ARE INTERNAL CAPITAL MARKETS EFFICIENT?*

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Using segment information from Compustat, we find that the investment by a segment of a diversified firm depends on the cash flow of the firm's other segments, but significantly less than it depends on its own cash flow. The investment by segments of highly diversified firms is less sensitive to their cash flow than the investment of comparable single-segment firms. The sensitivity of a segment's investment to the cash flow of other segments does not depend on whether its investment opportunities are better than those of the firm's other segments.

I. INTRODUCTION

The internal capital markets of diversified firms enable them to fund profitable projects that, because of information asymmetries and agency costs, the external capital market would not be able to finance. Consequently, one would expect a segment of a diversified firm to invest regardless of its cash flow if it has valuable investment opportunities and the firm has sufficient resources. If the diversified firm is credit-constrained, it can ensure that a segment's cash flow affects its investment only through its impact on firm cash flow. Therefore, it is not surprising that much of the literature on diversification argues that an efficient internal capital market creates value for shareholders.[1]

A number of recent papers show that, on average, diversification is not successful. Lang and Stulz [1994] provide evidence that during the 1980s the Tobin's q of diversified firms was significantly smaller than the q of matching portfolios of specialized

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1. See, for instance, Williamson [1975]. Recent theoretical papers model the benefits of internal capital markets. Gertner, Scharfstein, and Stein [1994] argue that internal capital markets offer increased monitoring incentives and easier asset redeployability relative to external capital markets. Fluck and Lynch [1996] show that agency costs prevent the financing of some positive net present value projects by stand-alone firms, but not within diversified firms. In Stein's [1997] model, diversification increases efficiency of firms that are liquidity-constrained because management allocates more funds to the more efficient divisions. .

firms. Berger and Ofek [1995] conclude that, on average, diversified firms are valued less than matching portfolios of specialized firms by 13 to 15 percent.[2] Further, Morck, Shleifer, and Vishny [1990] show that, during the 1980s, diversifying acquisitions decrease shareholder wealth. This paper investigates whether diversification is unsuccessful because firms' internal capital markets fail in their role to allocate corporate resources to the divisions that can make best use of them.

Internal capital markets could fail because each division is treated as a stand-alone firm that relies mostly on its own cash flow to finance its projects. Lamont [1997] shows that this is not the case for firms in the oil industry. He establishes that investment in nonoil divisions of petroleum companies falls when the cash flow of the oil divisions decreases dramatically because of the large drop in oil prices in the mid-1980s. Thus, his research shows that investment in a division of a diversified firm depends on the success of the firm's other divisions that are in unrelated industries in the context of the experience of an industry facing a sharp decline in cash flow.

Using the Compustat universe of firms that report segment information from 1980 to 1992, we analyze the investment of the smallest and largest segments of diversified firms. We find two results that show that the internal capital market is active, but less so than the literature would lead us to expect. First, the investment by a segment of a diversified firm depends significantly on the cash flow of the firm's other segments. However, we find that a decrease in a segment's cash flow by one dollar has about six times the impact on its investment than does a decrease in the cash flow by one dollar of the firm's other segments. This implies that there is no evidence suggesting that a segment's investment depends only on firm cash flow and not on its own cash flow. Second, in highly diversified firms a segment's investment depends less on its own cash flow than it would if it were a stand-alone firm.

Since the internal capital market affects the investment by segments, we examine whether the internal capital market fails because it does not direct corporate resources to their best uses. If a firm's management pursues its own objectives at the expense of shareholder wealth, it might use the firm's internal capital

2. In addition, Servaes [1996] shows that the diversification discount exists in the 1960s and part of the 1970s also.

market to finance pet projects with negative net present values (NPV). It might also subsidize losing divisions that, if they were stand-alone firms, would have to undergo dramatic changes to survive. Divisional managers can expend substantial resources in rent-seeking and internal politics, thereby distorting the allocation of resources and creating deadweight costs. Often, the divisional managers who benefit the most from expending resources to affect the allocation of funds run the weakest divisions.[3] When resources are allocated within a firm in such a way that the most profitable projects do not have priority, the benefit of having an internal capital market disappears. In such cases, one would expect the value of the diversified firm to be lower than the value of a matching portfolio of specialized firms.

If firms have limited funds available for investment because external funds are more expensive than internal funds, an efficient internal capital market allocates these funds to maximize shareholder wealth. We would expect that divisions with better investment opportunities would have priority in the allocation of funds and that their investment should be less affected by the performance of the firm as a whole than the investment of more marginal divisions. We show that a segment's sensitivity to the cash flow of the other segments (and, for highly diversified firms, to its own cash flow) does not depend on whether that segment has the best investment opportunities within the firm. These results suggest that divisions are treated alike when they should not be. Our results are consistent with what Scharfstein and Stein [1996] call "socialism" within the firm.

The paper proceeds as follows. In Section II we present our evidence on the relation between the investment of segments and their own cash flow, as well as on the relation between their investment and other divisions' cash flow. In Section III we investigate whether a segment's investment opportunities affect these relations. We conclude in Section IV.

II. Investment Policies of the Smallest and Largest Segments

SFAS No. 14 requires that firms report information for segments that represent 10 percent or more of consolidated sales

3. See Meyer, Milgrom, and Roberts [1992], Rajan and Zingales [1996], and Scharfstein and Stein [1996] for models in which the internal capital market allocates too much funding to the weakest divisions. Rajan, Servaes, and Zingales [1997] provide an interesting test of this hypothesis.

for fiscal years ending after December 15, 1977. The Business Information file of Compustat collects this information. We use this file to obtain our segment information. The Data Appendix provides further details on the sample and its construction.

Firms with efficient internal capital markets should find it easier to insulate their smallest segment from changes in firm cash flow and especially so if they are highly diversified. This is because the investment budget of the smallest segment is typically small relative to firm cash flow so that it can be kept intact as firm cash flow changes.[4] We therefore analyze whether the role of the internal capital market changes when the size of the segment and the level of diversification differ. We consider separately the smallest and largest segments of each firm: firms with less than five segments (the moderately diversified firms) and firms with five segments or more (the highly diversified firms).

To investigate whether investment at the segment level depends on other segments' cash flow, we regress investment on segment cash flow, proxies for segment investment opportunities, and other segments' cash flow. Our equation differs from the one usually estimated in the investment literature for two reasons. First, the investment literature typically uses a firm's Tobin's q as a measure of its investment opportunities. We cannot compute q at the segment level as a proxy for the segment's investment opportunities because we do not have an estimate of the market value of segments. We therefore estimate the median q for the specialized firms in the segment's industry by taking the ratio of firm value (defined as the value of equity plus the book value of total assets minus the book value of equity) to total assets. Industry is defined at the two-digit SIC level. To create a measure of investment opportunities that uses data from the segment, we use lagged segment sales growth and expect segments with higher sales growth to invest more. To the extent that we poorly estimate segment investment opportunities, we might overstate the impact of a segment's cash flow on its investment if cash flow proxies for investment opportunities. Second, to evaluate the impact of the internal capital market, we add other segments' cash flow as another explanatory variable.

If investment by a segment depends only on firm cash flow after controlling for its investment opportunities, a dollar of cash flow should have the same impact on the investment by a segment

4. Table VI provides data on the segments.

irrespective of its source within the firm. Our specification should therefore answer the following question: if other segments' cash flow increases by one dollar, what effect does this have on a segment's investment compared with an increase of its own cash flow by one dollar? To answer this question, we normalize the segment's cash flow and other segments' cash flow by the same variable, namely, the book value of the total assets of the firm. We therefore estimate

$$(1)\quad \frac{I_{i,j}(t)}{TA_j(t-1)} = a + b\frac{S_{i,j}(t-1) - S_{i,j}(t-2)}{S_{i,j}(t-2)} + c\frac{C_{i,j}(t)}{TA_j(t-1)} + d\frac{C_{not\,i,j}(t)}{TA_j(t-1)} + eq_{i,j}(t-1) + \eta_{i,j} + \epsilon_{i,j}(t),$$

where the variables are defined as follows:

$I_{i,j}(t)$ = the gross investment of the ith segment of firm j during year t (defined as the period from date $t-1$ to date t);
$TA_j(t-1)$ = the book value of the total assets of firm j at the end of year $t-1$;
$S_{i,j}(t-1)$ = the sales of segment i of firm j during year $t-1$;
$C_{i,j}(t)$ = the cash flow of the ith segment of firm j during year t;
$C_{not\,i,j}(t)$ = the sum of the cash flows of the segments of firm j except for the cash flow of the ith segment;
$q_{i,j}(t-1)$ = Tobin's q for the ith segment of firm j at the end of year $t-1$.

We assume that the error term has two components, $\eta_{i,j}$ and $\epsilon_{i,j}(t)$, one of which, $\eta_{i,j}$, is assumed to be specific to the segment. We use fixed-effects to accommodate the segment-specific component. Since the sample period we use corresponds to years in which tax regimes and stages of the business cycle differ, we add to the regression a dummy variable for each year except for 1980. We do not report these dummy variables in the tables. All our regressions use White's adjustment for heteroskedasticity.

Table I reports estimates of investment equations for the smallest and largest segments for moderately and highly diversified firms. Consider first the results for the smallest segments. All the coefficients are significant except for the coefficient on sales growth for firms with more than five segments. Investment increases significantly with the q ratio of the segment's industry,

TABLE I
ESTIMATES OF INVESTMENT EQUATIONS FOR SMALL AND LARGE SEGMENTS

	For the smallest segments only				For the largest segments only			
	2 to 4		5 or more		2 to 4		5 or more	
Sales growth	0.0033	(3.39)	0.0014	(1.61)	0.0098	(3.71)	0.0122	(2.25)
Own cash flow	0.1440	(10.03)	0.1225	(3.39)	0.1512	(14.35)	0.1359	(5.91)
Other cash flow	0.0182	(6.40)	0.0213	(3.41)	0.0449	(4.21)	0.0214	(1.34)
Segment's q	0.0107	(5.38)	0.0053	(4.46)	0.0231	(6.92)	0.0237	(4.12)
Adj-R^2	0.0834		0.0874		0.0863		0.0942	
Obs.	10,437		1886		10,676		2000	

The regressions use all the firms in our sample from 1980 to 1992 for which we can compute the ratios used in our regressions, and we exclude firms where one or more of the accounting ratios used in the regressions exceed one. The dependent variable is the segment's gross capital expenditure for year t divided by the book value of total assets of the firm at the end of year $t - 1$. Sales growth is the change in sales from the year $t - 2$ to year $t - 1$ divided by sales of year $t - 2$. Own cash flow is own segment's cash flow for year t divided by the book value of total assets of the firm at the end of year $t - 1$. Other cash flow is other segments' cash flow for year t divided by the book value of total assets of the firm at the end of year $t - 1$. Segment's q is segment's industry median q at the end of year $t - 1$. t-statistics are in parentheses.

the segment's cash flow, and other segments' cash flow. The coefficient on the q ratio shows that the internal capital market pays attention to investment opportunities. The sensitivity of a segment's investment to its own cash flow is significantly larger than its sensitivity to other cash flow at the 1 percent level. A dollar more of segment cash flow has about six times the impact of a dollar more of cash flow to other segments. Surprisingly, this ratio is essentially the same for both highly diversified firms and firms with limited diversification. This suggests that the sensitivity of the smallest segment's investment to other segment's cash flow does not change as the firm becomes more diversified. This evidence implies that a segment that experiences an adverse cash flow shock bears the brunt of that shock. It is clearly not the case that belonging to a diversified firm makes a segment's investment sensitive only to firm cash flow.

When we turn to the largest segment, we find that all coefficients are significant except for the coefficient on other cash flow for highly diversified firms. The coefficient on other cash flow is significantly larger than that for the smallest segment of firms with moderate diversification and insignificantly different for the smallest segment of firms with five or more segments. Therefore, the size of a segment seems to have little overall effect on the impact of a dollar of cash flow from other segments on a segment's

investment for highly diversified firms and seems to be positively related to that impact for firms with limited diversification. As for the smallest segment, the coefficient on own cash flow is significantly larger than the coefficient on other cash flow at the 1 percent significance level.

We also estimate the regressions of Table I for a subset of large firms, but do not reproduce the results. We would expect the accounting data for these firms to be more reliable. These are firms with sales of at least $1 billion in 1977 dollars when they enter the sample. We keep them in the sample if their sales fall below $1 billion to avoid a selection bias of keeping only growing firms in the sample. The coefficient estimates for the large-firm regressions are remarkably similar to those for the whole sample. For instance, the coefficient on other segments' cash flow in the regression for the smallest segment is 0.0182 with a t-statistic of 6.4 for the whole sample, and 0.0197 with a t-statistic of 3.24 for the sample of large firms. Interestingly, the R^2's are higher for the large firms. This is consistent with more reliable accounting data, but can also reflect the fact that large firms are more established and generally exhibit less volatility.

We interpret the results in Table I as demonstrating that the internal capital market plays a significant but limited role. This is because the coefficient on other cash flow is significant but small both in absolute value and in comparison to the coefficient on the segment's own cash flow. Could our evidence in Table I be consistent with the hypothesis that diversified firms treat each segment as a stand-alone firm? This would be the case if the coefficient on other cash flow is significant only because that variable proxies for the segment's investment opportunities. One can easily construct a theoretical example where such a proxy effect is at work. Suppose that all segments have the same investment opportunities and that a segment's cash flow is an estimate of these investment opportunities plus an error term uncorrelated across segments. In this case, other segments' cash flow would be a better estimate of investment opportunities than would a segment's cash flow and hence would be more strongly associated with a segment's investment than with its cash flow. Such an interpretation seems implausible. For the smallest-segment regressions we only consider firms where the largest and smallest segments are in different two-digit SIC codes. Consequently, it seems unlikely that the largest segment's cash flow has information about the investment opportunities of the smallest

segment, in addition to the proxies we use for that segment's investment opportunities. However, we provide a direct test of this hypothesis later by investigating whether a segment's other cash flow provides information on the investment opportunities of single-segment firms in the same industry and find that they do not.[5]

If the benefit of an internal capital market is that it can enable a segment to invest when the segment would not be able to do so if it were a stand-alone firm, then one would expect the dependence of investment on cash flow to differ between single-segment firms and comparable segments of diversified firms. Further, if cash flow proxies for liquidity, a segment's investment should depend less on its own cash flow than on the investment of a comparable single-segment firm if resources are allocated efficiently within the firm. This is because an increase in the cash flow of a segment increases resources at the level of the firm and hence brings about an increase in investment across the firm. One would expect the importance of this effect to increase with the degree of diversification of firms.[6]

To examine these hypotheses, we proceed as follows. For each smallest segment in a highly diversified firm, we choose a matching single-segment firm in the same two-digit SIC code that has the closest book value of assets to the book value of the segment's assets. The matching single-segment firm must satisfy the same sampling criteria as the segment of the diversified firm; namely, that none of the accounting ratios exceed one. We then estimate the investment regression without other cash flow, but with a dummy variable for single-segment firms and an interaction of that dummy variable with the single-segment firm's cash

5. Another concern is that our smallest segment has activities derived mostly from the activities of other segments. For instance, if our smallest segment provides administrative services to other segments, it would grow as the other segments' cash flow grows. However, this also does not seem plausible. Accounting rules require the segment to have sales "primarily" to unaffiliated customers, and our sample selection imposes the requirement that a segment has positive sales.

6. This experiment is similar in spirit to Hoshi, Kashyap, and Scharfstein's [1991]. In their paper they find that investment of firms that belong to Japanese keiretsus is less sensitive to liquidity than investment of Japanese firms that do not belong to a keiretsu. They argue that this supports their hypothesis that firms belonging to a keiretsu are less credit-constrained. Kaplan and Zingales [1997] question this interpretation and provide both empirical evidence and theoretical arguments that sensitivity of investment to cash flow can increase as a firm becomes less financially constrained. Applying their theoretical model to a multidivision firm shows that, as a segment's cash flow becomes small relative to the firm's cash flow, its own cash flow sensitivity becomes trivial and hence necessarily smaller than the cash flow sensitivity of a specialized firm.

TABLE II
ESTIMATES OF INVESTMENT EQUATIONS FOR MULTISEGMENT FIRMS AND SINGLE-SEGMENT FIRMS

	For the smallest segments only				For the largest segments only			
	2 to 4		5 or more		2 to 4		5 or more	
Sales growth	0.0410	(13.19)	0.0346	(4.66)	0.0494	(15.51)	0.0446	(5.67)
Own cash flow	0.0757	(11.81)	0.1033	(5.59)	0.1235	(17.99)	0.1380	(9.47)
Segment's q	0.0237	(7.51)	0.0288	(4.04)	0.0193	(7.53)	0.0255	(3.79)
Single-segment firm dummy	−0.00048	(−2.78)	−0.0071	(−1.70)	0.0020	(1.03)	−0.0089	(−1.87)
Single-segment firm dummy* Own cash flow	0.0242	(2.64)	0.0683	(2.52)	0.0131	(1.22)	0.1236	(4.27)
Adj-R^2	0.0696		0.0875		0.0931		0.1598	
Obs.	21,792		4202		22,012		4308	

We use all firms in our sample from 1980 to 1992. For each segment we find a stand-alone firm in the same two-digit SIC code that has the asset size closest to the asset size of the segment. These matching firms form our sample of single-segment firms. The single-segment dummy takes the value of one if a firm has only one segment, and zero otherwise. The dependent variable is gross capital expenditures for year t divided by the book value of segment assets at the end of year $t-1$. Sales growth is the change in sales from the year $t-2$ to year $t-1$ divided by sales of year $t-2$. Cash flow is the segment's cash flow for year t divided by the segment's assets at the end of year $t-1$. Segment's q is segment's industry median q at the end of year $t-1$. t-statistics are in parentheses.

flow. If single-segment firms' investment is more sensitive to cash flow than the investment of a comparable segment in a diversified firm, we expect the interaction of the dummy variable with the single-segment firm's cash flow to have a positive coefficient. We repeat the same procedure for the largest segment. For each estimated regression we allow for common fixed-effects in the segment of the diversified firm and in the single-segment firm. Note that in these regressions, to make investment comparable across segments of single-segment and multiple-segment firms, we normalize segment investment by segment assets.

The Table II results show that single-segment firms are more sensitive to their cash flow than are comparable smallest segments in diversified firms. These results are consistent with the view that diversification reduces the cash flow sensitivity of the smallest segment and leads firms to invest differently. However, since Table I shows that investment by a segment depends more on its own cash flow than on other segments' cash flow, this effect is limited. Nevertheless, as predicted, the difference in cash flow sensitivity of investment between segments of diversified firms

and specialized firms increases with the degree of diversification. This increase is significant at the 1 percent level. The negative coefficient on the dummy variable for single-segment firms indicates that, for low cash flow, single-segment firms invest less.[7] As cash flow becomes large, however, single-segment firms invest more than diversified firms do. The result that single-segment firms invest less than diversified firms invest for low cash flow is consistent with the view that the internal capital market allows divisions of diversified firms to invest when single-segment firms cannot.

When we look at the largest segments, we find similar results for the largest segment of highly diversified firms but not for the largest segment of moderately diversified firms. This is most likely due to the fact that for firms with a low level of diversification the largest segment is a large fraction of the firm and so resembles a single-segment firm more than the largest segment in a highly diversified firm.[8]

Using the sample of matching single-segment firms allows us to perform a test of whether other cash flow proxies for investment opportunities in our segment investment regressions. This is because, if other cash flow proxies for the investment opportunities of a segment, it should also be a proxy for the investment opportunities of a comparable stand-alone firm. To implement this test, we investigate whether a segment's other cash flow affects the investment of its matching single-segment firm.[9] We allow other cash flow to affect the investment of the matching single-segment firm in the Table II regressions and find that the investment of the single-segment firm is unrelated to the other cash flow.

The question now is whether our results are sensitive to the sample we use, the normalization we apply, or the estimation method. In Table III we provide regression estimates that use different samples and different estimation approaches. We show

7. Scharfstein [1997] shows that generally diversified firms invest more than single-segment firms do.

8. The discretion that diversified firms have in allocating costs across segments could be contributing to the cash flow sensitivity result in that it leads to mismeasurement of cash flow and hence creates an attenuation bias. However, we would expect this bias to be smaller for the largest segment because it is generally older so that reallocating costs away from it would change accounting practices and hence raise questions from accountants and reallocating costs from smaller segments toward it will have less impact because it is large. The fact that the interactive dummy variable is larger for the largest segment therefore suggests that this attenuation bias may not be important.

9. We thank one of the coeditors for suggesting this test.

TABLE III
OTHER REGRESSION ESTIMATES FOR SMALL AND LARGE SEGMENTS

Panel A. Firms with two to four segments

	For the smallest segments only							
	Regression 1		Regression 2		Regression 3		Regression 4	
Sales growth	0.0033	(0.84)	0.0003	(1.81)	0.0214	(3.82)	0.0036	(3.31)
Own cash flow	0.0926	(10.54)	0.0889	(4.06)	0.1857	(15.84)	0.1220	(6.19)
Other cash flow	0.0488	(5.69)	0.0195	(3.22)	0.1215	(8.94)	0.0227	(6.18)
Segment's q	0.0364	(5.78)	0.0108	(3.83)	0.0266	(4.55)	0.0126	(4.91)
Adj-R^2	0.0491		0.0228		0.1124		0.0753	
Obs.	10,437		10,473		10,757		7316	
	For the largest segments only							
	Regression 1		Regression 2		Regression 3		Regression 4	
Sales growth	0.0135	(3.03)	0.0038	(1.96)	0.0132	(2.82)	0.0088	(2.88)
Own cash flow	0.1384	(15.18)	0.0669	(2.37)	0.3313	(23.39)	0.1485	(12.24)
Other cash flow	0.0247	(3.45)	0.0553	(4.39)	0.0311	(5.44)	0.0473	(3.79)
Segment's q	0.0367	(7.04)	0.0229	(4.70)	0.0132	(3.14)	0.0214	(6.14)
Adj-R^2	0.0840		0.0264		0.2298		0.0826	
Obs.	10,676		10,864		11,170		7491	

Panel B. Firms with five or more segments

	For the smallest segments only							
	Regression 1		Regression 2		Regression 3		Regression 4	
Sales growth	0.0052	(0.60)	−0.0003	(−1.47)	0.0140	(0.82)	0.0027	(2.40)
Own cash flow	0.0604	(2.75)	0.1849	(1.93)	0.1351	(6.02)	0.1400	(4.17)
Other cash flow	0.1060	(3.31)	0.0180	(1.70)	0.2021	(4.38)	0.0316	(3.08)
Segment's q	0.0628	(5.14)	−0.0018	(−0.57)	0.0270	(1.87)	0.0082	(4.38)
Adj-R^2	0.0561		0.0411		0.0708		0.1229	
Obs.	1886		1857		2035		939	
	For the largest segments only							
	Regression 1		Regression 2		Regression 3		Regression 4	
Sales growth	0.0287	(2.73)	−0.0020	(−2.11)	0.0204	(1.72)	0.0121	(1.92)
Own cash flow	0.1108	(5.54)	0.0567	(1.71)	0.3882	(11.41)	0.1213	(5.10)
Other cash flow	0.0352	(1.62)	0.0393	(1.99)	−0.0123	(−0.62)	0.0203	(0.92)
Segment's q	0.0441	(4.24)	0.0156	(2.28)	0.0082	(0.83)	0.0240	(3.17)
Adj-R^2	0.0796		0.0208		0.2460		0.0776	
Obs.	2000		2008		2209		1058	

Regression 1 shows fixed-effects estimates normalizing investment and cash flow by segment assets. Regression 2 shows estimates of a regression in first differences. Regression 3 shows regression of investment and cash flow normalized by segment sales. Regression 4 shows fixed-effect estimates for a narrow sample. t-statistics are in parentheses.

results for firms with two to four segments in Panel A, and for firms with five segments or more in Panel B.

In Table III we first investigate whether the results are sensitive to how other cash flow is allowed to affect segment investment. The first regression normalizes segment investment and cash flow by segment assets and other cash flow by assets of other segments. This assumes that there is a fixed percentage relation between other segments' cash flow and these segments' assets and a segment's investment in its assets. The reported equation allows for fixed-effects. We find that our conclusion that investment by a segment depends on other segments' cash flow holds for this specification also. However, this specification explains less of the variation of investment across the smallest segments.

The next specification estimates a regression on first differences, allowing for fixed-effects. In this regression the difference in sales growth is the difference between concurrent sales growth and lagged sales growth. This enables us to keep using roughly the same segments throughout the table. Differencing has negligible impact on the coefficients of other cash flow.

The third specification is one used by Lamont [1997]. It uses ordinary least squares and normalizes the accounting variables by segment sales. Since the explanatory variables are different, the coefficients change, but the economic implications are unchanged.

The fourth specification is the one used in Table I, but here we use a sample of firms that do not change their number of segments for the three years around the year a firm enters the sample. These regressions verify that our results are not affected by accounting changes.

To examine whether our results are stable over time, we estimate the regressions in Table I for two subperiods, 1980–1985 and 1986–1992. In those regressions the subperiod regressions are similar to the regressions reported in Table I, but the coefficients on the other cash flow are generally more significant for the first subperiod.

Finally, we consider the issue of whether our results are industry-specific, or induced by vertical integration. We estimate our regressions restricting the sample each time to all firms with the same first-digit SIC code. The results are consistent across SIC codes, but the significance of the coefficients varies across the codes. The results are strongest for segments in the SIC code 3,

which corresponds to manufacturing industries. This SIC code is also the one with the most segments.

III. What Determines the Allocation of Funds within Diversified Firms?

So far, we can see that segments of a diversified firm invest more when the other segments have high cash flow, but that their investment depends more strongly on their own cash flow than on other segments' cash flow. These results are consistent with an active internal capital market, but they also show that the source of cash flow matters within a diversified firm. In this section we investigate further whether the evidence is consistent with an efficient internal capital market.

If the firm has limited funds to invest, an efficient internal capital market allocates funds within the firm so that the best investment opportunities are availed of before less valuable investment opportunities.[10] We define the internal capital market to be efficient if (1) it gives priority in the allocation of funds to the segment with the best investment opportunities; (2) it makes that segment's investment less sensitive to its own cash flow as well as to other segments' cash flow; and (3) its allocation of funds to a segment falls when other segments have better investment opportunities. We would expect small segments in highly diversified firms to benefit more from an efficient internal capital market because it would be easier for the internal capital market to shield segments with small capital expenditures relative to the firm's total investment budget from changes in that budget.[11]

To test for the efficiency of the internal capital market, we modify the regression specification of Table I to allow for a segment's investment to depend on the industry q of the other segments. We further allow for the sensitivity of a segment's investment to its own cash flow and to other segments' cash flow to depend on whether the segment has the best investment opportunities within the firm. We therefore compute the industry q of all segments for a firm and rank them. In our investment equations

10. Stein [1997] models the fund allocation decision of multidivision firms that are credit-constrained.

11. In some cases, if there are complementarities among segments, it might be optimal for the internal capital market to give priority to a segment that does not have the best investment opportunities. This might lead us to treat as inefficient an internal capital market that is actually efficient. However, such cases are exceptions and should not affect the inference we draw from our regressions.

we introduce a dummy variable that equals one if the smallest segment has the highest rank of a firm's investment opportunities and interact this dummy variable with the segment's cash flow and other segments' cash flow.

As before, we find that the industry q of a segment has a significant impact on its investment. However, for all regressions but one, we reject that the q's of the other segments affect the segment's investment. The exception is for the large segment regression for firms with two to four segments. In general, the coefficients on the q's of the other segments are insignificant and economically trivial. Consequently, an increase in the q of other segments does not appear to have much of an effect on a segment's investment. Unless one believes that firms face no costs of external finance, this evidence suggests that the internal capital market does not allocate resources efficiently.

As Table IV shows, the interactive dummy variables are not significant in highly diversified firms. This implies that the investment of the segment with the best investment opportunities within the firm is as sensitive to its cash flow and to other segments' cash flow as is the investment of segments with poorer investment opportunities. The internal capital market makes it possible for the sensitivity of segment investment to cash flow to differ depending on a segment's investment opportunities. At the very least, our evidence shows that firms do not take advantage of this opportunity and let changes in cash flow affect the investment of segments in the same way regardless of their investment opportunities.

With our definition of an efficient internal capital market, efficiency implies a lower cash flow sensitivity for the segment with the best investment opportunities than for the other segments. This is because the firm should allow that segment to take advantage of its best investment opportunities without regard to the segment's cash flow or firm cash flow as long as it has the resources to do so. One might argue that our view of efficiency is too narrow and that it excessively simplifies the investment decision of diversified firms. In particular, our results could be consistent with efficiency for two different reasons. First, information asymmetries and agency problems between headquarters and divisions could make it optimal for firms to put substantial weight on divisional cash flows in allocating resources. Second, it could be that the industry q is a poor measure of investment opportunities. Management allocates funds for investment based

TABLE IV

ESTIMATES OF INVESTMENT EQUATIONS ALLOWING FOR A DIFFERENT COEFFICIENT FOR THE CASH FLOW OF OTHER SEGMENTS FOR SEGMENTS WITH THE HIGHEST q IN THE FIRM AND USING THE q OF THE OTHER SEGMENTS AS EXPLANATORY VARIABLES

	For the smallest segments only				For the largest segments only			
	2 to 4		5 or more		2 to 4		5 or more	
Sales growth	0.0033	(3.41)	0.0014	(1.60)	0.0093	(3.51)	0.0119	(2.24)
Own cash flow	0.1668	(9.24)	0.1320	(3.36)	0.1508	(13.11)	0.1442	(6.58)
Other cash flow	0.0167	(5.36)	0.0211	(3.16)	0.0468	(4.01)	0.0200	(1.60)
Segment's q	0.0116	(5.32)	0.0055	(4.54)	0.0223	(5.96)	0.0252	(4.09)
Dummy for segment's q^* own cash flow	−0.0452	(−2.29)	−0.0371	(−0.79)	0.0026	(0.22)	−0.0225	(−0.65)
Dummy for segment's q^* other cash flow	0.0041	(1.10)	−0.0009	(−0.16)	−0.0173	(−1.19)	0.0025	(0.07)
Other segment 1's q	−0.0015	(−1.02)	0.0009	(0.33)	0.0057	(1.26)	−0.0011	(−0.10)
Other segment 2's q	−0.0004	(−0.40)	−0.0013	(−0.57)	0.0056	(3.41)	0.0003	(0.06)
Other segment 3's q	−0.0010	(−1.89)	0.0004	(0.32)	−0.0007	(−0.64)	−0.0046	(−1.40)
Other segment 4's q			0.0008	(1.44)			0.0023	(1.02)
Other segment 5's q			−0.0003	(−0.34)			0.0001	(0.07)
Other segment 6's q			0.0000	(0.06)			−0.0019	(−1.70)
Other segment 7's q			−0.0016	(−1.98)			−0.0002	(−0.15)
Adj-R^2	0.0854		0.0878		0.0881		0.0932	
Obs.	10,437		1886		10,676		2000	
F-value	1.4111		1.0127		7.2971		0.8046	
Prob > F	0.2374		0.4201		0.0001		0.5834	

Regressions use all the firms in our sample from 1980 to 1992 for which we can compute the ratios used in our regressions and we exclude firms where one or more of the accounting ratios used in the regressions exceed one. Dummy for segment's q takes the value of one if segment's q is the highest q in the firm for that year; it equals zero otherwise. F-value is for the joint hypothesis that coefficients of other segments' q are zero. t-statistics are reported in parentheses.

on its information. One possible benefit of diversification is that management gets to observe the investment opportunities of segments better than outside investors. Thus, investment might be efficient yet unrelated to q because, given management's private information, the segments' investment opportunities are

unrelated to q. However, in order to make these other interpretations of our results convincing, one would have to explain why a segment's investment opportunities measured by the industry q affect its investment directly but affect neither the other segments' investment nor the cash flow sensitivity of its investment. It is not clear to us how to explain this.

For firms with moderate diversification one interactive dummy variable—the one for the own cash flow of the smallest segment—is significantly negative. All the other dummy variables are insignificant. In all regressions the coefficient estimates for the interactive dummy variables for other cash flow are economically trivial, and half of them have the wrong sign. If the other segments perform less well, then a segment has to contract investment by the same amount regardless of whether or not it is the segment with the best investment opportunities. For the smallest segment, though, the coefficient on the interactive dummy variable for own cash flow is about one-quarter of the coefficient estimate on own cash flow. Hence, there is some evidence, especially for firms with limited diversification, that the own cash flow sensitivity of the smallest segment is lower when it has the best investment opportunities among a firm's segments.

A concern is that investment's sensitivity to other cash flow depends on whether other cash flow is positive or negative. In particular, the smallest segment with good investment opportunities could gain more from positive other cash flow than it loses from negative other cash flow. However, there are few cases where other cash flow is negative. Nevertheless, we estimated our regressions allowing for a different sensitivity to negative other cash flow. Results of these regressions do not alter our conclusions. Finally, we split the sample according to liquidity (firm-level cash and investments divided by total assets) to make sure that our results are not due to some correlation between q and liquidity. There is no significant difference between the two subsamples.

IV. Conclusion

In this paper we explore the segment investment policies of diversified firms. We can summarize our results as follows.

1. The investment by a segment of a diversified firm depends significantly more on its own cash flow than on the cash flow of the firm's other segments.

2. For highly diversified firms, segment investment is less sensitive to its cash flow than for comparable single-segment firms.
3. Segment investment increases with its q but is not related to the other segments' q.
4. Segment investment for the segment with the best investment opportunities within the firm has the same sensitivity to other segments' cash flow and for highly diversified firms to its own cash flow, as the investment of segments with less valuable investment opportunities.

An internal capital market should allocate more resources to segments that have better investment opportunities within the firm, and it should protect the investment budgets of these segments when the firm cuts back on investment. We find that segments with better investment opportunities invest more, but we find no evidence that the internal capital market protects the investment budgets of a segment with better investment opportunities when the segment or the firm experiences an adverse cash flow shock. Our evidence shows that the internal capital market does not equalize the impact of cash flow shortfalls equally across segments since a segment bears the brunt of its cash flow shortfall. Hence, investment by a segment depends more on its own cash flow than it does on firm cash flow. At the same time, however, a segment's investment is affected by the cash flow shortfall of other segments regardless of the value of its investment opportunities. This is inconsistent with our definition of efficient internal capital markets. Future theoretical and empirical research should help us better understand why internal capital markets operate this way.

Data Appendix

FASB-SFAS No. 14 and SEC Regulation S-K require that firms report segment information for fiscal years ending after December 15, 1977. SFAS No. 14 defines an industry segment as, "A component of an enterprise engaged in providing a product or service, or a group of related products or services primarily to unaffiliated customers (i.e., customers outside the enterprise) for a profit." Since we use lagged variables in our regressions, we can report results for investment from 1980 onward. For our analysis we use the active and research files of COMPUSTAT, so that our sample includes the firms that subsequently delisted from

COMPUSTAT because of mergers, bankruptcies, liquidations, etc. From 1980 on we have 96,228 segment years. For each segment we collect six variables: net sales, operating profit (loss), depreciation, capital expenditures, identifiable total assets, and SIC code. We exclude segments that do not contain complete information on these variables. Doing so reduces the sample to 53,064 segment years.

In an earlier study measuring the degree of diversification of firms, Ravenscraft and Scherer [1987] use data from the 1975 Line of Business sample of the Federal Trade Commission (FTC). To construct this sample, the FTC collected sales and other financial variables from 471 large corporations. The data classify sales using 262 manufactured product categories, but allow firms to aggregate sales from different categories into one in cases where sales in one category are small. Wernerfelt and Montgomery [1988], Lichtenberg [1992], and Liebeskind and Opler [1992] use census data on plants and measure diversification in terms of numbers of different SIC codes for plants. Lichtenberg also uses the Compustat SIC File, which reports up to 90 SIC codes per company. More recently, Berger and Ofek [1995], Comment and Jarrell [1995], and Lang and Stulz [1994] use the same database we do. For this study, none of the alternative databases would be suitable because they do not provide time series of investment. However, the Compustat database reports information for up to ten segments only, does not have private firms, and, as argued by Lichtenberg [1991], is subject to possible reporting biases.

An important difficulty in using these data is that firms reorganize their segments over time. To prevent such reorganizations from affecting our conclusions, we pursue three different strategies. First, for our base sample, we eliminate segment years in which any of the following five ratios exceeds one.[12] The ratios are the current value of net capital expenditure (gross capital expenditure minus depreciation) over the previous year's segment assets, sales change over the previous year's sales, cash flow to segment assets, and, other segments' cash flow divided by total assets of these segments. Cash flow is defined as operating profit (loss) plus depreciation. The ratios we use are determined by data availability. After excluding outliers, we end up with 49,851 segment-year records corresponding to 3265 different firms.

12. We also estimate the regressions of Table I excluding firms with ratios greater than 5 and firms with ratios greater than 10. The qualitative results are unchanged.

TABLE V
DISTRIBUTION OF THE SAMPLE FIRMS ACROSS YEARS AND ACROSS NUMBER OF SEGMENTS

	Number of segments									
Frequency	2	3	4	5	6	7	8	9	10	Total
80	391	410	288	156	74	22	14	4	7	1366
81	380	380	282	144	63	26	15	5	3	1298
82	386	365	268	139	60	25	10	4	3	1260
83	384	351	266	126	55	23	11	1	4	1221
84	348	353	242	110	38	19	9	4	3	1126
85	320	327	212	91	32	17	6	5	2	1012
86	360	313	196	79	34	18	6	3	1	1010
87	317	286	195	76	30	12	7	3	2	928
88	320	282	174	75	31	18	4	2	3	909
89	301	285	170	64	33	17	6	1	4	881
90	326	297	177	69	41	16	5	1	4	936
91	350	297	196	78	29	19	2	3	4	978
92	248	238	157	61	26	7	3	2	3	745
Total	4431	4184	2823	1268	546	239	98	38	43	13670

All data come from the Business Information file of COMPUSTAT. We use all firms from 1980 to 1992 for which we can compute the ratios that are used in our investment equations, and we exclude firms where one or more of the accounting ratios used in the regressions exceed one.

Throughout the paper we focus on the largest and smallest segments (using segment sales as a measure of segment size) for which data are available for each firm. To make sure that we are considering firms that are truly diversified, we exclude cases in which the smallest segment has the same two-digit SIC code as the largest segment. This yields 13,670 firm-year records, corresponding to 2631 different firms.

The distribution of the firms across number of segments and years is given in Table V. The number of firms exceeds 900 each year except in 1989 and 1992. Note that the number of segments falls over time. Although some of this decrease could be attributed to changes in reporting practices, most of it is due to the decrease in firm-level diversification during the 1980s. Evidence consistent with this interpretation is found in studies using different databases that also document a decrease in diversification.[13] We use two other strategies to ensure that we are not misled by problems with the segment data that involve using subsets of the sample

13. For instance, Liebeskind and Opler [1992] document a decrease in firm diversification using the Trinet database.

TABLE VI
DESCRIPTIVE STATISTICS FOR INITIAL SAMPLE DATA SET

	Firms with 2 to 4 segments							
	For the smallest segments only				For the largest segments only			
	Gross capital expenditure	Sales	Own cash flow	Other cash flow	Gross capital expenditure	Sales	Own cash flow	Other cash flow
Mean	13.93	177.55	24.90	181.67	58.66	968.06	115.81	94.15
99%	249.08	2547.60	379.50	2901.00	870.55	12976.00	1724.00	1487.75
95%	60.80	803.20	113.90	726.00	237.60	3810.40	499.67	332.00
90%	27.01	407.20	57.30	366.97	115.40	1981.00	250.20	159.87
Median	0.93	25.00	2.49	18.09	4.49	129.90	13.74	5.98
10%	0.00	1.41	−0.37	0.48	0.11	9.69	0.32	−0.08
5%	0.00	0.46	−2.02	−0.25	0.03	4.66	−0.43	−1.10
1%	0.00	0.03	−21.00	−11.24	0.00	0.85	−12.59	−16.17
	Firms with 5 or more segments							
	For the smallest segments only				For the largest segments only			
	Gross capital expenditure	Sales	Own cash flow	Other cash flow	Gross capital expenditure	Sales	Own cash flow	Other cash flow
Mean	25.41	235.07	38.87	502.06	98.67	1735.37	180.98	359.94
99%	391.60	2853.00	688.43	5655.00	1560.54	21232.00	2472.61	4864.00
95%	107.00	977.00	164.80	2014.00	362.02	7500.00	711.00	1555.00
90%	53.00	554.00	87.63	1271.00	239.00	4229.30	434.98	923.30
Median	3.03	66.73	7.35	153.90	14.80	510.90	51.81	92.83
10%	0.00	2.05	−1.41	5.11	0.24	38.10	1.46	2.12
5%	0.00	0.60	−7.86	1.02	0.00	16.00	−0.70	−0.64
1%	0.00	0.01	−60.12	−38.22	0.00	4.69	−125.00	−53.75

All data come from the Business Information file of COMPUSTAT. We use all firms from 1980 to 1992 for which we can compute the ratios that are used in our investment equations, and we exclude firms where one or more of the accounting ratios used in the regressions exceed one. Own cash flow is own segment's cash flow. Other cash flow is other segments' cash flow. The dollar values are in million dollars.

just described. We construct a second sample, which we call the narrow sample. This narrow sample is constructed in such a way that we use only segments that have continuity in their activities and accounting practices. With this sample we eliminate all segments from our base sample when firms change their number

of segments or their SIC code for a period of three years centered on the year the segment is in the sample. Finally, we construct a sample of large firms to isolate firms that are subjected to more scrutiny from analysts and regulators. Firms are included in the large firm sample if they have sales of more than $1 billion in 1977 dollars. A firm that meets this condition one year is kept in the sample in subsequent years, thus insuring that losers do not drop out of that sample.

In Table VI we provide information on the smallest segment and the largest segment both for the moderately diversified firms and for the highly diversified firms. It is important to note that in dollar terms other cash flow is extremely large relative to own cash flow for the smallest segment. These numbers suggest that if the firm wants the smallest segment to invest regardless of its own cash flow, it can make this possible.

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