over segments in firm. Diversity is the standard deviation of the segments' asset-weighted q $\left(\sqrt{ \sum_{j=1}^{n} [(w_j q_j - \overline{wq})^2 /(n-1)] } \right)$ divided by the equally weighted average q. The Herfindahl index of segment's size is based on the assets of the segment. Size is the logarithm of total sales. All regressions contain firm fixed effects and calendar-year dummies. Heteroskedasticity robust t-statistics are reported in parentheses. All the data are for the period 1980 to 1993.

	1	2	3	4
Inverse of average q	0.420	0.421	0.179	0.180
	(15.078)	(15.095)	(4.978)	(4.983)
Diversity	−0.276	−0.367	−0.169	−0.291
	(−5.686)	(−6.412)	(−2.892)	(−4.184)
Herfindahl index of division size		0.214		0.280
		(3.049)		(3.320)
Company's size	0.025	0.033	−0.209	−0.200
	(1.385)	(1.766)	(−7.938)	(−7.546)
R^2	0.643	0.643	0.700	0.700
N	13,868	13,868	12,169	12,169

To verify whether the estimates are robust, we undertake a kernel estimation of the relationship between excess value and diversity, after purging the effect of all the other explanatory variables contained in the specification in column 1, Table VII. The fitted values from the kernel regression and the corresponding grid points are reported in Figure 4.[28] The plotted relationship between excess value and diversity is strongly negative.

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[28] The kernel density is estimated using the Epanechnikov kernel with a bandwith of 0.5 and a grid of 100 points.

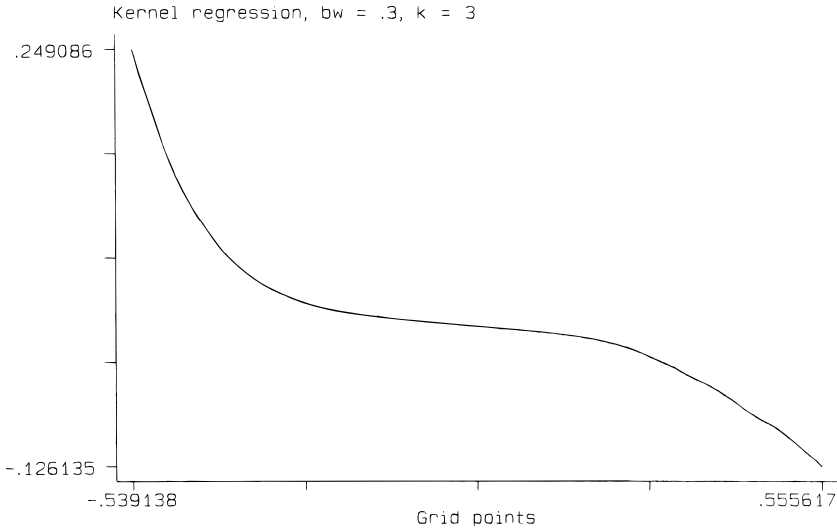Kernel regression, bw = .3, k = 3

Figure 4. Kernel regression of the excess value on diversity. We plot the fitted values from the kernel regression of the relation between excess value and diversity. Before estimating the relationship, we partial out the inverse of the equally weighted q, firm size (logarithm of total sales), firm-specific effects as well as the calendar-year dummies. The kernel density is estimated using the Epanechnikov kernel with a bandwith of 0.5 and a grid of 100 points. The y-axis contains the fitted values from the kernel regression and the x-axis the corresponding grid points.

In columns 3 and 4, we employ the excess value measure based on market-to-sales ratios as an alternative valuation measure, with very similar results.

To summarize our evidence: we have shown that the average misallocation found in the previous literature conceals much richer behavior—the firm sometimes allocates in the right direction, and sometimes in the wrong direction, based on how segments within the firm interrelate. Average misallocation increases with diversity (in asset-weighted opportunities) between segments. Finally, firm value falls with the increase in diversity between segments in the firm.

M. Our Theory and Related Empirical Literature

There is a growing recent literature that documents investment behavior by conglomerates. Our paper clearly draws upon this literature but we also believe our model can explain some of the anomalies the literature highlights.[29]

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[29] We cannot, however, explain the findings of Maksimovic and Phillips (1998), who argue that firms concentrate their growth in their relatively most productive industry segments. The differences in data sets and methodologies make the results hard to compare and further work is needed to understand where the differences in results come from.

Lamont (1997) finds that the investment in non-oil segments of diversified oil firms responded to the reduction in cash flow of the oil segments resulting from the unanticipated oil shock of 1986. This suggests that the adverse burden of the oil shock was shared with the non-oil segments. Lamont suggests that decreases in the oil firms' financing capacity decreased their ability to finance the non-oil segments. Yet subsequent work (Schnure (1997)) indicates that the oil firms were not particularly constrained, so financial constraints do not explain the drop-off in investment in non-oil segments. Why did investment then drop off in the non-oil segments even though their investment opportunities were relatively unaffected by the oil price shock? Our model may help resolve this puzzle. The oil segments in these firms were typically large, had high weighted opportunities, and were likely to be transferring resources to the other segments prior to the shock. The oil price shock would have reduced their opportunities, thereby reducing the diversity in the firms, and reducing the need to cross-subsidize (our measure of diversity for the companies in Lamont's sample drops from an average of 0.22 before, to 0.17 during, the oil shock). Lamont indeed suggests that the reduction in investment in non-oil segments may have simply been correcting prior overinvestment.

Shin and Stulz (1998) find that investment by the small segments of diversified firms is sensitive to other segment cash flows. Moreover, they show that for small segments, the sensitivity of segment investment to other segment cash flows is not related to the segments' Tobin's q. Our model can explain this. Small segments are likely to have low size-weighted opportunities, and thus receive transfers. Hence their investments are sensitive to other segment cash flows (unlike for large segments who typically make transfers). While small segments that have poor investment opportunities get transfers to improve their incentives to make appropriate investments, small segments with good investment opportunities get transfers because their opportunities are, indeed, good. Thus small segments get transfers that bear little relationship to the quality of their investment opportunities, which may explain the observed absence of correlation.

Scharfstein (1997) analyzes a sample of truly unrelated divisions in the same firm and finds that the deviation of segments' capital expenditures from the industry median are negatively related to the industry Tobin's q. This suggests that firms invest more than the industry in low q segments and less than the industry in high q segments.[30] Scharfstein also finds that the capital expenditures of large segments are positively related to q while they are negatively related to q for the smallest segments. Our model can explain these findings. Assume that segments generate resources adequate for investment, absent any transfers. Then absent transfers, high q seg-

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[30] This result is consistent with cross-subsidization, but it does not directly test for it. For instance, in a conglomerate composed of only below average q divisions, his result would suggest that all divisions overinvest relative to the industry, but not necessarily that they cross-subsidize each other inefficiently.

ments should, and will, invest more. However, the transfers small segments receive are likely to be large relative to the resources they have available to invest, and may swamp the latter. Small divisions with the worst opportunities need the greatest transfers to restore incentives, and so the negative relationship between q and investment may be driven entirely by the transfer. By contrast, the transfers made by the largest segments may be small relative to the resources they have to invest, and hence a relationship between q and investment may persist even after the transfers. Of course, we have not tested this explanation, and other theories may be consistent with the data. Scharfstein also provides some evidence that internal agency problems may be at work by showing that diversified firms with concentrated ownership invest in ways that are much more sensitive to q. Our model has nothing to say about this finding.[31]

An important puzzle noted by Lang and Stulz (1994) is that the value loss associated with diversification is mainly caused by firms going from one to two segments and that the loss in value in increasing the number of segments beyond that is limited. Our model can explain this in light of the following empirical observation. Average diversity increases when we move from one-segment firms to two-segment firms (obviously), but it does not increase after that. That firms with more than two segments are not substantially more diverse than firms with two segments would suggest why the additional value loss when we go beyond two segments is small.[32]

Finally, there is a growing literature (Hyland (1996), Campa and Kedia (1999), and Chevalier (1999)) that claims the diversification discount and possibly the direction of transfers is not evidence of inefficiency but rather a consequence of the fact that firms choose to diversify in certain lines of business. We agree that mismeasurement or selection biases could account for some of the between-firm results on diversification, but we do not think they can easily explain our results, since in all our analysis we control for firm-specific effects. By doing so, we control for any consequences stemming from the way the firm is set up and our results derive only from within-firm variations over time.

N. Other Theories and the Evidence

Although our theory can explain some of the evidence, it is not clear that the evidence is consistent with all theories. Agency theories have little to say on why diversity in opportunities should affect the efficiency of allocations. In fact, the predictions of simple agency models should be in line with Efficient Internal Market theories; if managers want to build empires, they should

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[31] Denis and Thothadri (1999) find the diversification discount is particularly pronounced for high growth firms. Our results are consistent with theirs if high growth firms also have high diversity.

[32] Diversity strongly reduces value even if we restrict the regression to firms with two segments only. Moreover, all our results hold when we include the number of segments as an additional explanatory variable.

build them in the sectors with the best opportunities, rather than in sectors with the worst opportunities. In a similar vein, influence cost theories fail to explain why larger segments, which presumably have more influence, make, rather than get, transfers.

Finally, consider a behavioral explanation of our findings, inspired by sociological models of intra-organizational equity (see Adams (1965) and Homans (1974)). According to this, inefficient cross-subsidies may simply reflect a CEO adhering to norms of intrafirm equity. The CEO gives each division a "fair," rather than value-maximizing, share of the capital budget to avoid upsetting anyone. It is not clear, however, what "fair" is. Divisions with better opportunities may well think it unfair to be held back in the interests of intrafirm equity. Furthermore, we need a precise metric for how the CEO allocates funds to reject this explanation. Diversified firms do not allocate funds to divisions based purely on relative size (they seem to give proportionately more to small divisions as Shin and Stulz (1998) suggest) nor do they allocate on the basis of investment opportunities. Of course, it could be argued that our model provides a rationale for why intrafirm equity makes sense: divisions should not grow too far apart else they will not cooperate. We would not quarrel too much with such an interpretation, though we would argue that the model adds value by pointing out the metric according to which funds appear to be transferred (i.e., weighted opportunities).

IV. Conclusions

The intent of this paper is to develop and test a simple model that compares the decisions made within organizations with decisions made in the marketplace. To do that we abandon the metaphor of the all-powerful headquarters and we model the capital budgeting problem in a diversified firm as a political battle between different divisions. Using a simple framework, and what we think are plausible, but admittedly strong, assumptions, we obtain clear-cut implications about the costs (and lesser benefits) of diversity. The data seem to suggest that, on average, diversity is indeed costly.

Our theoretical model is largely meant to direct our empirical work. It can be generalized, and perhaps the most important way to do so is to repeat the game. An efficient internal market requires the firm to reallocate resources based on opportunities, but, anticipating such reallocation in the future, divisions will distort investment today. Thus the dynamic evolution of investment opportunities within, and across, divisions will affect the nature of distortions, the transfers, and the size of the discount. This is a task for future research.

An important caveat is that we have not explored the reasons why segments that are very diverse are brought together in the same firm, and why they do not break apart when inefficiencies are observed. We have some evidence that break-ups that reduce diversity tend to add value. Evidence from studies of spin-offs (see Daley, Mehrotra, and Sivakumar (1997)) suggest that performance improvements take place when the spun-off entity is

in a different industry. It is the parent that typically shows significant signs of improvement. Furthermore, when divisions are spun off, they tend to be small (see Schlingemann, Stulz, and Walkling (1998)). Taken together, this evidence suggests that spin-offs reduce diversity, and stop the flow of cross-subsidies away from the larger parent. More detailed examination of the data is needed to understand why spin-offs take place in some firms and not in others.

A practical implication of our research is that the introduction of a new subunit in a hierarchy can have ramifications for other subunits because it alters the power structure in the hierarchy, and affects the decision making process even if there is no operational link between the new subunit and other subunits. The notion that larger is better—because it expands the realm of possible decisions and loosens constraints—is clearly wrong. In this framework, strategies employed by successful diversified firms such as General Electric of keeping only high performing divisions, and getting rid of losers, start to make sense. Poor performers can drag the rest of the organization down because, though they may not add much value to the organization, they have considerable ability to take value out. Consistent with our priors, we find that the disparity in resource-weighted opportunities is small for GE as compared to other firms in our sample. Over the sample period the average diversity for GE is 0.09, compared to a sample average of 0.295.

Finally, the paper suggests that there are important differences between the way decisions are made in hierarchies and the way they are made in the market. More can clearly be learned about the difference between markets and hierarchies from further research on diversified firms.

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