ELSEVIER Journal of Financial Economics 59 (2001) 477–515

JOURNAL OF Financial ECONOMICS

www.elsevier.com/locate/econbase

Leverage and internal capital markets: evidence from leveraged recapitalizations☆

Urs C. Peyer, Anil Shivdasani*

Kenan-Flagler Business School, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599, USA

Received 3 March 1999; received in revised form 21 April 2000

Abstract

We study the internal allocation of resources for diversified firms that complete a leveraged recapitalization. Before the recapitalization, internal capital markets allocate investment to high q segments. After the recapitalization, segment investment becomes less sensitive to q and more sensitive to segment cash flow. We show that firm value is positively related to investment's sensitivity to segment q and negatively related to investment's sensitivity to segment cash flow. Our analysis highlights an indirect cost of debt that has received little attention: pressure to meet interest obligations creates an incentive to emphasize investments that generate high levels of current cash flow.

JEL classification: G31; G32; G34

Keywords: Leverage; Investment; Recapitalization; Internal capital market

☆We thank David Denis (the referee), Amy Dittmar, Andrew Karolyi, John McConnell, David Ravenscraft, Bill Schwert, Henri Servaes, René Stulz, Sunil Wahal, Ralph Walkling, Karen Wruck, Marc Zenner, and seminar participants at the Georgetown University, University of Illinois, University of North Carolina, Ohio State University, Securities and Exchange Commission, University of New Orleans, George Mason University, the 1999 European Finance Association meetings, and the 2000 American Finance Association meetings for helpful comments.

* Corresponding author. Tel.: + 1-919-962-3182; fax: + 1-919-962-2068.

E-mail addresses: peyeru@bschool.unc.edu (U.C. Peyer), shivadasa@bschool.unc.edu (A. Shivdasani).

0304-405X/01/$ - see front matter
PII: S0304-405X(00)00094-5

1. Introduction

In the presence of market imperfections, leverage has the potential to have an important influence on investment decisions. For example, it is well recognized that distorted investment policies represent a cost of high leverage. Some well-known examples of such distortions are the asset substitution problem (Jensen and Meckling, 1976), the underinvestment problem (Myers, 1977), and inefficient liquidation policies (Harris and Raviv, 1990). However, leverage also has the potential to induce improvements in a firm's investment decisions. Jensen (1986, 1989) argues that leverage reduces managerial discretion over free cash flow and lowers the likelihood that resources are expended for negative net present value investments.

While the potential costs and benefits are generally well understood, the empirical evidence is less conclusive. Whited (1992) finds that firms with high leverage display a higher sensitivity of investment to cash flow. To the extent that investment sensitivity equations can be interpreted as evidence of financial constraints (see Kaplan and Zingales, 1997, for a discussion), this implies that highly levered firms might be constrained from pursuing valuable investment policies. Alternatively, these findings could suggest that leverage restricts overinvestment if the firm's investment opportunities are unattractive. Supporting this view, Lang et al. (1996) find that leverage inhibits investment for firms with poor investment opportunities and argue that high leverage constrains managers from pursuing investment policies that dissipate free cash flow. In an analysis of firms undergoing a leveraged recapitalization, Denis and Denis (1993) find that these firms curtail total investment and reverse poor investment decisions following the recapitalization. Supporting both views, McConnell and Servaes (1995) find that leverage is positively related to firm value for low-growth firms, but negatively related to firm value for high-growth firms.

Much of the evidence regarding the effect of leverage on investment comes from the analysis of firm-level data. While the effect of leverage in determining the level of the firm's overall investment is clearly of interest, it is also important to understand how leverage influences the internal allocation of resources within a firm, which is unobservable using firm-level data. In this paper, we use segment-level data to investigate how changes in leverage influence the allocation of investment expenditures across a firm's business segments.

Our analysis is motivated by a growing literature studying the allocation of investment across a firm's business segments. Lamont (1997) and Shin and Stulz (1998) show that a segment's investment depends upon the cash flow of the firm's other segments, suggesting that diversified firms reallocate capital across segments. However, as Shin and Stulz show, capital expenditures are not systematically redirected to segments with favorable investment opportunities. Scharfstein (1998) also finds that investment by segments of diversified firms is less sensitive to Tobin's q than it is for single-segment firms. Rajan et al. (2000)

find that diversified firms tend to invest more in industries with low q ratios than do single-segment firms. According to these findings, diversified firms do not appear to allocate investment in an efficient manner to segments with the most favorable investment opportunities.[1] However, the role of leverage in this process remains unexplored. In this paper, we explore whether and how leverage affects the internal allocation of capital across business segments and if such changes are beneficial or detrimental to firm value.

We study a sample of multidivisional firms that undergo a leveraged recapitalization between 1982 and 1994. Leveraged recapitalizations provide a useful setting because they involve discrete and large changes in overall firm leverage, thereby facilitating comparison of investment policies across time. As suggested by Jensen (1986) and others, we expect that the substantial increase in interest obligations for these firms creates an emphasis on managing the firm's cash flows. Denis and Denis (1993, 1995) and Palepu and Wruck (1992) document significant cash flow improvements for samples of recapitalizing firms. Case study analyses of Kroger (Denis, 1994) and Sealed Air Corp. (Wruck, 1994) display similar evidence of cash flow improvements following recapitalizations.

Leverage can influence both the overall level of investment for the firm as well as the allocation of investment across divisions. Using segment-level data, we focus on how the emphasis on cash flows following a recapitalization alters the allocation of investment expenditures across business segments. We argue that the pressure to improve cash flow can be either beneficial or detrimental to a firm's divisional investment policy. If certain segments generate substantial free cash flow, it is possible that in the absence of a recapitalization, this free cash flow would be used to finance investment in segments that generate high private benefits for management, instead of segments that display the highest marginal returns. In this scenario, the pressure to meet interest payments following a recapitalization can be beneficial if it forces firms to allocate investment to segments with the highest marginal returns while cutting back on inefficient cross-subsidization of investment across segments. However, the emphasis on cash flow can also be detrimental to a firm's divisional investment policy if it creates an incentive to focus on short-term cash flows without regard to long-term profitability. In this scenario, the pressure to service debt obligations might create the incentive to invest in segments that provide the greatest potential for short-term cash flows, while ignoring segments with the highest marginal returns.

[1] The exact magnitude of distortions in divisional investment allocations is a topic of debate. Chevalier (2000) argues that self-selection bias in how firms diversify could be responsible for some of the documented patterns in divisional policies. Gertner et al., (1999) show that spun-off subsidiaries display improvements in investment policies, and Dittmar and Shivdasani (2000) show that internal capital allocations improve after firms divest assets.

We show that firms alter the internal allocation of investments following the recapitalization. Prior to the recapitalization, sample firms allocate divisional investment in a manner similar to the broad sample of diversified firms studied by Shin and Stulz (1998). Consistent with their findings, we find that segment capital expenditures are positively related to the segment's imputed q ratio, the segment's own cash flow, and the cash flow of other segments. After the recapitalization, firms cut back substantially on investment expenditures, and the reduction in investment is larger in high q segments. We show that following the recapitalization, the sensitivity of segment investment to segment q declines, whereas the sensitivity of segment investment to segment cash flow increases substantially. In addition, the cash flow of other segments becomes unimportant as a determinant of segment investment. We interpret these findings as evidence that the reallocation of resources between segments ceases following the recapitalization. We show that this change in divisional investment policy is most pronounced for those firms for which the ex ante pressure to service debt payments is the highest.

To understand how these changes affect firm value, we compute firm-level measures of the sensitivity of segment investment to both segment q and segment cash flow. We find that the sensitivity of segment investment to segment q is positively related to measures of excess firm value in the sample, while segment investment's sensitivity to segment cash flow tends to be negatively related to excess firm value. These findings suggest that leveraged recapitalizations are followed by a deterioration in divisional investment policy.

It is worth noting, however, that our results do not imply that overall investment policy is worse after the recapitalization. The overall effect of investment policy on firm value depends on both the level of investment for the entire firm as well as how investment is allocated among divisions. Denis and Denis (1993) show that recapitalizing firms are plagued by overinvestment in the years before the recapitalization and that firm value increases as a result of cutbacks in investment spending. We also find that firm value increases significantly after the recapitalization. Therefore, in our sample, the benefits of lower firm-level investment appear to outweigh the costs of distorted divisional investment allocation.

The evidence in this paper adds to the existing literature on how leverage affects investment policy. Our results suggest that high leverage can impose a cost on divisional investment policy by creating an incentive to allocate investment to divisions with high cash flow. Although recapitalizations substantially increase shareholder wealth, the increase in firm value represents a tradeoff between a more efficient level of investment spending for the entire firm and the costs of an internal capital market that ceases to allocate funds to divisions with the highest net present value opportunities. Therefore, our findings suggest that the improvement in firm value would be even greater in the absence of the changes in divisional allocation that we document. In addition, our evidence

comes from a sample of firms characterized by overinvestment in the years before the recapitalization that hence benefit from lowered investment levels. Thus, it is conceivable that the altered investment policy induced by high leverage would impose higher costs in firms not characterized by systematic overinvestment.

The paper is organized as follows. Section 2 describes the construction of the sample and the data. Section 3 presents results on the changes in investment policy and the sensitivity of investment to q and cash flow. Section 4 investigates the effect of recapitalizations and investment sensitivities on excess firm value. Section 5 concludes.

2. Data

2.1. Sample selection

We obtain our sample from several sources, including a list of recapitalizing firms from Securities Data Company (SDC), keyword searches of Lexis-Nexis, and samples used by Denis and Denis (1993), Palepu and Wruck (1992), and Gupta and Rosenthal (1991). We exclude financial companies (primary SIC codes 6000–6999). One of the sample firms reports a financial segment. We retain the firm in the analysis, but exclude this segment. Our results are unchanged if the entire firm is excluded from the analysis. We choose events that are completed between 1982 and 1994 in order to be able to collect other data for the six years surrounding the event year. The earlier limit is set by the availability of segment data, which we collect from the Compustat Business Segment Information (CIS) database.

The firms identified from the above sources include instances of proposed but not completed recapitalizations, as well as cases where one type of debt is exchanged for another. To ensure a sample of firms that undergo a substantial increase in leverage, we require that the change in total firm leverage surrounding the recapitalization year be at least 20 percentage points. Specifically, we require $(\text{Total Debt/Total Assets})_{\text{Year}+0} - (\text{Total Debt/Total Assets})_{\text{Year}-1} \geqslant 20\%$. This screen eliminates observations that are recorded on the SDC database as undertaking a leveraged recapitalization, but in which leverage remains virtually unchanged or actually decreases following the event. For this set of firms, we verify that some of the proceeds are paid out to shareholders in the form of a special dividend, a share repurchase, or any other form of payout.

A total of 38 firms meet our requirements and have all the necessary data available. Although we study a longer time period than prior studies of leveraged recapitalizations, our sample size is limited due to requirements that the recapitalization actually be completed, the firm remain independent for

three years after the event,[2] and the leverage increase after the recapitalization. Of these 38 firms, 22 firms report multiple lines of business in the CIS database in the year prior to the recapitalization. Because we are interested in how funds are allocated across business segments, we focus on the 22 multidivisional firms in the subsequent analysis.

Consistent with prior studies, we find a high frequency of corporate control activity preceding the leveraged recapitalization. Fourteen of the sample firms receive a takeover bid or merger proposal in the year prior to the recapitalization. In an additional four cases, we find reports of takeover rumors for the sample firms. Thus, some form of external pressure appears to trigger the recapitalization in about 82% of the sample firms. A similar pattern is reported by Denis and Denis (1993) and Palepu and Wruck (1992).

2.2. Sample characteristics

Fig. 1 shows that the majority of recapitalizations take place in 1988 and 1989. Not surprisingly, leveraged recapitalizations tend to be infrequent events in the early 1990s. The scarcity of events in the 1990s raises the question of whether these events are somehow different from those that occur in the presence of the active junk-bond market of the 1980s. We conduct all the tests reported in the paper excluding events after 1991, but observe no noticeable differences. We report results using the entire sample of firms.

We align the recapitalization events in event-time. The event year is denoted by year 0, year -3 denotes three years prior to the event, and year $+3$ refers to three years after the event. The number of multisegment firms in the sample declines from 22 at year -1 to 20 by year $+3$. Since the sample size is limited, we emphasize medians rather than means throughout the paper.

As required by the sample selection process, leverage, defined as the ratio of total debt to total assets, increases drastically. The average leverage ratio in the three years preceding the recapitalization is 19% but rises to 38% in the three years following the recapitalization. Fig. 2 shows that the median leverage ratio increases from 20% at year -1 to 50% at year 0, representing a highly statistically significant change. It is worth noting, however, that leverage decreases steadily after the recapitalization. As shown in Fig. 2, leverage decreases from a median of 50% at year 0 to 34% at year 3. Despite the

[2] A potential concern is the extent to which our requirement that the firm be listed for three years after the recapitalization induces a survivorship bias in the sample. We find only one multisegment firm that satisfies our other data requirements and is delisted during the three years following the recapitalization. Thus, it appears unlikely that this requirement imposes a meaningful survivorship bias. Of the 22 multisegment firms in the sample, two firms become single-segment firms due to divestitures. These firms are retained in the analysis for all sample years during which they operate as multisegment firms.

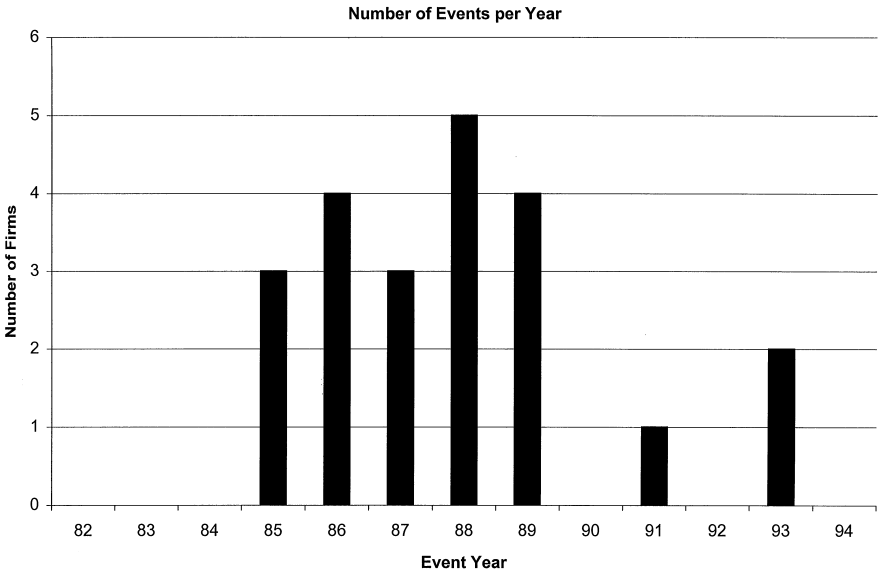

Fig. 1. Distribution of leveraged recapitalization events. Number of recapitalizing firms by year. The sample comprises 22 multidivisional firms that complete a leveraged recapitalization between 1982 and 1994.

steady decline in leverage following the recapitalization, the sample firms remain more highly leveraged three years after the recapitalization than before the recapitalization.

The increase in leverage is also apparent when recapitalizing firms are compared to industry averages. Fig. 2 shows that median industry leverage, defined as the leverage ratio of all firms in the same primary three-digit SIC code, shows a slight increase around year 0. We also plot the imputed leverage, computed as the sum of the median leverage of single-segment firms in the same three-digit SIC code as each segment of the recapitalizing firm, weighted by segment sales. Imputed industry leverage also increases slightly around year 0, but the increase in leverage for sample firms is substantial when compared to these industry medians.

We employ Tobin's q as a measure of growth opportunities and the market's assessment of management's potential to efficiently deploy assets. We proxy for firm-level Tobin's q by the ratio of the market value of assets to the book value of assets. The market value of assets is computed as the market value of common equity plus the book value of assets less the book value of common equity minus deferred taxes. Data on market values are obtained from the Center for Research in Security Prices, and accounting data are collected from Compustat. Our sample firms have a median Tobin's q of 1.05 before and 1.31 after the

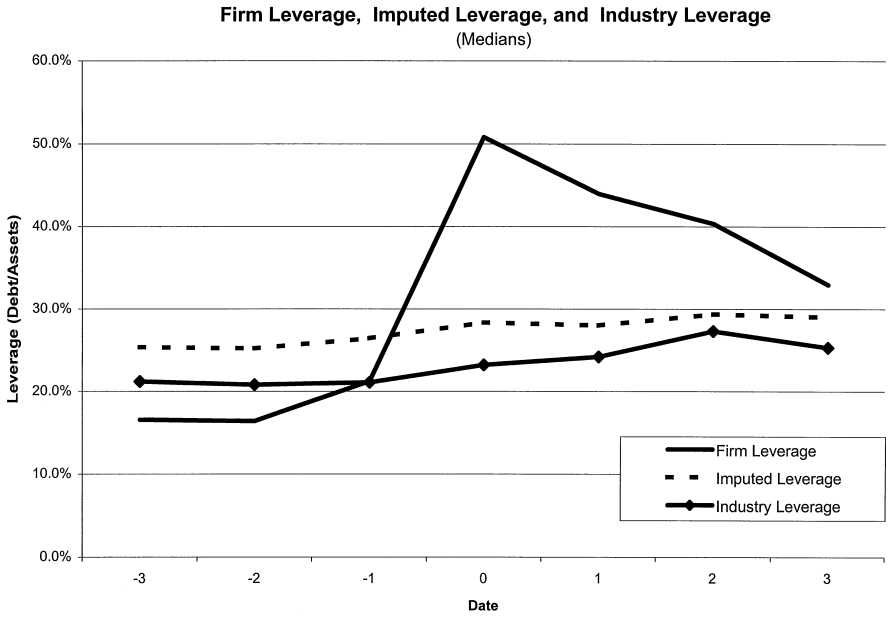

Fig. 2. Firm leverage, imputed leverage, and industry leverage around recapitalization. Median leverage ratio surrounding recapitalization. The sample comprises 22 multidivisional firms that complete a leveraged recapitalization between 1982 and 1994. Leverage is the ratio of total debt to assets. Imputed leverage is the sum of median leverage of single-segment firms in the same three-digit SIC code as segments of the recapitalizing firms, weighted by segment sales. Industry leverage is the median leverage ratio of firms in the same three-digit primary SIC code. Date 0 corresponds to the year in which the firms recapitalize.

recapitalization, as shown in Panel A of Table 1. The difference is statistically significant, indicating a change in the market's perception of growth opportunities and/or management's potential to employ the assets efficiently. This is consistent with prior studies that show an increase in firm value around recapitalizations (Gupta and Rosenthal, 1991; Denis and Denis, 1993; Wruck, 1994).

The sample firms' growth is noticeably lower following the recapitalization, similar to findings by Denis and Denis (1993). As shown in Panel B of Table 1, the growth rate of capital expenditures from year -1 to year $+1$ is significantly negative. We also analyze growth rates relative to the industry. From each firm's raw growth rate we subtract the sum of the median growth rates of single-segment firms in the same three-digit SIC code as each segment of the diversified firm, weighted by segment sales. The industry-adjusted growth rates in capital expenditures, sales, and assets are all significantly negative for sample firms. Thus, recapitalizing firms cut back investments levels significantly

Table 1
Descriptive statistics

Medians of firm and segment characteristics for 22 multidivisional firms that complete a leveraged recapitalization between 1982 and 1994. Tobin's q is the ratio of the market value of assets to book value of assets at the beginning of a fiscal year. Market value of assets is the market value of common equity plus book value of assets minus book value of common equity minus deferred taxes. Industry-adjusted capital expenditures/sales equals

$$\sum_{i=1}^{n} \frac{\text{Sales}_i}{\text{Firm Sales}}\left[\left(\frac{\text{Capex}}{\text{Sales}}\right)_i - \left(\frac{\text{Capex}}{\text{Sales}}\right)_{\text{ss}}\right],$$

where subscript i refers to segment i of the diversified firm with n segments and subscript ss refers to the median of single-segment firms in the same three-digit SIC code. Capex is capital expenditures. The coefficient of variation in Tobin's q is

$$\sqrt{\sum_{i=1}^{n}\left(\text{Sales}_i \Big/ \sum_{i=1}^{n} \text{Sales}_i\right)(q_i - \bar{q})/\bar{q}},$$

where subscript i refers to segment i of the diversified firm with n segments, q is the median q of single-segment firms in the same 3-digit SIC code, and $\bar{q}$ is the sales-weighted average q of the diversified firm. Variables are averaged over the three years before and the three years after the leveraged recapitalization. The growth rate variables are computed over the three-year interval from year −1 to year + 1. The last column contains p-values of Wilcoxon tests for difference in variables from before to after the recapitalization.

Panel A: Firm-level statistics

	Before	After	p-Value for difference
Number of firms	22	20	
Leverage (total debt/total assets)	0.19[a]	0.38[a]	0.00
Firm capital expenditures/firm sales	0.048[a]	0.046[a]	0.31
Industry-adjusted capital expenditures/sales	− 0.007	0.001	0.38
Firm cash flow/firm sales	0.127[a]	0.124[a]	0.69
Tobin's q	1.05[a]	1.31[a]	0.00
Coefficient of variation in Tobin's q	0.146[a]	0.098[a]	0.09
Number of segments per firm	3.83[a]	3.17[a]	0.27

Panel B: Firm-level statistics change from year −1 to year + 1

	Raw growth rate	Industry-adjusted growth rate
Capital expenditures growth rate	− 0.339[a]	− 0.432[a]
Sales growth rate	− 0.088	− 0.205[a]
Asset growth rate	− 0.137	− 0.209[b]

Panel C: Segment-level statistics

	Before	After	p-Value for difference
Number of segment-years	233	176	
Segment capex/segment sales	0.046[a]	0.039[a]	0.03
Segment capex/segment assets	0.066[a]	0.059[a]	0.04
Imputed segment Tobin's q	1.22	1.17	0.01

[a]Medians are significantly different from zero at the 5% level using a two-tailed signed-rank test.
[b]Medians are significantly different from zero at the 10% level using a two-tailed signed-rank test.

after the recapitalization and grow at a slower pace than their single-segment industry peers. Denis and Denis (1993) show that prior to a recapitalization, announcements of investment expenditures are associated with negative announcement returns. Thus, this reduction in investment expenditures should represent an improvement in overall investment policy for sample firms.

Panel C of Table 1 summarizes the segment-level data. We have 233 segment-years of data for the period before the recapitalization and 176 segment-years afterwards. These numbers exclude segments that have a missing value on segment sales (one observation) and segment capital expenditures (13 observations). Following Shin and Stulz (1998), we also exclude segments with a capital expenditure to sales ratio greater than one (16 observations).

The segment-level data show the same pattern as documented by Denis and Denis (1993) at the firm level. Capital expenditures decrease significantly from before to after the recapitalization. The median ratio of capital expenditures to sales drops from 0.046 to 0.039, with the change statistically significant at the 5% level.

In order to assess the segment's growth opportunities, we compute imputed Tobin's q ratios. The imputed segment Tobin's q is the median Tobin's q of single-segment firms in the same three-digit SIC code as the segment of the diversified firm. Tobin's q is calculated at the beginning of the year in which the investment decisions have to be made. As shown in Panel C, the median imputed q decreases following the recapitalization.

Consistent with Denis and Denis (1993), firms divest assets following the recapitalization. The sample firms report, on average, 3.83 segments before the recapitalization year and 3.17 afterwards. The corresponding medians, reported in Table 1, are four segments before and three segments after the recapitalization. Thirteen of the sample firms report a decline in the number of segments three years after the recapitalization relative to the year prior to the recapitalization. Of these, eight firms reduce the number of reported segments by one, while the remaining five firms report two fewer segments.

The divestitures surrounding the recapitalization alter the dispersion of growth opportunities for sample firms. Panel A shows the coefficient of variation in Tobin's q across the firms' segments. Following Rajan et al. (2000), we compute this measure as

$$\sqrt{\sum_{i=1}^{n}\left(\text{Sales}_i/\sum_{i=1}^{n}\text{Sales}_i(q_i-\bar{q})\right)}\Big/\bar{q},$$

where subscript i refers to segment i of the diversified firm with n segments, q is the median q of single-segment firms in the same three-digit SIC code as the segment of the diversified firm, and $\bar{q}$ is the sales-weighted average q of the

diversified firm. As shown in Table 1, the median coefficient of variation prior to the recapitalization is 0.15 and declines to 0.10 after. This decline is similar to the pattern documented by Schlingemann et al, (1999), who find that the variation in investment opportunities drops following asset sales. They show that firms are likely to sell segments that contribute more to the dispersion of a firm's investment opportunities.

This divestiture of segments raises the question of whether the composition of segments in the sample differs substantially from before to after the recapitalization. To examine this, we compare the divested segments to the remaining segments of the firm in the year prior to their divestiture. Divested segments tend to be smaller and exhibit significantly lower ratios of cash flow to sales and capital expenditures to sales than segments that are retained. The difference between the capital expenditures to sales ratio and the cash flow to sales ratio is significantly negative for divested segments, suggesting that these segments are unlikely to be cash-flow constrained. In addition, imputed q ratios are higher for divested segments, although this effect lacks statistical significance. Schlingemann et al. (1999) also find that firms are much more likely to divest small segments, but that the average imputed q is similar for divested and retained segments. To ensure that the results below are not driven by the changing composition of segments in the sample, we also estimate subsequent tests using a constant- composition sample, which includes only the segments that are present in the sample during all firm-years.

3. Changes in internal investment allocation

3.1. Univariate analysis

If investment is allocated efficiently across segments, investment should flow to the segment with the best investment opportunities until the marginal benefit of an increase in investment falls to the marginal benefit of investing in the second-best segment. We follow prior work (Lang and Stulz, 1994; Denis and Thothadri, 1999) and measure expected marginal returns using the imputed Tobin's q of the firm's segments, since lack of market prices prevents direct computation of divisional q ratios.

As a first step, Table 2 examines the investment allocation for segments before and after the recapitalization. We compute investment allocation as the difference between the ratio of capital expenditures to sales for the segment and the corresponding ratio for the firm. A positive (negative) number denotes segments that receive more (less) capital expenditures per dollar of sales than the firm average. Before the recapitalization, the median investment allocation is -0.003 for segments with below-median q. This is significant at the 10% level using a signed-rank test. For segments with above-median q, the investment

allocation is 0.0007 and significant at the 10% level.[3] The difference in investment allocation between high and low q segments is statistically significant with a p-value of 0.05 using a Wilcoxon test. Thus, the allocation of capital expenditures prior to the recapitalization indicates that more capital is allocated to segments that display higher expected marginal returns, a pattern consistent with an optimal allocation of resources.

This picture, however, changes after the recapitalization. The median investment allocation is -0.007 and statistically significant at the 10% level for the high q segments within a firm. Thus, investment expenditures are no longer higher for segments with the most attractive investment opportunities. For the low q segments, the median investment allocation is estimated to be higher at -0.004, which is statistically significant.[4] The difference in investment allocation between high and low q segments is no longer statistically significant. Thus, there is no evidence of higher investment expenditures by segments with relatively attractive investment opportunities after the recapitalization. In this regard, the allocation of investment expenditures changes significantly following a leveraged recapitalization.

We also compute a measure of the transfer of funds between segments to examine whether internal capital markets divert resources away from segments with poor growth opportunities to those with valuable opportunities. This transfer measure, computed for each segment, is defined as the difference between capital expenditures and cash flow for each segment, as a fraction of the segment's sales. A positive (negative) value for this measure indicates segments that invest more (less) than their cash flow. Table 2 shows that irrespective of whether q is high or low, the median transfer is estimated to be significantly negative both before and after the recapitalization. Thus, at the median, both high and low q segments invest less than cash flow, indicating that segment cash flow is not a binding constraint on investment for either high or low q segments. These medians show that funds are not actively transferred from low q to high q segments on an absolute level either before or after the recapitalization.

Investment expenditures are, however, reallocated on a relative basis between high and low q segments. Prior to the recapitalization, the median transfer for low q segments is -0.087 and -0.067 for high q segments. The difference is significant at the 10% level. After the recapitalization, median transfers for high and low q segments are statistically indistinguishable. Thus, before the

[3] We assign observations at the median in the high q category. The results do not differ materially if we assign the median q segments to the low q partition instead.

[4] The negative values for investment allocation for both high and low q segments following the recapitalization arise because we are discussing medians rather than means. Inspection of means, reported in parentheses, shows that average investment allocation is negative for only high q segments after the recapitalization.

Table 2
Transfer of investment funds within multidivisional firms

Investment across segments of 22 multidivisional firms that complete a leveraged recapitalization between 1982 and 1994. Investment allocation is (segment capital expenditures/segment sales) − (firm capital expenditures/firm sales). Transfer is (segment capital expenditures − segment cash flow)/segment sales. Relative transfer is (segment capital expenditures − segment cash flow)/segment sales − (firm capital expenditures − firm cash flow)/firm sales. The sample consists of 233 segment-years before and 176 segment-years after the recapitalization. Observations with a ratio of segment capital expenditures to segment sales greater than one are excluded. The *p*-values of Wilcoxon signed-rank tests for investment allocation, transfer, and relative transfer across high and low *q* segments are reported. The table reports medians on the first line and the corresponding means on the second line.

	Before		*p*-Value	After		*p*-Value
	$q <$ median q	$q \geqslant$ median q		$q <$ median q	$q \geqslant$ median q	
Investment allocation	−0.0030[a]	0.0007[a]	0.05	−0.0040[b]	−0.0070[a]	0.43
	−0.0021	0.0014		0.0071	−0.0013	
Transfer	−0.0872[b]	−0.0670[b]	0.09	−0.0821[b]	−0.0902[b]	0.99
	−0.0949[b]	−0.0594[b]		−0.1073[b]	−0.1149[b]	
Relative transfer	−0.0050[a]	0.0126[b]	0.07	0.0061[a]	−0.0005	0.42
	−0.0154	0.0181		0.0053	−0.0191	
Number of observations	91	142		65	111	

[a]Medians (means) are significantly different from zero at the 10% level using a two-tailed signed-rank test.
[b]Medians (Means) are significantly different from zero at the 5% level using a two-tailed signed-rank test.

recapitalization, high q segments invest more of their cash flow relative to low q segments, but this pattern is absent after the recapitalization.

The reallocation of funds on a relative basis prior to the recapitalization can be observed if we use a measure of relative transfer across segments. We compute the relative transfer as the difference between investment and cash flow of a segment, standardized by segment sales, minus the corresponding ratio for the entire firm. The advantage of this measure is that the weighted sum of relative transfers must be zero across all the firm's segments. Prior to the recapitalization, the median relative transfer is -0.005 for low q segments and 0.0126 for high q segments. The difference in relative transfers across high and low q segments is significant at the 10% level. Thus, high q segments invest more of their cash flow than the typical segment in the firm, whereas low q segments invest less of their cash flow than the typical segment. After the recapitalization, the relative transfer is estimated to be positive for low q segments, and is indistinguishable from zero for high q segments. There is also no statistically significant difference between relative transfers across high and low q segments. Thus, internal capital markets do not appear to divert resources away from low q segments towards high q segments following the recapitalization. Rather, segments appear to operate more as stand-alone entities after the recapitalization.

3.2. Multivariate analysis

We estimate the changes in the internal allocation of funds in a multivariate framework in Table 3. Our tests estimate regressions of the ratio of capital expenditures to sales at the segment level following the approach of Shin and Stulz (1998). Since we have panel data on segments, we use firm-fixed-effects regressions. Because we are interested in how the functioning of internal capital markets changes after a recapitalization, the regressions exclude observations during year 0. The regressions allow the intercept for each firm to vary before and after the recapitalization. This alleviates the concern that estimates on explanatory variables will be biased if we restrict the level of investment spending by a segment to be constant before and after the recapitalization. Because we are interested in observing how the importance of growth opportunities and cash flow varies from before to after the event, we interact the explanatory variables with an indicator, BEFORE, that equals one if the observation precedes the recapitalization. For ease of interpretation, we also interact the other explanatory variables with an analogous indicator, AFTER, that equals one if the observation occurs after the recapitalization. We test for whether the estimates of the BEFORE indicators differ significantly from those of the AFTER indicators using an F-test and report significant differences alongside the coefficient estimates in the table.

In Column 1, we estimate the relation between segment capital expenditures and segment growth opportunities measured by imputed Tobin's q. Column 1 shows that before the recapitalization, the coefficient on Tobin's q is positive and statistically significant. Thus, high q segments receive more capital expenditures per dollar of sales than low q segments. This finding is consistent with results in previous tables and with Shin and Stulz (1998) who also find such a relation in a broader sample of firms. Column 1 provides evidence that the internal capital allocation changes after a recapitalization. After the recapitalization, the coefficient on the segment's imputed q is estimated to be negative and statistically significant. Since total investment declines for our sample after the recapitalization, Column 1 implies that the decline in investment is greater for high q segments.

The reduced importance of segment q in the capital allocation process appears puzzling in light of the documented value-increasing consequences of leveraged recapitalizations (Denis and Denis, 1993; Palepu and Wruck, 1992). A possible explanation for this change is that the high levels of leverage pursuant to a recapitalization create strong incentives for managers to generate cash sufficient to meet interest payments. The evidence on severe costs borne by managers of financially distressed firms (Gilson, 1989) suggests that managers have strong incentives to avoid default on debt obligations. According to this view, managers might place greater emphasis on generating cash flow to meet debt payments after a recapitalization. The evidence on steadily declining leverage ratios following the recapitalization also suggests that managers attempt to pay down debt after a recapitalization. This potentially creates additional incentive to emphasize investments that provide high current cash flow.

If the pressure to generate cash flows sufficient to service the interest payments on debt is responsible for the change in capital allocation, capital expenditures should be more sensitive to cash flow after the recapitalization. Column 2 of Table 3 evaluates this argument by including the ratio of segment cash flow to sales before and after the recapitalization as additional explanatory variables. Consistent with Column 1, the coefficient on imputed q goes from being significantly positive prior to the recapitalization to significantly negative after. At the same time, the importance of the segment's own cash flow increases substantially. The point estimate on the segment's own cash flow increases from 0.23 to 0.48 after the recapitalization. The latter estimate is significantly positive and an F-test indicates that it is also significantly higher than the estimate on segment cash flow prior to the recapitalization. Thus, the importance of segment cash flow as a determinant of segment investment increases substantially following the recapitalization.

There are two possible explanations for the importance of cash flow in the internal allocation of funds even prior to the recapitalization. If imputed q ratios perfectly measure the investment opportunities of segments, then the

Table 3
Regression analysis of segment investment

Fixed-effects regressions of segment investment expenditures. The dependent variable is segment capital expenditures divided by segment sales. Regressions are estimated using firm-fixed effects, with the intercept allowed to vary from before to after the recapitalization. Independent variables are interacted with one of two indicator variables, BEFORE or AFTER. BEFORE equals one if the observation is prior to the recapitalization and equals zero if it is after the recapitalization. AFTER equals one if the observation is after the recapitalization and zero if it is before the recapitalization. Tobin's q is the imputed q for the segment. Cash flow is the segment's cash flow, defined as the segment's operating income before depreciation standardized by segment sales. Other cash flow is the sum of all segment cash flows minus the segment cash flow standardized by segment sales. Segment size is the ratio of segment assets to the sum of all segment assets. Segment rank equals one if the segment has the highest imputed q within the firm, two if the segment has the second-highest imputed q, and so on. The constant composition sample consists of segments that are present in the data for all firm-years. The first line reports the estimated coefficient, and the corresponding p-values are reported on the second line.

	Dependent variable: segment capital expenditure/segment sales							
	Full sample (1)	Full sample (2)	Full sample (3)	Constant composition sample (4)	Full sample (5)	Full sample (6)	Full sample (7)	Constant composition sample (8)
BEFORE × Tobin's q	0.036 0.028[a]	0.039 0.003[a]	0.038 0.003[a]	0.021 0.260[b]				
AFTER × Tobin's q	− 0.072 0.001[a]	− 0.038 0.037[a]	− 0.039 0.030[a]	− 0.048 0.030[b]				
BEFORE × cash flow		0.230 0.000[a]	0.241 0.000[a]	0.222 0.000[a]		0.228 0.000[a]	0.228 0.000[a]	0.211 0.000[a]
AFTER × cash flow		0.480 0.000[a]	0.480 0.000[a]	0.489 0.000[a]		0.490 0.000[a]	0.491 0.000[a]	0.500 0.000[a]
BEFORE × other segments cash flow			0.002 0.000[a]	0.002 0.000[a]			0.002 0.000[a]	0.002 0.000[a]
AFTER × other segments cash flow			0.000 0.920[a]	0.000 0.910[a]			0.000 0.930[a]	0.000 0.911[a]

BEFORE × segment size			− 0.015	0.00			− 0.018	− 0.002
			0.611	0.993			0.542	0.954
AFTER × segment size			0.016	0.03			0.017	0.04
			0.621	0.432			0.611	0.351
BEFORE × segment rank					− 0.011	− 0.011	− 0.011	− 0.009
					0.060a	0.026[a]	0.022[a]	0.171[b]
AFTER × segment rank					0.014	0.009	0.010	0.012
					0.045[a]	0.100[a]	0.092[a]	0.062[b]
Number of observations	409	409	409	303	409	409	409	303
R^2	0.01	0.35	0.38	0.42	0.00	0.20	0.23	0.26

[a]BEFORE and AFTER coefficients are significantly different at the 1% level.
[b]BEFORE and AFTER coefficients are significantly different at the 5% level.

importance of cash flow could be construed as evidence that other considerations also drive the allocation of resources. Alternatively, as Kaplan and Zingales (1997) note, cash flow could provide incremental information regarding investment opportunities that is not captured by average q ratios. We examine this possibility in more detail in Section 4.

Column 3 of Table 3 includes the size of the segment (measured as the fraction of the segment's total assets to the firm's total assets) as well as the cash flow of other segments as additional explanatory variables. Scharfstein and Stein (2000) argue that small segments engage in rent-seeking activities and need to be bribed by higher investment funding in order to facilitate the maximization of firm value. Segment capital expenditures are estimated to be unrelated to segment size both before and after the recapitalization. Shin and Stulz (1998) find that segment capital expenditures are positively related to the cash flow of other segments. Consistent with Shin and Stulz, we find that segment capital expenditures are positively related to the cash flow of other segments prior to the recapitalization. However, this pattern is altered following the recapitalization, when the importance of other segments' cash flow decreases and the coefficient on this variable becomes statistically insignificant. Together with the evidence in Table 2 that shows how relative transfers cease following the recapitalization, this pattern suggests that an active internal capital market that reallocates funds across divisions ceases to operate following the recapitalization.

A potential concern is whether changes in the composition of the segments from before to after the recapitalization drive these results. To address this issue, we estimate the model using segments that are present in the sample both before and after the recapitalization. As shown in Column 4, use of the constant-composition sample yields inferences similar to those presented above. The importance of imputed q declines substantially after the recapitalization, whereas that of cash flow increases substantially. Also similar to the full sample results, the cash flow of other segments is unimportant following the recapitalization.

As an alternative measure of the attractiveness of segment growth opportunities, we rank all segments within a firm according to their imputed q. The segment with the most attractive opportunities receives a ranking of one, the segment with the next-highest imputed q receives a rank of two, and so on. Columns 5–8 duplicate the analysis using the relative ranking of a segment's growth opportunities instead of the imputed q. The use of a segment's relative ranking of growth opportunities within a firm provides results that are similar to those obtained by using the level of imputed q for both the full sample and the constant-composition subsample. Consistent with the notion of a well-functioning internal capital market, a segment's ranking is estimated to have a negative effect on its capital expenditures prior to the recapitalization. Subsequent to the recapitalization, however, the estimated coefficient on segment rank is positive, indicating that funds are more likely to be allocated to the segments that have

relatively poorer investment opportunities. As with the previous results, the effect of the segment's own cash flow increases markedly in magnitude while cash flow of other segments becomes unimportant after the recapitalization.

A possible explanation for the results is that recapitalizing firms reorganize their operations to focus on their core segments. If these core segments generate substantial cash flow and lie in low q industries, this might explain the increased importance of cash flow and the diminished importance of q following the recapitalization. To evaluate this possibility, we divide our sample into core and non-core segments. Following Schlingemann et al. (1999), we identify core segments as segments that operate in the same two-digit SIC code as the primary SIC code for the firm. According to this criterion, our sample consists of 172 core segment-years and 237 non-core segment-years. In untabulated tests, we find that the subsample of non-core segments is largely responsible for the change in the importance of q and cash flow following the recapitalization. We find no significant change in the coefficients on q or cash flow after the recapitalization for the subsample of core segments, indicating that our results are not an artifact of focusing activities.

Current cash flow is important in understanding how funds are allocated following the recapitalization. Investment expenses are lower in segments that display a relatively low cash-generating capability. In addition, the cash flow of other segments becomes unrelated to segment investment. Thus, internal capital markets cease to reallocate funds across divisions following the recapitalization. Rather, the cash flow of individual divisions appears to become a primary determinant of their investment expenditure.

We explore whether the pressure to service debt payments is responsible for the reduced importance of q and the increased importance of cash flow after the recapitalization. If so, these changes should be most pronounced for firms that experience the greatest pressure to meet interest payments. To examine this prediction, we segregate the sample into firms that are under relatively high pressure to meet interest payments and those under relatively low pressure to meet interest payments.

We use a measure of the firm's ex ante coverage ratio to assess the pressure to meet interest payments. We define the ex ante coverage ratio as the ratio of the firm's pretax cash flow in year -1 relative to leverage in year 0. We avoid the use of the traditional interest coverage ratio, computed as the ratio of contemporaneous cash flow to interest expense, because it is subject to two important biases for our purposes. First, given the large decline in leverage following the recapitalization in our sample, interest expenses in a given year are likely to be a downward-biased measure of the potential payment that would have been required had leverage remained constant. In other words, ex post expenditures on interest payments as reported by Compustat will be a downward-biased measure of the ex ante interest obligations for firms that reduce their

outstanding debt during the year.[5] To circumvent this issue, we use the total leverage at the beginning of the year as a proxy for the potential interest burden. Second, our measure of coverage uses the lagged cash flow in the computation of coverage ratio. Since sample firms appear to alter their internal capital markets to generate higher cash flow, use of contemporaneous cash flow would capture the *effect* and not the *cause* of the distorted investment allocation. Use of the lagged cash flow serves as a proxy for the contemporaneous cash flow in the absence of investment distortions.

Use of lagged cash flows overcomes the problem of cash flow endogeneity but ignores the effects of operating improvements caused by higher leverage. Therefore, we supplement the analysis with an additional measure of debt pressure that examines changes in leverage after the recapitalization. If the pressure to lower outstanding debt is responsible for the change in investment policy, we would expect such changes to be more pronounced for firms that actually reduce their debt outstanding ex post. To investigate this, we divide the sample according to the observed change in leverage from the year of the recapitalization to three years after. We expect that changes in investment policy will be least pronounced for firms that experience relatively low changes in leverage following the recapitalization and most pronounced for firms that reduce leverage substantially following the recapitalization. Supporting the view that the firms that reduce debt the most following a recapitalization are also those in which ex ante coverage is low, we find that 70% of the firms in the sample either have both low coverage and high leverage reductions or have both high coverage and low leverage reductions.

Table 4 reports the results of estimating the segment capital expenditure models for subsamples stratified according to the median coverage ratio at time 0. In Column 1, we estimate the effect of growth opportunities on segment capital expenditures for firms with above median ex ante interest coverage. For these firms, capital expenditures are estimated to be positively related to imputed q both before and after the recapitalization, though the latter coefficient lacks significance. The estimated coefficients on q are statistically indistinguishable before and after the recapitalization. This suggests that there is no significant change in the importance of q following the recapitalization for firms in which the likelihood of default is relatively low.

Column 2 includes the segment's cash flow, the cash flow of other segments, and segment size. Unlike the results for the entire sample, the subsample of high-coverage firms provides no evidence that capital expenditures become

[5] One might argue that recapitalizing firms plan to finance the reduction in debt by proceeds from asset sales. However, even when asset sales were planned, uncertainty about whether or not the assets will eventually be sold and the price at which they will sell is likely to generate pressure to increase cash flow. Further, Denis and Denis (1995) show that proceeds from asset sales following recapitalizations often fall short of expectations.

Table 4
Segment investment, interest coverage, and decline in leverage after the recapitalization

Fixed-effects regressions of segment investment expenditures across subsamples segregated by ex ante interest coverage and post-recapitalization decline in leverage. The dependent variable is segment capital expenditures divided by segment sales. Regressions are estimated using firm-fixed effects, with the intercept allowed to vary from before to after the recapitalization. Ex ante coverage is the ratio of earnings before interest and taxes in year -1 to total leverage at year 0. A firm is classified as a high ex ante coverage firm if this ratio equals or exceeds the sample median in the year of the recapitalization. The change in leverage after the recapitalization is measured as the difference between the leverage at year 0 and year 3. High-leverage-decline firms have an above-median decline in leverage. Independent variables are interacted with one of two indicator variables, BEFORE or AFTER. BEFORE equals one if the observation is prior to the recapitalization and equals zero if it is after the recapitalization. AFTER equals one if the observation is after the recapitalization and zero if it is before the recapitalization. Tobin's q is the imputed q for the segment. Cash flow is the segment's cash flow, defined as the segment's operating income before depreciation standardized by segment sales. Other cash flow is the sum of all segment cash flows minus the segment cash flow standardized by segment sales. Segment size is the ratio of segment assets to the sum of the firm's segment assets. Segment rank equals one if the segment has the highest imputed q within the firm, two if the segment has the second-highest imputed q, and so on. The first line reports the estimated coefficient, and the corresponding p-values are reported on the second line.

	Dependent variable: segment capital expenditure/segment sales							
	High ex ante coverage		Low ex ante coverage		Low decline in leverage from time 0 to 3		High decline in leverage from time 0 to 3	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BEFORE × Tobin's q	0.06	0.055	0.021	0.02	0.031	0.030	−0.032	0.015
	0.000	0.000	0.40[a]	0.20[b]	0.001	0.000	0.22[b]	0.44[a]
AFTER × Tobin's q	0.011	0.015	−0.092	−0.05	0.028	0.022	−0.069	−0.035
	0.74	0.56	0.001[a]	0.047[b]	0.008	0.045	0.016[b]	0.10[a]
BEFORE × cash flow		0.29		0.21		0.25		0.29
		0.000		0.000[a]		0.000[c]		0.000[a]
AFTER × cash flow		0.07		0.49		0.13		0.51
		0.65		0.000[a]		0.015[c]		0.000[a]
BEFORE × other segments cash flow		0.008		0.002		0.000		0.008
		0.37		0.000[b]		0.28		0.000[a]
AFTER × other segments cash flow		−0.004		0.000		0.000		−0.002
		0.59		0.93[b]		0.83		0.53[a]
BEFORE × segment size		−0.02		0.002		−0.066		0.014
		0.56		0.96		0.016[c]		0.73
AFTER × segment size		−0.048		0.033		0.002		0.054
		0.24		0.49		0.93[c]		0.22
Number of observations	149	149	260	260	213	213	196	196
R^2	0.10	0.22	0.006	0.42	0.08	0.25	0.000	0.53

[a]BEFORE and AFTER coefficients are significantly different at the 1% level.
[b]BEFORE and AFTER coefficients are significantly different at the 5% level.
[c]BEFORE and AFTER coefficients are significantly different at the 10% level.

more sensitive to segment cash flow. The estimate on cash flow is positive before the recapitalization as well as after. While the latter effect lacks statistical significance, an F-test for equality of the cash flow coefficients is not rejected at the 10% level.

The results for firms with low ex ante coverage stand out in sharp contrast. Column 3 estimates the effect of imputed q on segment capital expenditures for the firms with below-median ex ante coverage. Prior to the recapitalization, we find little evidence of a relation between segment investment and q. However, after the recapitalization, these firms appear to allocate funds away from high q segments. An F-test reveals that the coefficient on q declines significantly from before the recapitalization to after.

Inspection of the augmented model in Column 4 also indicates that this subsample is largely responsible for the increased importance of segment cash flow following the recapitalization. The coefficient on the segment's own cash flow prior to the recapitalization is estimated to be 0.21 and significant at the 1% level. Subsequent to the recapitalization, the estimate on cash flow increases to 0.49. Using an F-test, we find the post-recapitalization estimate on segment cash flow to be significantly greater than the estimate on segment cash flow prior to the recapitalization at the 1% level.

Columns 5–8 in Table 4 separate the sample according to the decline in leverage after the recapitalization. Columns 5 and 6 report the estimates for the subsample that experiences a below-median decline in leverage in the three years following the recapitalization. As shown in Column 5, the estimate on imputed q is positive and statistically significant both before and after the recapitalization, and the coefficients are statistically indistinguishable. Thus, for these firms, the recapitalization is unaccompanied by a change in internal capital allocation. In the augmented model in Column 6, these firms display a positive sensitivity to the segment's own cash flow both before and after the recapitalization, and this sensitivity actually declines at the 10% level of significance. For this subsample, there is no evidence that capital expenditures are less sensitive to imputed q or that they are more sensitive to current cash flow.

The picture is different for firms that experience large declines in leverage following the recapitalization. Column 7 shows that for these firms, q is estimated to be unrelated to capital expenditures prior to the recapitalization. Following the recapitalization, however, the segment imputed q is estimated to be negative and significantly related to segment expenditures. An F-test indicates that the two coefficients are statistically distinguishable at the 5% level. Column 8 finds a similar effect, and also shows that the importance of segment cash flow increases substantially for this subsample of firms. Prior to the recapitalization, the estimate of cash flow is 0.29. This increases to 0.51 after the recapitalization, suggesting that firms that emphasize segment cash flow are also the firms that decrease their leverage the most after the recapitalization.

We examine whether the difference in results between subsamples stratified according to the coverage ratio and reduction in outstanding debt are driven by the changing composition of segments in the sample. In untabulated tests, we estimate these models using the constant-composition subsample. As with the full sample results, we find that the coefficient on imputed q declines and the coefficient on segment cash flow increases following the recapitalization for firms facing high pressure to meet debt obligations. Such changes are not observed for firms classified as facing relatively less pressure to meet debt obligations. Thus, the results do not appear to be an artifact of changes in the composition of segments surrounding the recapitalization.

The subsample results raise the possibility that our findings are driven by firms that become financially distressed after the recapitalization. Denis and Denis (1995) show that recapitalizing firms frequently encounter bouts of financial distress after the recapitalization. The onset of financial distress might explain why firms alter their investment policy to focus on cash flow instead of q in internal capital allocation. We search Lexis-Nexis for press coverage of financial distress for sample firms. Of the 22 firms in the sample, we find two firms that file for Chapter 11, two firms that violate debt covenants or renegotiate bank debt, and one firm that is acquired. When we estimate the analysis in Tables 3 and 4 excluding these firms, we obtain qualitatively similar results, suggesting that our results are not driven by firms that subsequently encounter financial distress.

Overall, these findings show that the interest payments and/or the pressure to lower outstanding debt are at least partly responsible for the change in the functioning of internal capital markets following a leveraged recapitalization. Further, firms that experience such changes tend to reduce debt to a greater extent than firms in which the change in internal capital markets is less pronounced.

3.3. *Analysis of investment sensitivity*

An alternative approach to evaluating the functioning of internal capital markets is to assess the sensitivity of investment at the firm level. Rajan et al. (2000) develop one such measure of firm-level sensitivity of investment to segment q. We use a similar approach to assess the investment sensitivity to q at the firm level, as opposed to the measure in Table 2 that is computed at the segment level. We define this measure as the q-sensitivity of investment and compute it as

$$\frac{\sum_{j=1}^{n} \text{Sales}_j(q_j - \bar{q})[(\text{Capex/Sales})_j - (\text{Firm Capex/Firm Sales})]}{\text{Firm Sales}},$$

where q_j is the imputed Tobin's q of segment j and $\bar{q}$ is the sales-weighted imputed q of the firm. *Capex* is the capital expenditure of the segment, and Firm

Capex is the capital expenditure of the firm. This measure differs from Rajan et al. in that we measure deviations in segment capital expenditures to sales from the average capital expenditure to sales for the entire firm, rather than the deviation relative to other single-segment firms in same SIC code. For the purposes of our analysis, this approach provides a concise measure of the sensitivity of segment investment to segment q for each firm. This measure will be positive if the high q segments within the firm receive more investment per dollar of sales than do the low q segments.

The results are reported in Table 5, which compares the median q-sensitivity before and after the recapitalization. The median q-sensitivity prior to the recapitalization is 0.000002 and is statistically significant at the 10% level. After the recapitalization, the median q-sensitivity is estimated to be -0.00004 and is also significant at the 10% level. The change in q-sensitivity from before to after the recapitalization is statistically significant at the 5% level. Thus, despite the small number of firms in the sample, firm-level measures of the sensitivity of segment investment to segment q show a reduction in the importance of q as a determinant of internal capital allocations following the recapitalization.

We also investigate changes in q-sensitivity for subsamples classified by the ex ante coverage ratio. Firms with above-median ex ante coverage have a median q-sensitivity that is statistically indistinguishable from zero. The median q-sensitivity is also statistically indistinguishable from zero after the recapitalization for these firms. There is no evidence of a significant change in the sensitivity of investment to segment q for these firms.

In contrast to these results, firms with low ex ante coverage ratios display a pattern of declining q-sensitivity. For these firms, median q-sensitivity is estimated to be 0.002 and significantly positive at the 5% level prior to the recapitalization. Following the recapitalization, however, the median q-sensitivity is -0.0003, which is statistically significant at the 10% level. The decline in q-sensitivity is statistically significant at the 1% level.

To assess whether the decline in q-sensitivity is also pronounced in the subsample of firms that lower their outstanding debt, we partition the sample according to the change in leverage from year 0 to year 3. For firms whose decline in leverage exceeds the median decline, q-sensitivity is positive and statistically insignificant prior to the recapitalization, but is negative and statistically significant after. For this subsample, the decline in q-sensitivity is statistically significant at the 1% level. In comparison, for firms with below-median declines in leverage, median q-sensitivity is statistically insignificant both before and after the recapitalization and the change lacks statistical significance.

Overall, the univariate analysis of firm-level investment sensitivity corroborates the segment regression analysis of the firm's internal allocation of capital expenditures. Segment investment's sensitivity to q exhibits a significant decline following a leveraged recapitalization, and this decline is driven primarily by the

Table 5
Sensitivity of investment to q and cash flow

Investment sensitivity for sample of 22 multidivisional firms completing a leveraged recapitalization between 1982 and 1994. The sensitivity of investment to q is defined as

$$q\text{-sensitivity} = \frac{\sum_{j=1}^{n} \text{Sales}_j(q_j - \bar{q})[(\text{Capex Sales})_j - (\text{Firm Capex/Firm Sales})]}{\text{Firm Sales}},$$

and cash-flow sensitivity as

$$\text{cash flow sensitivity} = \frac{\sum_{j=1}^{n} \text{Sales}_j(\text{cf}_j - \overline{\text{cf}})[(\text{Capex/Sales})_j - (\text{Firm Capex/Firm Sales})]}{\text{Firm Sales}},$$

where q_j is the imputed Tobin's q of segment j, $\bar{q}$ is the sales-weighted q of the firm, cf_j is the cash flow to sales ratio for segment j, and $\overline{\text{cf}}$ is the sales-weighted cash flow to sales ratio for the firm. Capex is capital expenditures of the segment and firm capex is the capital expenditures of the firm. The table reports medians and means of average q-sensitivity and cash flow sensitivity before and after the recapitalization year. Ex ante coverage is the ratio of earnings before interest and taxes in year -1 to total leverage at year 0. A firm is classified as a high ex ante coverage firm if this ratio equals or exceeds the sample median in the year of the recapitalization. The change in leverage after the recapitalization is measured as the difference between the leverage at year 0 and year 3. High-leverage-decline firms have an above-median decline in leverage. The first line reports medians and the second line reports means. The last column reports the p-values of Wilcoxon tests for medians and t-tests for means for differences in variables from before to after the recapitalization.

	q-Sensitivity			Cash flow sensitivity		
	Before	After	p-Value	Before	After	p-Value
All firms	0.000002[a]	−0.00004[a]	0.04	0.000303	0.0001957	0.86
	0.004948	−0.000699	0.06	0.005780	0.0057582	0.99
High ex ante coverage firms	0.00000	0.00004	0.53	0.000173	0.0000378	0.54
	0.0070	0.00077	0.29	0.0076	0.00069	0.76
Low ex ante coverage firms	0.002[b]	−0.0003[a]	0.008	0.000343	0.00045[b]	0.09
	0.00287	−0.0019	0.05	0.0040	0.0092	0.08
Low leverage decline	0.00000	0.00005	0.52	0.00015[b]	0.000035	0.38
	0.00516	0.00019	0.33	0.0035	0.00037	0.16
High leverage decline	0.00077	−0.00025[b]	0.002	0.00050[b]	0.00056[b]	0.86
	0.0047	−0.00114	0.04	0.00854	0.0098	0.83

[a]Medians are significantly different from zero at the 10% level using a two-tailed signed-rank test.
[b]Medians are significantly different from zero at the 5% level using a two-tailed signed-rank test.

subsample of firms that face the greatest pressure to meet their interest obligations.

We also construct an analogous variable as a firm-level measure of the importance of segment cash flow in the internal allocation of investment. We refer to this measure as the cash flow sensitivity of investment and compute it as

$$\frac{\sum_{j=1}^{n} \text{Sales}_j(\text{cf}_j - \overline{\text{cf}})[(\text{Capex/Sales})_j - (\text{Firm Capex/Firm Sales})]}{\text{Firm Sales}},$$

where cf_j is the ratio of cash flow to sales of segment j and $\overline{\text{cf}}$ is the sales-weighted cash flow to sales ratio for the firm. Table 5 also summarizes the changes in cash flow sensitivity around the recapitalization. For the full sample, we do not find a statistically significant change in cash flow sensitivity around the recapitalization. However, for the subsample of firms with low ex ante interest coverage, cash flow sensitivity increases from 0.034% to 0.045% and the change is significant at the 10% level. There is also a modest increase in cash flow sensitivity from 0.05% to 0.056% around the recapitalization for firms with a high decline in leverage, but this change lacks statistical significance. Thus, firm-level measures of cash flow sensitivity also suggest that firms facing high pressure to meet interest obligations are likely to be responsible for the increased importance of cash flow in the internal investment allocation process.

3.4. Additional evidence

The statistical evidence presented above supports the idea that firms pay considerable attention to each segment's cash flow in determining their allocation of investment expenditures. To ensure that this finding is not a statistical artifact, we examine companies' annual reports and press coverage immediately following the recapitalization. It is clear from studying these documents that firms pay considerable attention to cash flow following the recapitalization. Almost all the firms in the sample describe measures such as asset sales and reduction in capital expenditures designed to improve cash flow. Several sample firms note that the generation of cash flow is a key strategic objective of the firm following the recapitalization. For example, USG notes that it "adopted an aggressive cash flow management policy" (1988 Annual Report, p. 6), Interlake says that it has a "highly cash conscious strategy" (1989 Annual Report, p. 2), and Owens Corning notes that a key goal is to "maximize cash flow for continued debt reduction" (1989 Annual Report, p. 3).

An investment policy that seeks to maximize the present value of all cash flows from investments should be value maximizing. However, in some cases, the articles specifically note that the objective is to maximize short-term cash flows. For example, USG adopted programs to generate cash flows "that were deemed achievable in the near term" (1989 Annual Report, p. 4). Phillips Petroleum describes that its "best strategy … is to concentrate on development

of existing oil and gas discoveries that can contribute most quickly to an improvement in earnings" (1987 Annual Report, p. 4). One analyst specifically critiques this aspect of Phillip's investment strategy by observing, "I don't see the company doing very much with respect to the kind of investment you have to do to grow and expand five to ten years from now" (PR Newswire, 4/29/86). Similarly, Texaco also notes that "operations like exploration were refocused on lower-risk prospects with modest, but quick, paybacks" (New York Times, 12/24/89, p. 4).

Although most of the press coverage is about the firm's overall investment policy, some articles describe the firm's divisional investment policy. Union Carbide distinctly notes that its segments become more dependent on their own cash flow. For example, the CEO observes, "Our three core businesses are quite independent. We want to give them the freedom, flexibility, and accountability to manage and live within their own cash flow on a global basis" (1988 Annual Report, p. 8). Goodyear Tire and Rubber points out that "Our plans for business segments include special emphasis on cash flow" (1987 Annual Report, p. 3), and General Signal describes that "In striving for Class 1 (goals), we continually evaluate our business units on their cash flow" (1990 Annual Report, p. 3).

As discussed earlier, maximizing cash flow has the potential to be either beneficial or detrimental to firm value. In the case of Goodyear Tire and Rubber, chairman Robert E. Mercer argues that the company was forced to delay construction of new tire factories that would have helped the company be a more effective player in the highly competitive world tire market because the money had to be diverted to repay debt (New York Times, 10/30/88, p. 1). According to this view, the emphasis on generating cash flow sufficient to meet interest payments caused Goodyear to forgo certain valuable investment opportunities. Although this argument suggests that the emphasis on segment cash flow might be detrimental for internal investment allocation, this evidence is not conclusive. Therefore, we proceed to an analysis of the effects of divisional investment policy on firm value for recapitalizing firms.

4. Investment sensitivity and excess value

Prior studies such as Gupta and Rosenthal (1991), Denis and Denis (1993), and Wruck (1994) document positive announcement abnormal returns for recapitalizations, indicating that these events are associated with significant improvements in firm value. In this section, we explore how the changes in internal capital allocation around the recapitalization affect firm value.

4.1. Excess value around recapitalizations

We use methodologies similar to Lang and Stulz (1994) and Berger and Ofek (1995) to estimate the difference between the market value of the multisegment

firm and the value the firm would have if all its segments were priced as stand-alone firms. Lang and Stulz compute the excess value as the difference between the Tobin's q of the diversified firm and a weighted-average of imputed segment q's. We follow this approach to compare the firm's Tobin's q to the sum of segment-sales-weighted imputed q's. The natural log of the ratio of the firm's q to its imputed q is a measure of excess firm value.

We also compute Berger and Ofek's excess value measure using a sales multiplier as follows:

$$\text{Excessvalue} = \log\left(\frac{V}{I(V)}\right),\ I(V) = \sum_{i=1}^{n} \text{Sales}_i[M_i(V/\text{Sales})_{\text{MS}}],$$

where V is the sum of market value of equity and book value of assets less the book value of equity and deferred taxes, $I(V)$ is the imputed firm value, Sales_i is the segment i's sales, $M_i(V/\text{Sales})_{\text{MS}}$ is the sales multiplier (calculated as the median of the single-segment firms in the same three-digit SIC code industry), and n is the number of segments per firm.

Table 6 reports the median of the average excess value for the three years before the recapitalization and the three years after the recapitalization from the two approaches. Both approaches display a highly significant increase in the

Table 6
Excess value

Excess firm value before and after a leveraged recapitalization. The sample consists of 22 multidivisional firms that complete a leveraged recapitalization between 1982 and 1994. The Lang and Stulz (1994) excess value measure is

$$\log\left(\frac{Q}{I(Q)}\right), \quad \text{where } I(Q) = \sum_{i=1}^{n} \frac{\text{Sales}_i}{\text{Firm Sales}} q_{i,\text{IMPUTED}},$$

and $q_{i,\text{ imputed}}$ is the median q of single-segment firms in the same three-digit SIC code as the segment of the diversified firm. The Berger and Ofek (1995) excess value measure is

$$\log\left(\frac{V}{I(V)}\right), \quad \text{where } I(V) = \sum_{i=1}^{n} \text{Sales}_i[M_i(V/\text{Sales})_{\text{MS}}],$$

where V is the market value of the firm (market value of equity plus book value of assets minus book value of equity minus deferred taxes), $I(V)$ is the imputed V, Sales_i is segment i's sales, $M_i(V/\text{Sales})_{\text{MS}}$ is the sales multiplier calculated as the median of single-segment firms in the same three-digit SIC code, and n is the number of segments. The last column reports p-values for difference in excess value from before to after the recapitalization using a Wilcoxon signed-rank test.

Excess value	Before	After	p-Value
Lang and Stulz excess value	-0.224[a]	0.05	0.04
Berger and Ofek excess value	-0.262[a]	-0.008	0.04
Number of firms	22	20	

[a]Medians are significantly different from zero at the 5% level using a two-tailed signed-rank test.

excess value for recapitalizing firms. According to the Lang and Stulz measure, the median excess value is a significant −22.4% before the recapitalization and 5% afterwards. The difference in excess values is statistically significant, indicating that the market reassesses the value of the diversified firms favorably after the recapitalization. Inspection of the Berger and Ofek measure shows that the median excess value is −26.2% prior to the recapitalization. After the recapitalization, however, multisegment firms have a median discount of −0.8%, which is not significantly different from zero.

In summary, both the Lang and Stulz (1994) and the Berger and Ofek (1995) measures of excess value indicate that the multidivisional firms are valued at a discount prior to the recapitalization event, and that this discount essentially disappears following the recapitalization. Overall, the recapitalizations are a value-enhancing event for our sample firms, similar to the pattern documented by earlier studies.

4.2. Multivariate analysis of excess value and investment sensitivity

The optimal investment policy dictates that segments with a higher marginal expected return from investment receive greater funding than segments in which the marginal return from investment is lower. Our analysis to this point assumes that the imputed q of a segment is a reasonable measure of the segment's marginal q ratio. Under this interpretation, a decline in the coefficient on imputed q following a recapitalization suggests a deterioration of the functioning of internal capital markets.

Given that marginal q is unobservable, however, it is possible that a segment's own cash flow is more highly correlated with its marginal q than is its imputed average q. If a segment's cash flow is more informative about its marginal q, the increased importance of cash flow following the recapitalization should be interpreted as evidence of an improvement in the allocation of investment across segments.

To understand whether the observed changes in investment allocation improve or hurt firm value, we study the relation between excess firm value and investment sensitivity. If a segment's imputed average q is a reasonable proxy for its marginal q, we expect that firms with greater q-sensitivity should be valued more highly by investors. According to this interpretation, therefore, we expect a positive relation between q-sensitivity and excess value.

We estimate firm-fixed-effects regressions using excess value as the dependent variable and q-sensitivity as an explanatory variable. The results, estimated using the three years of data before and after the recapitalization, are reported in Table 7. Columns 1 and 2 report regression estimates using the Lang and Stulz (1994) methodology to compute excess value. As explanatory variables, we use the firm's leverage and an indicator equal to one if the observation is after the recapitalization. We also include the firm's q-sensitivity and, for interpretational

Table 7
Regression analysis of excess value

Firm fixed-effects regressions. The sample consists of 22 multidivisional firms that complete a leveraged recapitalization between 1982 and 1994. The dependent variable in Columns 1 and 2 is excess value computed according to Lang and Stulz (1994). Columns 3 and 4 use the Berger and Ofek (1995) excess value measure as the dependent variable, as defined in Table 6. q-Sensitivity equals

$$\frac{\sum_{j=1}^{n} \text{Sales}_j(q_j - \bar{q})[(\text{Capex/Sales})_j - (\text{Firm Capex/Firm Sales})]}{\text{Firm Sales}},$$

where q_j is the imputed Tobin's q of segment j and $\bar{q}$ is the sales-weighted q of the firm. Cash flow sensitivity is

$$\frac{\sum_{j=1}^{n} \text{Sales}_j(\text{cf}_j - \overline{\text{cf}})[(\text{Capex/Sales})_j - (\text{Firm Capex/Firm Sales})]}{\text{Firm Sales}},$$

where cf_j is the ratio of capital expenditures to sales of segment j and $\overline{\text{cf}}$ is the sales-weighted ratio of cash flow to sales for the firm. AFTER is a dummy variable that equals one if the observation is in the three years after the recapitalization, BEFORE is a dummy variable that equals one if the observation is in the three years before the recapitalization, and leverage is total debt to assets. Columns 2, 4, 6, and 8 also control for industry effects at the one-digit SIC code level (these coefficients are not reported). The first line reports coefficient estimates and the corresponding p-values are reported on the second line.

	Dependent variable: Lang and Stulz excess value		Dependent variable: Berger and Ofek excess v(alue		Dependent variable: Lang and Stulz excess value		Dependent variable: Berger and Ofek excess value	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AFTER (indicator variable)	0.26	0.27	0.31	0.32	0.28	0.28	0.34	0.34
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Leverage	0.15	0.17	0.32	0.38	0.14	0.16	0.335	0.38
	0.13	0.07	0.032	0.013	0.12	0.09	0.018	0.01

BEFORE × q-sensitivity	3.65	3.29	0.65	− 0.28				
	0.027	0.04	0.80	0.92				
AFTER × q-sensitivity	9.89	7.86	3.82	2.78				
	0.07	0.08	0.69	0.78				
log(assets) t − 1		− 0.27		0.28		− 0.26		0.32
		0.014		0.11		0.019		0.059
Firm capital expenditures/firm sales		0.99		3.33		0.79		2.42
		0.46		0.13		0.57		0.26
Net income/firm sales		0.17		0.001		0.11		− 0.013
		0.38		0.99		0.55		0.96
BEFORE × cash flow sensitivity					− 1.41	− 1.49	− 8.20	− 9.05
					0.54	0.51	0.020	0.012
AFTER × cash flow sensitivity					− 8.13	− 6.29	− 13.88	− 12.91
					0.003	0.03	0.001	0.004
Number of observations	122	122	122	122	122	122	122	122
R^2	0.18	0.15	0.13	0.07	0.26	0.18	0.15	0.12

convenience, interact this variable with indicators denoting whether the observation is prior to or subsequent to the recapitalization.

The point estimates in Column 1 show a substantial increase in excess value subsequent to a recapitalization. Importantly, q-sensitivity has a positive and statistically significant effect on excess value, both before and after the recapitalization. This positive relation between excess value and q-sensitivity indicates that investors place a higher valuation on firms in which the segment investment is more sensitive to q. Although the point estimate on q-sensitivity is larger following the recapitalization, an F-test does not reject equality of coefficients on q-sensitivity before and after the recapitalization. In addition, leverage is estimated to have a positive coefficient, although it is statistically insignificant.

Column 2 augments the analysis by including the log of firm size, capital expenditures, and profitability as additional explanatory variables. These measures are employed by Berger and Ofek (1995) in their analysis of excess value and are intended to control for the influence of firm size, profitability, and growth opportunities. Column 2 also controls for industry effects at the one-digit SIC code level; however, to conserve space these coefficients are not reported. These additional variables display little statistical significance. The coefficient on leverage, however, is positive and significant at the 7% level. These results suggest that the decline in q-sensitivity after the recapitalization is detrimental to firm value.

Columns 3 and 4 repeat the analysis using Berger and Ofek's (1995) definition of excess value. Consistent with the previous results, these estimates also reveal a large improvement in excess value following the recapitalization. Leverage is also estimated to be positively and significantly related to excess value in these models. According to our estimates, an increase in leverage of ten percentage points is associated with an average increase in excess value of three percentage points, which is around one-fourth of the average diversification discount estimated by Berger and Ofek (1995). However, unlike the models employing the Lang and Stulz (1994) methodology, these models do not display a significant relation between excess value and q-sensitivity. It appears that the positive relation between excess value and q-sensitivity is sensitive to the methodology used to compute excess value.

We also examine the extent to which cash flow sensitivity is related to excess value. If a segment's cash flow provides an informative measure of its marginal q, cash flow sensitivity should be positively related to excess firm value. If, however, increased sensitivity of segment investment to segment cash flow is symptomatic of investment distortions, we expect cash flow sensitivity to be negatively related to firm value.

Columns 5–8 duplicate the preceding analysis using cash flow sensitivity instead of q-sensitivity as an explanatory variable. We find no evidence that increased cash flow sensitivity is associated with greater excess value. If any-

thing, the results suggest that a greater emphasis on segment cash flow in the allocation of investment is detrimental to firm value. Cash flow sensitivity is negatively related to Berger and Ofek excess value measures both before and after the recapitalization and is also negatively related to Lang and Stulz excess value measures following the recapitalization. An alternative interpretation is that highly valued firms do not need to allocate investment to segments with high cash flow. Under either interpretation, the results do not support the view that the increased importance of cash flow following a recapitalization can be interpreted as an improvement in the efficiency of internal investment allocation.

The increase in firm value surrounding the recapitalization and the concurrent distortion in internal investment allocation suggest that the costs of a distorted internal investment policy are outweighed by other benefits associated with a leveraged recapitalization. Therefore, other factors related to high leverage, such as tax savings, reduced managerial discretion over investment, operating improvements, or the payout of free cash flow, appear to dominate the costs of the deterioration in internal capital markets. For example, Kaplan (1989) investigates sources of gains in management buyouts and finds tax savings to be a first-order determinant of shareholder gains in such transactions. His estimates suggest that 21–143% of the premium can be attributed to tax savings. Since both management buyouts and leveraged recapitalizations dramatically increase leverage, it is likely that tax savings are an important factor contributing to the gains in recapitalizations.[6] Consistent with this view, Berger and Ofek (1993) show that in a cross-sectional analysis, firms that pay higher taxes exhibit lower excess value. Similarly, the evidence in Handa and Radhakrishnan (1991) suggests that shareholder gains in leveraged recapitalizations are related to the amount of cash paid out to shareholders.

If q-sensitivity is positively related to excess value, a natural question is whether the decline in this sensitivity affects the gains to investors from leveraged recapitalizations. In Table 8, we estimate regressions using the change in average excess value from the three years before to the three years after the recapitalization as the dependent variable and the change in q-sensitivity as an explanatory variable. We obtain similar results if we compute the change in excess value as the difference in excess value between year $+1$ and year -1 relative to the recapitalization. In addition, we examine whether these results are sensitive to the inclusion of firms that subsequently become financially distressed, but do not detect meaningful differences.

[6] A back of the envelope calculation suggests that non-tax factors are important in explaining the increase in excess value for our sample firms. We compute an upper bound on the importance of taxes under the assumption that all firms use the full tax savings of the increase in leverage forever, and that the marginal tax rate is 30%. Under these assumptions, the interest tax shield accounts for 50% of the change in excess value around the recapitalization.

Table 8
Changes in excess value

Regressions of changes in excess value on changes in q-sensitivity and cash flow sensitivity. Changes in variables are computed as the difference between the mean of the variable before and the mean of the variable after the recapitalization. The sample consists of 22 multidivisional firms that undergo a leveraged recapitalization between 1982 and 1994. In Columns 1–3, the dependent variable is excess value, computed according to the Lang and Stulz (1994) methodology. In Columns 4–6, the dependent variable is excess value computed according to the Berger and Ofek (1995) methodology, as defined in Table 6. q-Sensitivity is defined as

$$\frac{\sum_{j=1}^{n} \text{Sales}_j(q_j - \bar{q})[(\text{Capex/Sales})_j - (\text{Firm Capex/Firm Sales})]}{\text{Firm Sales}},$$

where q_j is the imputed Tobin's q of segment j and $\bar{q}$ is the sales-weighted q of the firm. Cash flow sensitivity is

$$\frac{\sum_{j=1}^{n} \text{Sales}_j(\text{cf}_j - \overline{\text{cf}})[(\text{Capex/Sales})_j - (\text{Firm Capex})/\text{Firm Sales}]}{\text{Firm Sales}},$$

where cf_j is the ratio of capital expenditures to sales of segment j and $\overline{\text{cf}}$ is the sales-weighted ratio of cash flow to sales for the firm. We report coefficients on the first line and the corresponding p-values, adjusted for heteroskedasticity, on the second line.

	Dependent variable: change in Lang and Stulz excess value			Dependent variable: change in Berger and Ofek excess value		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.27	0.24	0.27	0.31	0.31	0.32
	0.02	0.03	0.02	0.08	0.08	0.09
Change in q-sensitivity	12.28		12.17	2.97		2.62
	0.01		0.001	0.18		0.08
Change in cash flow sensitivity		− 4.64	− 4.41		− 13.73	− 13.68
		0.52	0.000		0.008	0.001
Change in leverage	0.15	0.14	0.16	0.33	0.35	0.35
	0.45	0.51	0.44	0.32	0.29	0.30
Number of observations	20	20	20	20	20	20
R^2	0.22	0.06	0.25	0.05	0.15	0.16

As shown in Column 1, changes in q-sensitivity are positively related to changes in the Lang and Stulz excess value measure, but are not significantly related to the Berger and Ofek excess value measure in Column 4. We also explore whether changes in the sensitivity of segment investment to segment

cash flow affect changes in excess value by including the measure of cash flow sensitivity of investment. The change in cash flow sensitivity is negatively related to Berger and Ofek excess value measures, and is negatively related to both measures of excess value when the change in q-sensitivity is controlled for. In Column 6, where changes in both q-sensitivity and cash flow sensitivity are included, changes in q-sensitivity are also positively related to changes in the Berger and Ofek excess value measure. These results suggest that the increase in excess value surrounding a recapitalization is greater for firms in which the distortion in the allocation of divisional investment is less pronounced.

To understand the economic importance of these effects, we evaluate the estimated coefficients in Columns 3 and 6 of Table 8. The average change in q-sensitivity from the three years prior to the recapitalization to three years after is -0.005647 and the average change in cash flow sensitivity is -0.000024. Thus, Column 3 implies that, on average, changes in internal investment allocation lower firm value by 6.8% $((-0.00567 \times 12.17) + (-0.0000218 \times -4.41) = -0.0687)$. Since the median change in excess value according to the Lang and Stulz (1994) measure is 27.4%, these estimates imply that improvement in excess value would be 25% higher in the absence of changes in internal investment policy. The effects of investment changes are larger for subsamples in which the pressure to meet interest payments is higher. For the sample of low ex ante coverage firms, the change in Lang and Stulz excess value is estimated to be 30% higher in the absence of changes in internal investment allocation. This suggests that at least for the subsamples in which the changes in investment policy are pronounced, the economic magnitude of the costs of such changes are nontrivial.

Although this discussion suggests that changes in the working of internal capital markets have an economically large effect on changes in excess firm value, two caveats are in order. First, the economic magnitude of the effect of investment policy on excess value is sensitive to the technique used to compute excess value. For all sample firms, the average change in the Berger and Ofek (1995) excess value would be only 5.7% higher in the absence of internal investment changes. Nonetheless, the Berger and Ofek excess value methodology also suggests a meaningful effect on firm value for the subsample of firms with low ex ante coverage. For these firms, excess value is estimated to be 33% higher in the absence of changes in investment allocation. Thus, for the subsample in which debt obligations are most likely to pose a binding constraint, the effect of leverage on internal capital markets appears to be economically meaningful.

The second caveat relates to the precision of the estimates presented in Table 8. The regression estimates require evaluating coefficients at the mean, but the use of median changes in q and cash flow sensitivity result in much smaller estimates of the economic effect. In addition, the limited sample size in this paper

is likely to lead to relatively imprecise point estimates in the regressions. Thus, we advocate caution in interpreting the magnitude of the economic effects.

5. Conclusion

We study how leverage influences the allocation of resources across divisions of diversified firms. Our analysis focuses on a sample of diversified firms that undergo a leveraged recapitalization during 1982–1994. These recapitalizations are accompanied by a large discrete change in leverage, and typically occur in response to an external takeover or control threat. We study how firms allocate resources across divisions by investigating the determinants of divisional capital expenditures three years before and three years after the leveraged recapitalization.

We find that prior to the recapitalization, segment capital expenditures are positively related to imputed q, the segment's cash flow, and the cash flow of the firm's other segments. These findings are consistent with prior evidence on segment expenditures documented in studies using more representative samples of diversified firms. The allocation of capital expenditures appears to change significantly following a recapitalization. After the event, we find that capital expenditures are less likely to be directed to segments with favorable investment opportunities, and are more likely to be directed to segments with high cash flow. Analysis of the q-sensitivity of segment investment at the firm level confirms this pattern. Whereas sensitivity of investment to q is estimated to be significantly positive prior to the recapitalization for our sample firms, it is estimated to be negative following the event.

The decline in the sensitivity of investment to q for our sample is driven by firms that face the greatest pressure to meet interest payments on outstanding debt. For firms in which this pressure is high, the change in investment allocation appears to be most pronounced. In contrast, we find little evidence of similar changes for firms that face below-median pressure to service interest payments. If high debt levels impose substantial costs by distorting firms' divisional investment policies, we would expect firms to undertake reductions in leverage when this cost is high. Consistent with this view, we document that the distortions in divisional investment policies are the most severe for firms that undergo large reductions of the debt incurred during the recapitalization.

These results suggest that high leverage has the potential to distort a firm's internal investment policy. This evidence, however, comes from a sample of firms that choose to undergo a dramatic increase in leverage. Since firms have self-selected into the sample, it is possible that the indirect costs of high leverage are less important in our sample firms. Whether our results generalize to broader samples of firms is an open issue. By focusing on recapitalizing firms that exhibit a large and discrete increase in leverage, our approach is

a potentially more powerful test of the effect of leverage on internal capital markets than an analysis of a large cross-section of firms. Prior research also shows that recapitalizing firms tend to overinvest in the years prior to the recapitalization. For this sample, the benefits of reduced overall firm investment might outweigh the costs of an altered divisional investment policy. It is possible, therefore, that the net effect of the changes in investment policy that we document might be negative for a sample of firms not characterized by systematic overinvestment.

Our sample also contains a much larger fraction of firms that witness an extreme change in leverage than would be observed in a broader sample. Since extreme leverage changes appear to drive most of the results we document, such patterns might be less observable in broader samples in which similarly large shifts in leverage would be less common. In addition, since most of the events in our sample appear to occur at least partially in response to an external control threat, it is possible that some of our sample firms overlevered in an attempt to diffuse the takeover threat. The adjustment of debt levels subsequent to the recapitalization could be construed as evidence of such an overleveraging. If this is indeed the case, it creates the further likelihood that this setting permits a more powerful test of the costs of high leverage than samples in which firms are likely to have chosen an optimal capital structure that minimizes such costs. Nonetheless, examining the extent to which such costs prevail in broader samples appears to represent a useful endeavor for future work.

Prior empirical research on leverage shows that leverage can constrain investment (Lang et al., 1996; Denis and Denis, 1993). In addition, leverage has been shown to be associated with significant improvements in firm-level operating performance (Kaplan, 1989; Denis and Denis, 1993). Our result that the overall effect of leverage recapitalizations is to improve firm value supports the prior literature. Consistent with earlier literature, we also find a significant reduction in overall investment expenses. Since recapitalizing firms have been documented to exhibit non-value-maximizing investment patterns prior to the recapitalization (Denis and Denis, 1993), the reduction in firm-level investment expenditures is likely to represent a value-enhancing change.

However, our evidence also points to a straightforward indirect cost of financial leverage that has received relatively little attention in the literature. High leverage generates interest payments that can be high relative to current levels of cash flow. When managers face substantial personal costs of financial distress, this can create incentives to emphasize investments that maximize the cash flow of the firm, possibly at the expense of undertaking investments with the highest net present value. Our results show that this effect of high leverage is likely to influence the divisional allocation of investment within a firm. Our estimates suggest that the increase in firm value around the recapitalization would be larger in the absence of such changes in divisional allocation. In this regard, our paper adds to a wide literature emphasizing the indirect costs of debt financing.

References

Berger, P.G., Ofek, E., 1993. Leverage and value: the role of agency costs and taxes. Unpublished Working Paper, New York University.

Berger, P.G., Ofek, E., 1995. Diversification's effect on firm value. Journal of Financial Economics 37, 39–65.

Chevalier, J., 2000, What do we know about cross-subsidization? Evidence from the investment policies of merging firms. Unpublished Working Paper, University of Chicago.

Denis, D.J., 1994. Organizational form and the consequences of highly leveraged transactions: Kroger's recapitalization and Safeway's LBO. Journal of Financial Economics 36, 193–224.

Denis, D.J., Denis, D.K., 1993. Managerial discretion, organizational structure, and corporate performance. A study of leveraged recapitalizations. Journal of Accounting and Economics 16, 209–236.

Denis, D.J., Denis, D.K., 1995. Causes of financial distress following leveraged recapitalizations. Journal of Financial Economics 37, 129–157.

Denis, D.J., Thothadri, B., 1999. Internal capital markets, growth opportunities, and the valuation effects of corporate diversification. Unpublished Working Paper, Purdue University.

Dittmar, A., Shivdasani, A., 2000. Divestitures and internal capital markets. Unpublished Working Paper, University of North Carolina.

Gertner, R., Powers, E., Scharfstein, D., 1999. Learning about internal capital markets from corporate spinoffs, Unpublished working paper. Massachusetts Institute of Technology.

Gilson, S., 1989. Management turnover and financial distress. Journal of Financial Economics 25, 241–262.

Gupta, A., Rosenthal, L., 1991. Ownership structure, leverage, and firm value: the case of leveraged recapitalizations. Financial Management 20, 69–83.

Handa, P., Radhakrishnan, A.R., 1991. An empirical investigation of leveraged recapitalizations with cash payout as takeover defense. Financial Management 20, 58–68.

Harris, M., Raviv, A., 1990. Capital structure and the informational role of debt. Journal of Finance 45, 321–349.

Kaplan, S.N., 1989. The effects of management buyouts on operating performance and value. Journal of Financial Economics 24, 217–254.

Kaplan, S.N., Zingales, L., 1997. Do investment-cash flow sensitivities provide useful measures of financing constraints? Quarterly Journal of Economics 112, 169–215.

Jensen, M.C., 1986. Agency costs of free cash flow, corporate finance and takeovers. American Economic Review 76, 323–329.

Jensen, M.C., 1989. Eclipse of the public corporation. Harvard Business Review 67, 61–74.

Jensen, M.C., Meckling, W.H., 1976. Theory of the firm: managerial behavior, agency costs, and capital structure. Journal of Financial Economics 3, 305–360.

Lamont, O., 1997. Cash flow and investment: evidence from internal capital markets. Journal of Finance 52, 83–109.

Lang, L.H.P., Ofek, E., Stulz, R.M., 1996. Leverage, investment, and firm growth. Journal of Financial Economics 40, 3–29.

Lang, L.H.P., Stulz, R.M., 1994. Tobin's q, corporate diversification, and firm performance. Journal of Political Economy 102, 1248–1280.

McConnell, J.J., Servaes, H., 1995. Equity ownership and the two faces of debt. Journal of Financial Economics 39, 131–157.

Myers, S., 1977. The determinants of corporate borrowing. Journal of Financial Economics 5, 147–175.

Palepu, K.G., Wruck, K.H., 1992. Consequences of leveraged shareholder payouts: defensive versus voluntary recapitalizations. Unpublished Working Paper, Harvard University.

Rajan, R., Servaes, H., Zingales, L., 2000. The cost of diversity: the diversification discount and inefficient investment. Journal of Finance 55, 35–80.

Scharfstein, D.S., 1998. The dark side of internal capital markets II: evidence from diversified conglomerates. NBER working paper No. 6352.

Scharfstein, D.S., Stein, J.C., 2000. The dark side of internal capital markets: divisional rent-seeking and inefficient investment. Journal of Finance 55, 2537–2564.

Schlingemann, F.P., Stulz, R.M., Walkling, R.A., 1999. Corporate focusing and internal capital markets. Unpublished Working Paper, Ohio State University.

Shin, H., Stulz, R.M., 1998. Are internal capital markets efficient? The Quarterly Journal of Economics 113, 531–552.

Whited, T., 1992. Debt, liquidity constraints, and corporate investment: evidence from panel data. Journal of Finance 47, 1425–1461.

Wruck, K.H., 1994. Financial policy, internal control, and performance: Sealed Air Corporation's leveraged special dividend. Journal of Financial Economics 36, 157–192.