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Diversification's effect on firm value

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Abstract

We estimate diversification's effect on firm value by imputing stand-alone values for individual business segments. Comparing the sum of these stand-alone values to the firm's actual value implies a 13% to 15% average value loss from diversification during 1986–1991. The value loss is smaller when the segments of the diversified firm are in the same two-digit SIC code. We find that overinvestment and cross-subsidization contribute to the value loss. The loss is reduced modestly by tax benefits of diversification.

Key words: Diversification; Focus; Overinvestment; Cross-subsidization; Organizational structure

JEL classification: G32; G34

1. Introduction

During the 1950s and '60s many corporations undertook massive diversification programs. This process reached its climax with the merger wave of the late 1960s and the accompanying rise to prominence of huge conglomerate firms. In the last 15 years the trend has reversed, with recent studies by Comment and

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Jarrell (1994) and Liebeskind and Opler (1993) documenting a return to specialization. This push toward focus apparently resulted from the view that unrelated diversification decreases firm value.

Theoretical arguments suggest that diversification has both value-enhancing and value-reducing effects. The potential benefits of operating different lines of business within one firm include greater operating efficiency, less incentive to forego positive net present value projects, greater debt capacity, and lower taxes. The potential costs of diversification include the use of increased discretionary resources to undertake value-decreasing investments, cross-subsidies that allow poor segments to drain resources from better-performing segments, and misalignment of incentives between central and divisional managers. There is no clear prediction about the overall value effect of diversification.

We use segment-level data to estimate the valuation effect of diversification and to examine the potential sources of value gains or losses. We compare the sum of the imputed stand-alone values of the segments of diversified companies to the actual values of those companies. We document that diversified firms have values that average, during 1986–91, 13% to 15% below the sum of the imputed values of their segments. The loss in value is, however, considerably less for related diversifications. We identify overinvestment in segments from industries with limited investment opportunities, as measured by a low Tobin's *q-ratio*, as one source of the value loss. An additional source of loss in value is cross-subsidization of poorly performing divisions by better-performing divisions. The value loss is reduced by a modest decrease in taxes.

Section 2 reviews the related literature and details the predictions resulting from prior theoretical work. Section 3 describes the sample and explains our empirical approach. Section 4 assesses the overall value effect of diversification using imputed segment values and a comparison of profitability between diversified and single-segment firms. Section 5 explores the individual sources of value loss and gain, and Section 6 concludes. The appendix provides additional details on our empirical approach and variable construction.

2. Hypotheses

Consistent with observed trends in diversification activity, theoretical arguments developed during the late 1960s and early '70s generally address the benefits of diversification, whereas more recent papers address the costs. Chandler (1977) argues that, because multidivision firms create a level of management concerned with coordination of specialized divisions, they are inherently more efficient and thus more profitable than their lines of business would be separately. Weston (1970) states that resource allocation is more efficient in internal than in external capital markets. He therefore contends that diversified firms allocate resources more efficiently because they create a larger

internal capital market. A version of this argument raised by Stulz (1990) is that diversified firms, by creating a larger internal capital market, reduce the underinvestment problem described by Myers (1977). These internal capital market arguments predict that diversified companies make more positive net present value investments than their segments would make as separate firms.

Another potential benefit of diversification arises from combining businesses with imperfectly correlated earnings streams. This coinsurance effect gives diversified firms greater debt capacity than single-line businesses of similar size (Lewellen, 1971). One way in which increased debt capacity creates value is by increasing interest tax shields. Thus, diversified firms are predicted to have higher leverage and lower tax payments than their businesses would show if operated separately. A further tax advantage arises from the tax code's asymmetric treatment of gains and losses. Majd and Myers (1987) note that undiversified firms are at a significant tax disadvantage because tax is paid to the government when income is positive, but the government does not pay the firm when income is negative. This disadvantage is reduced, but not eliminated, by the tax code's carryback and carryforward provisions. The Majd and Myers analysis predicts that, as long as one or more segments of a conglomerate experience losses in some years, a conglomerate pays less in taxes than its segments would pay separately.

Diversification can create several costs. Stultz (1990) argues that diversified firms will invest too much in lines of business with poor investment opportunities. Jensen's (1986) assertion that managers of firms with unused borrowing power and large free cash flows are more likely to undertake value-decreasing investments has a similar implication. To the extent that lines of business have access to more free cash flow as part of a diversified firm than on their own, Jensen's argument predicts that diversified firms invest more in negative net present value projects than their segments would if operated independently. Meyer, Milgrom, and Roberts (1992) make a related argument regarding the cross-subsidization of failing business segments. Since a failing business cannot have a value below zero if operated on its own, but can have a negative value if it is part of a conglomerate that provides cross-subsidies, Meyer, Milgrom, and Roberts predict that unprofitable lines of business create greater value losses in conglomerates than they would as stand-alone firms. For example, when Michael Walsh was preparing to take over as CEO of Tenneco, he discovered that 'Tenneco's profitable auto-parts and chemicals divisions didn't strive as hard as they might for higher earnings because their surplus was routinely dumped into the company's money-losing farm-equipment operation' (*Wall Street Journal*, March 29, 1993). Finally, Myerson (1982) and Harris, Kriebel, and Raviv (1982) discuss the information asymmetry costs that arise between central management and divisional managers in decentralized firms. These costs are higher in conglomerates than in focused firms to the extent information is

more dispersed within the firm, leading to the prediction that diversified firms are less profitable than their lines of business would be separately.

The theoretical arguments discussed above do not distinguish between related and unrelated diversification. Many authors argue, however, that related diversified firms perform better than conglomerates. Rumelt (1974) argues that related diversification affects value more positively than unrelated diversification because skills and resources can be used in related markets. Others discuss the effects of reputation and economies of scope, which arise when the joint cost of producing two or more outputs is less than the sum of the costs of producing each output by itself. Nayyar (1993), for example, argues that benefits from a positive reputation in an existing business and from economies of scope are available from related, but not from unrelated, diversification. The resulting prediction is that the valuation effect of diversification is more positive for related than unrelated lines of business.

Empirical studies have generally produced mixed results on diversification's overall value effect.¹ Copeland and Weston (1979) cite several studies that find superior stock price performance by conglomerates over mutual funds in the 1960s and early '70s. Other studies, however, find inferior performance during this period. Ravenscraft and Scherer (1987) argue that the performance of a sample of conglomerates becomes noticeably worse if the 1970s are included. De (1992), however, finds no cross-sectional correlation between the degree of focus and measures of excess return calculated over the period 1976–85.

Other studies addressing the effect of focus on performance also produce mixed results. Chatterjee and Wernerfelt (1991) review the literature measuring performance with accounting numbers and find that no consensus emerges. Event studies generally attribute a comparative penalty to diversification, especially in the 1980s, although its magnitude is rarely statistically significant. While these event studies examine the buyers of related and unrelated firms, John and Ofek (1994) find that increased focus is a significant determinant of seller gains from asset sales.

Two recent studies provide evidence of a negative relation between diversification and value. Comment and Jarrell (1994) find a negative relation during 1978–89 between abnormal stock returns and several measures of diversification, including the number of segments reported by management and revenue- and asset-based Herfindahl indexes. Similarly, Lang and Stulz (1994) present evidence of a negative relation between Tobin's *q*-ratio and these diversification measures. Neither study examines the potential sources of these value losses.

¹Many of these studies are discussed by Comment and Jarrell (1994), and we draw heavily on their review.

3. Sample selection and estimation of segment values

3.1. Sample selection and description

FASB No. 14 and SEC Regulation S-K require firms to report segment information for fiscal years ending after December 15, 1977. Firms must report audited footnote information for segments whose sales, assets, or profits exceed 10% of consolidated totals. The Compustat Industry Segment (CIS) database reports segment information for all active Compustat firms other than utility subsidiaries. For approximately 6,500 firms per year, the file contains information on five variables by segment [net sales, earnings before interest and taxes (EBIT), depreciation, capital expenditures, and assets] as well as the number of reported segments for the firm.

We obtain data for all firms on the CIS tape during the 1986–91 period that have total sales of at least \$20 million and have no segments in the financial services industry (SIC codes between 6000 and 6999). To avoid distorted valuation multiples for firms with sales or assets near zero, we require firms to have sales of at least \$20 million. Firms with financial services segments are removed from consideration because applying the valuation methods we use is problematic for such firms. Specifically, many firms in the financial services industry do not have information available on earnings before interest and taxes (EBIT), because such earnings are not meaningful for financial companies. To be included in the final sample, diversified corporations must have data on both the CIS and Compustat data files. Additionally, total capital (measured as market value of common equity plus book value of debt) for the firm must be available. Unlike assets and earnings, sales are usually completely allocated among the reported segments of a diversified firm; therefore, we require that the sum of segment sales must be within 1% of total sales for the firm. These procedures result in a sample of 3,659 firms with 16,181 observations, of which 5,233 are multi-segment. Of the multi-segment observations, 2,473 are two-segment, 1,557 are three-segment, 752 are four-segment, and 451 report five or more segments.

Table 1 describes the single-segment and multi-segment firms, as well as the differences between the groups. Due to skewness in the distributions, we emphasize medians rather than means. At the median, multi-segment firms have three segments and roughly three times the total capital of single-segment firms. Their median industry-adjusted leverage ratio (book value of debt over total assets) is 2.9% higher than that of focused firms, consistent with segments of diversified firms borrowing more, and their median industry-adjusted taxes do not differ from those of single-line firms, inconsistent with tax benefits from diversification.

The segment level characteristics in the bottom panel of Table 1 are based on the segment data. Segments of diversified companies tend to be slightly smaller than stand-alone segments, although this difference is due in part to an incomplete allocation of assets by diversified firms to their segments. When we

Table 1

Descriptive statistics for a sample of 16,181 observations of single-business-segment and multi-segment firms with sales of more than \$20 million and information available from the Compustat Industry Segment (CIS) database

Segments are lines of business for which separate accounting disclosures are made by management in accordance with FASB No. 14 and SEC Regulation S-K. Single-segment firms are those reporting exactly one segment on the CIS database, whereas multi-segment firms are those reporting two or more segments. Significance levels are indicated for the difference between multi-segment and single-segment firms. The significance of the difference in medians is assessed using the nonparametric median test.

	Single-segment firms			Multi-segment firms			Difference	
	Med.	Mean	STD	Med.	Mean	STD	Med.	Mean
<i>Sample characteristics at the firm level</i>								
Number of segments	1,000	1,000	0.000	3,000	2,885	1,088	2,000 ^b	1,885 ^b
Total capital (\$ millions)	116	878	4086	316	1961	4734	200 ^b	1083 ^b
Total debt to assets	0.257	0.278	0.217	0.290	0.305	0.191	0.033 ^b	0.026 ^b
Industry-adjusted leverage	0.000	0.027	0.198	0.029	0.041	0.193	0.029 ^a	0.014 ^b
Taxes/sales	0.016	0.027	0.044	0.017	0.024	0.039	0.000	– 0.003 ^b
Industry-adjusted taxes	0.000	– 0.001	0.023	0.000	– 0.002	0.015	0.000 ^c	– 0.001 ^b
Observations	10,948			5,233				

Sample characteristics at the segment level

Segment sales (\$ millions)	123	776	4224	116	649	2033	— 7 ^c	— 127 ^b
Segment assets (\$ millions)	106	784	3494	92	549	1662	— 14 ^d	— 235 ^b
Capital expenditures/sales	0.044	0.087	0.136	0.045	0.101	0.176	0.001	0.014 ^b
Negative CF segments ^a	0.000	0.082	0.274	0.000	0.090	0.286	0.000 ^c	0.008 ^c
Observations	10,948			15,093				

Total capital is the sum of book value of debt and market value of equity. *Industry-adjusted leverage* is the difference between a firm's actual leverage, defined as the ratio of total debt to total assets, and its imputed leverage. Imputed leverage for each of the firm's segments is calculated as the segment's assets multiplied by the industry's median ratio of debt to assets. *Industry-adjusted taxes* paid is the difference between the firm's actual taxes paid and its imputed taxes, all standardized by total sales. Imputed taxes for each of the firm's segments are calculated as the segment's EBIT multiplied by the industry's median ratio of taxes paid to EBIT.

^a Indicator that equals 1 if a segment has negative cash flow (EBITD) and 0 otherwise.

^b Significant at the 1% level.

^c Significant at the 5% level.

^d Significant at the 10% level.

allocate all assets of a firm to its segments, the difference between the median assets of segments of diversified firms and stand-alone firms from the same industry is insignificant (result not reported). Segments do, however, differ somewhat from single-line firms in their investment levels and their likelihood of having negative cash flow. The investment level, as measured by the ratio of capital expenditures to sales, is higher for the segments of diversified companies, although only the difference in means is significant. In addition, the 9% of segments of diversified firms with negative cash flow is higher than the 8.2% for single-line businesses. The larger presence of negative cash flow among segments of diversified firms is consistent with diversified firms keeping poorly performing divisions in business beyond the point where they would fail if independent.

3.2. *Estimating segment values using multipliers*

To examine whether diversification enhances or decreases corporate value, we measure the percentage difference between a firm's total value and the sum of imputed values for its segments as stand-alone entities (see the Appendix for additional details not described below). We calculate the imputed value of each segment by multiplying the median ratio, for single-segment firms in the same industry, of total capital to one of three accounting items (assets, sales, or earnings) by the segment's level of the accounting item. The industry median ratios are based on the narrowest SIC grouping that includes at least five single-line businesses with at least \$20 million of sales and sufficient data for computing the ratios. Using this algorithm, the imputed value for 44.6% of all segments of diversified companies is based on four-digit SIC code industries, 25.4% on three-digit industries, and 30% on two-digit industries.

The sum of the imputed values of a company's segments estimates the value of the firm if all of its segments are operated as stand-alone businesses. The natural log of the ratio of a firm's actual value to its imputed value is our measure of excess value, or the gain or loss in value from diversification. Positive excess value indicates that diversification enhances the value of segments beyond that of their stand-alone counterparts. Negative excess value indicates that diversification reduces value.

The validity of the multiplier approach depends on management disclosure policies. Theoretical models of managerial disclosure decisions suggest that managers may have incentives to misstate segment data to both providers of capital and product market competitors.² Their ability to misstate depends on the discretion managers have to allocate dollars between segments. Since segment assets must be specifically identifiable with the segment for which they

²See Darrough and Stoughton (1990), Wagenhofer (1990), Feltham and Xie (1992), Feltham, Gigler, and Hughes (1992), and Newman and Sansing (1993).

are reported, there is little discretion to misstate them. Managers do have some ability to allocate sales and greater discretion to allocate expenses, so segment sales and earnings (sales less expenses) are vulnerable to manipulation. Givoly, Hayn, and D'Souza (1993) assess the quality of segment reporting, with quality defined as the difference between the correlation of accounting measures from segments with those of their industries and the correlation of measures from single-line firms in the same industries with the aggregate industry measures. They find a marginally significant difference in correlation coefficients of 0.061 for sales and a significant difference of 0.146 for earnings. Thus, there is some evidence that the segment earnings numbers may not be as reliable as segment sales and asset figures. The earnings multiplier has the advantage, however, of imputing value directly from current profitability, which may be more directly linked to firm value than sales or assets. Therefore, we report results for all three multipliers.

Examining diversification using the industry multiplier approach on individual business segments has several advantages over other methods. For example, an event study requires a clearly defined event date. It is difficult to identify and precisely date an event that unambiguously conveys information about diversification. The stock price response to takeover announcements may reflect the terms of the offer, the probability of success, or information signalled about opportunities in the bidder's core line of business. Thus, it is difficult to clearly identify investors' attitudes about diversification by examining an announcement-date stock price response.

Tobin's *q*-ratio is also widely used in studies examining how the level of firm value varies with firm structure. Calculation of *q* requires assumptions about rates of depreciation and inflation to estimate the firm's replacement value. In addition, valuation studies do not generally industry-adjust *q* despite its large variation across industries. Attempting to industry-adjust *q* is, however, problematic when studying diversification, because neither segment market values nor segment replacement values can be computed directly from available data. Additionally, event studies and studies that assess value effects using Tobin's *q*-ratio provide only limited opportunities to examine the potential sources of gains or losses from diversification. The industry multiplier approach not only provides a direct estimate of the excess value associated with diversification, but also allows further investigation at the segment level of the sources of any overall value effect.

4. The overall value effect of diversification

4.1. The excess value measure of overall effect

Table 2 describes the excess value measures obtained using each of the three multipliers. We report the single-segment firms' values to evaluate whether the

Table 2

Descriptive statistics for the excess value measures using asset, sales, and EBIT multiples

Excess value is the natural logarithm of the ratio of a firm's actual value to its imputed value. A firm's imputed value is the sum of the imputed values of its segments, with each segment's imputed value equal to the segment's assets, sales, or EBIT multiplied by its industry median ratio of capital to that accounting item. The sample includes 16,181 observations between 1986 and 1991. The significance of median values is based on the Wilcoxon signed-rank test. The significance of the difference in medians is assessed using the nonparametric median test.

Actual/imputed value	Med.	Mean	Quartiles		STD	Obs.
			1st	3rd		
<i>Using asset multiples</i>						
Single-segment firms	− 0.000	0.014 ^a	− 0.266	0.265	0.463	10,664
Multi-segment firms	− 0.162 ^{a,b}	− 0.122 ^{a,b}	− 0.371	0.098	0.408	3,884
<i>Using sales multiples</i>						
Single-segment firms	0.000	0.001	− 0.370	0.366	0.561	10,373
Multi-segment firms	− 0.106 ^{a,b}	− 0.097 ^{a,b}	− 0.471	0.278	0.542	5,015
<i>Using EBIT multiples</i>						
Single-segment firms	0.009 ^a	0.073 ^a	− 0.225	0.342	0.486	10,047
Multi-segment firms	− 0.079 ^{a,b}	− 0.061 ^{a,b}	− 0.323	− 0.177	0.414	2,973

Using asset multiples: The natural logarithm of actual value/imputed value where: actual value is total book value of debt plus market value of equity, and imputed value is the sum of the imputed values of the firm's segments. Each segment's imputed value is the segment's assets multiplied by its industry median capital-to-assets ratio. *Using sales multiples:* The natural logarithm of actual value/imputed value with each segment's imputed value equal to the segment's sales multiplied by its industry median capital-to-sales ratio. *Using EBIT multiples:* The natural logarithm of actual value/imputed value with each segment's imputed value equal to the segment's EBIT multiplied by its industry median capital-to-EBIT ratio.

^aSignificant at the 1% level.

^bThe difference between the single-segment and multi-segment medians or means is significant at the 1% level.

excess value measures are well-behaved, and report the multi-segment values to provide a preliminary indication of diversification's effect on value. By using multipliers for the median single-segment firm in each industry, the excess values are constructed with median values of approximately zero for the single-segment firms. The median values differ slightly from zero due to the elimination of extreme excess values, and adjustments to the EBIT multiplier for segments with negative earnings (as described in the Appendix). The distributions of excess value for single-segment firms are quite symmetric around zero for the valuation multiples of assets and sales. For the multiples of EBIT, the distribution is positively skewed. Our tests are based on mean differences between the excess

values of diversified and single-segment firms, however, so a mean excess value of zero for the single-segment firms is not required in order to measure diversification's value effect.

Table 2 reports negative differences in mean and median excess values between stand-alone and multi-segment firms, indicating that diversification reduces value. Additional evidence of an association between value loss and diversification is provided in panel A of Table 3, which reports regressions of excess value on various controls and an indicator variable that equals one if the firm is multi-segment.³ The multi-segment indicator variable captures the percentage difference in average excess value between focused and diversified firms. We control for factors that could affect excess value and whose magnitudes are not entirely determined by whether or not the firm is diversified. Firm size, profitability, and growth opportunities are controlled for by using the firm's natural log of total assets, its EBIT-to-sales ratio, and its ratio of capital expenditures to sales. The results are consistent across the three multipliers, with the lost value from diversification ranging from 12.7%, using the asset multiplier, to 15.2%, using the EBIT multiplier. Since these losses are based on total capital, the value loss to equity holders is even larger than these measures suggest. Using the average book leverage of about 30% for multi-segment firms, and assuming no effect on debt value, we calculate the value loss to equity holders as ranging from 18.1% to 21.7%.

We also calculate average dollar losses from diversification as the mean difference between imputed and actual value. Using the asset multiplier, the mean dollar loss per firm during 1986–91 is \$235.1 million, implying a total loss in value for the approximately 850 multi-segment sample firms of \$200 billion. We also compare the value losses of multi-segment firms with differing numbers of segments by comparing the value losses among diversified firms with two, three, four, and five or more segments. The (unreported) results show the value loss increases with the number of segments.⁴

³The White test rejects the null of homoskedasticity at the 0.01 level for most reported regressions. Therefore, reported significance levels are calculated using White (1980) heteroskedasticity-consistent standard errors.

⁴All reported percentage changes in value represent logarithmic percentages. The results presented in panel A of Table 3 are unchanged when (1) extreme values are included in the sample, (2) influential observations are omitted (see Belsey, Kuh, and Welsch, 1980, for the method used to identify influential observations), and (3) the effect of the fineness of industry partitioning is addressed by using just two-digit SIC codes to define industries. We also test the sensitivity of the results to our diversification metric by replacing the multi-segment indicator variable with a revenue-based Herfindahl index, whose calculation is detailed in the Appendix. The regression coefficient on the Herfindahl index is significantly positive, consistent with a larger loss of value as diversification increases.

Table 3

Coefficient estimates from regressions of excess value on: a multi-segment indicator and control variables (in panel A) and the number of segments, a related segments measure, and control variables (in panel B)

Excess value is the natural logarithm of the ratio of a firm's actual value to its imputed value. A firm's imputed value is the sum of the imputed values of its segments, with each segment's imputed value equal to the segment's assets, sales, or EBIT multiplied by its industry median ratio of capital to that accounting item. The sample in panel A includes 16,181 observations between 1986 and 1991. The sample in panel B includes 5,233 observations between 1986 and 1991 that report two or more segments. *P*-values (in parentheses) are based on the White-adjusted standard errors.

Panel A: Value loss from diversification						
Dependent variable: Actual/imputed value	Obs. R ²	Intercept	Multi-segment indicator ^a	Log of assets	EBIT/sales	Capex/sales
Using asset multiples	14,547 0.086	− 0.004 (0.730)	− 0.127 ^d (0.000)	0.011 ^d (0.000)	0.935 ^d (0.000)	0.051 ^f (0.064)
Using sales multiples	15,287 0.114	− 0.329 ^d (0.000)	− 0.144 ^d (0.000)	0.046 ^d (0.000)	1.038 ^d (0.000)	0.320 ^d (0.000)
Using EBIT multiples	12,952 0.021	0.003 (0.833)	− 0.152 ^d (0.000)	0.011 ^d (0.000)		0.174 ^d (0.000)

Panel B: Relatedness and excess value in diversified firms

Dependent variable: Actual/imputed value	Obs. R ²	Intercept	No. of segments ^b	Related segments ^c	Log of assets	EBIT/sales	Capex/sales
Using asset multiples	3870 0.070	– 0.102 ^d (0.000)	– 0.027 ^d (0.002)	0.026 ^d (0.006)	– 0.010 ^e (0.017)	1.126 ^d (0.000)	– 0.009 (0.866)
Using sales multiples	4901 0.109	– 0.332 ^d (0.000)	– 0.077 ^d (0.000)	0.037 ^d (0.001)	0.050 ^d (0.000)	0.937 ^d (0.000)	0.509 ^d (0.000)
Using EBIT multiples	2893 0.012	– 0.087 ^e (0.011)	– 0.022 ^e (0.033)	– 0.002 (0.843)	0.010 ^e (0.028)		0.273 ^d (0.000)

Using asset multiples: The natural logarithm of actual value/imputed value where: actual value is total book value of debt plus market value of equity, and imputed value is the sum of the imputed values of the firm's segments. Each segment's imputed value is the segment's assets multiplied by its industry median capital-to-assets ratio. *Using sales multiples:* The natural logarithm of actual value/imputed value with each segment's imputed value equal to the segment's sales multiplied by its industry median capital-to-sales ratio. *Using EBIT multiples:* The natural logarithm of actual value/imputed value with each segment's imputed value equal to the segment's EBIT multiplied by its industry median capital-to-EBIT ratio.

^aIndicator that equals 1 if the firm has two or more reported segments, and 0 if the firm reports only one line of business.

^bThe number of segments reported by the multi-segment firm.

^cThe difference between the total number of segments reported by the diversified firm and the number of segments with different main two-digit SIC codes.

^dSignificant at the 1% level.

^eSignificant at the 5% level.

^fSignificant at the 10% level.

In panel B of Table 3, we examine how the value loss varies between related and unrelated diversified firms. We use an SIC code algorithm to classify segments as related. Therefore, we cannot identify vertically integrated segments, which get classified as unrelated. Specifically, we classify segments within a firm as unrelated if they have different SIC codes at the two-digit level. We then measure the difference between the total number of segments reported by a firm and its number of unrelated segments. This related-segments variable varies between zero, when no segments are related, and the number of firm segments minus one, when no segments differ.

The excess value measure is regressed on the number of segments reported by the diversified firm, the related-segments variable, and the controls for size, profitability, and growth opportunities. The regressions use only the 5,233 multi-segment observations. The significantly negative coefficient estimates on the number of segments indicate that, all else being equal, multi-segment firms lose more value as they become more diversified. This result is consistent with the nearly monotonic relation we found between the magnitude of the value loss and the number of segments. The significantly positive coefficient estimates, using the asset and sales multipliers, on the related-segments variable show that relatedness mitigates the value loss from diversification. All the coefficient estimates remain positive when the pooled regressions reported in panel B of Table 3 are performed by year, with the magnitudes significant at better than the 0.10 level in five of 12 cases.

Panel A of Table 4 reports the coefficient estimates on the multi-segment indicator when the regressions reported in panel A of Table 3 are performed by year. These results are of interest because the *t*-statistics for the pooled results of Table 3 are overstated if the inclusion of the same firm for multiple years results in observations that are not independent. Using all three multipliers, the coefficient estimates are significant at the 0.01 level in all years. There is some variation in the value loss during the period, with losses ranging from 17.7% to 9.2% for the asset multiplier, from 14.9% to 13.1% for the sales multiplier, and from 17.6% to 12.7% for the EBIT multiplier.

Panel B of Table 4 reports the coefficient estimates on the multi-segment indicator when the regressions reported in panel A of Table 3 are re-estimated (absent the size control) on four size-based subsamples with approximately the same number of observations. The results show that the value loss occurs for all firm sizes, with the greatest percentage loss occurring in the smallest firms.

4.2. Profitability as an alternative measure of overall effect

Table 5 examines whether segments of diversified companies have lower operating profitability than their counterpart single-line firms. We use two industry-adjusted measures of profitability, operating margin (EBIT/sales) and

Table 4

Measures of the percentage value loss from diversification by year and by firm size

The value loss measure is the coefficient estimate of the multi-segment indicator from regressions of the logarithm of the ratio of a firm's actual value to its imputed value on a multi-segment indicator variable, the natural logarithm of assets (in panel A regressions only), EBIT/sales, and capital expenditures/sales. All of the reported coefficients are significant at the 0.01 level. The sample includes 16,181 observations between 1986 and 1991.

Panel A: Loss from diversification by year

Actual/imputed value	1986	1987	1988	1989	1990	1991
Using asset multiples	– 0.177	– 0.137	– 0.092	– 0.103	– 0.120	– 0.133
Using sales multiples	– 0.149	– 0.138	– 0.131	– 0.143	– 0.131	– 0.146
Using EBIT multiples	– 0.135	– 0.164	– 0.140	– 0.176	– 0.127	– 0.166
Number of observations ^a	2,143	2,401	2,547	2,643	2,742	2,806

Panel B: Loss from diversification by firm size (TA = total assets in millions of dollars)

Actual/imputed value	TA < 50	50 < TA < 150	150 < TA < 500	TA > 500
Using asset multiples	– 0.161	– 0.117	– 0.142	– 0.120
Using sales multiples	– 0.167	– 0.112	– 0.144	– 0.141
Using EBIT multiples	– 0.201	– 0.116	– 0.159	– 0.146
Number of observations ^a	3,964	3,849	3,482	3,989

Using asset multiples: The natural logarithm of actual value/imputed value where: actual value is total book value of debt plus market value of equity and imputed value is the sum of the imputed values of the firm's segments. Each segment's imputed value is the segment's assets multiplied by its industry median capital-to-assets ratio. *Using sales multiples:* The natural logarithm of actual value/imputed value with each segment's imputed value equal to the segment's sales multiplied by its industry median capital-to-sales ratio. *Using EBIT multiples:* The natural logarithm of actual value/imputed value with each segment's imputed value equal to the segment's EBIT multiplied by its industry median capital-to-EBIT ratio.

^aNumber of observations in the sales multiplier regressions.

the return on assets (EBIT/assets), or ROA (see the Appendix for additional details). To correct for unallocated EBIT, we gross up or down the EBIT of each segment in a firm by the percentage deviation, if any, between the sum of its segments' EBITs and the total firm EBIT. We correct for unallocated assets in the same way. In addition, to examine whether profitability differences depend on segment size, we report the differences in profitability for three size sub-samples.

To increase the power of the remaining tests, we exclude multi-segment firms with all segments in the same two-digit SIC code (completely related multi-segment firms). The profitability results, using both the operating margin and

Table 5

Mean and median differences in industry-adjusted profitability, as a function of sales or assets, between single-segment firms and segments of diversified firms

Multi-segment firms that do not have two or more segments with different two-digit SIC codes are eliminated from the sample. The first number in the square brackets is the number of single-segment observations and the second number is the number of observations from multi-segment firms. The sample period is 1986–91. The significance of the difference in medians is assessed using the nonparametric median test.

		Segment sales (SS) in millions of dollars		
	Total sample	SS < 50	50 < SS < 250	SS > 250
<i>Profitability measured by industry-adjusted EBIT/sales</i>				
Mean	− 0.020 ^a	− 0.037 ^a	− 0.011 ^a	− 0.008 ^a
Median	− 0.009 ^a	− 0.024 ^a	− 0.009 ^a	− 0.003 ^b
Observations	[10922, 8422]	[2767, 2765]	[4614, 2459]	[3541, 3198]
<i>Profitability measured by industry-adjusted EBIT/total assets</i>				
Mean	− 0.015 ^a	− 0.030 ^a	− 0.006 ^b	− 0.005 ^b
Median	− 0.019 ^a	− 0.039 ^a	− 0.017 ^a	− 0.004 ^a
Observations	[10922, 8227]	[2767, 2726]	[4614, 2431]	[3541, 3070]

EBIT-to-sales ratio is the ratio of the segment minus the industry median EBIT-to-sales ratio. If the sum of the segments' EBIT does not match the total firm EBIT then each segment's EBIT for that firm is grossed up (or down) by the percentage deviation. *EBIT-to-asset* is the ratio of the segment minus the industry median EBIT-to-assets ratio. If the sum of the segments' EBIT does not match the total firm EBIT then each segment's EBIT for that firm is grossed up (or down) by the percentage deviation. A similar procedure is performed for assets.

^aSignificant at the 1% level.

^bSignificant at the 10% level.

ROA measures, indicate that segments of diversified companies are significantly less profitable than stand-alone companies for the total sample and across all three size groups. The – 0.009 lower operating margin of the full sample of segments is significant at the 0.01 level, as is the – 0.019 median difference in ROA. Under both measures, the reduction in operating profitability is greatest for the smallest segments, which was also true of the reduction in value documented in Table 4. When the single-segment companies are compared to the excluded group of completely related multi-segment firms, the (unreported) median differences in profitability continue to be significantly negative, but with magnitudes only about 60% of those reported in Table 5. Thus, related diversification has a less negative effect than unrelated diversification on operating profitability. Overall, the operating profitability results are consistent with those found using the excess value measures.

5. Sources of gains and losses from diversification

5.1. *Overinvestment and the value loss in diversified firms*

Jensen (1986) and Stulz (1990) argue that overinvestment is a potential source of value loss from diversification. We examine whether overinvestment is associated with value loss in diversified firms by regressing excess value on a measure of overinvestment and controls for size, profitability, and capital expenditures. We restrict the sample to unrelated multi-segment firms. We measure a firm's overinvestment as the sum of the depreciation-adjusted capital expenditures of all its segments operating in industries whose median Tobin's q is in the lowest quartile (below 0.76), scaled by total sales (see the Appendix for details of the Tobin's q calculation). Thus, higher values of the overinvestment variable represent more unprofitable investment.

Table 6 shows that the coefficient estimates range from -0.399 to -0.924 on the overinvestment variable and are significant at the 0.10 level or better for all three methods of calculating excess value. Thus, more overinvestment is associated with less excess value for multisegment firms with unrelated segments. An increase in depreciation-adjusted capital expenditures of 1% of sales in low- q industries is associated with an average decrease of 0.4% to 0.9% in excess value. The results continue to hold when the regressions are performed using data for separate years.

The overall value loss we documented in Section 4 was a mean difference between diversified and single-line firms. Therefore, the amount of value loss attributable to overinvestment can be calculated as the product of: (1) the rate of value loss per unit of overinvestment (estimated in Table 6) and (2) the mean difference in overinvestment between segments of diversified firms and single-segment businesses. Using a regression analysis controlling for profitability and size, we find (but do not report in a table) that, on average, overinvestment by unrelated segments of multi-segment firms exceeds that of single-line companies by 3.6% of sales. When segments are related, the difference in overinvestment is 2.6% of sales. Given the coefficient estimates on the overinvestment variable in Table 6, the difference in overinvestment of 3.6% of sales implies an excess value loss of 1.4% to 3.3% for low investment opportunity segments of diversified firms.

5.2. *Cross-subsidization and the value loss in diversified firms*

Another theorized source of the value loss in diversified firms is the subsidization of failing segments. For example, Jensen (1989, 1991, 1993) argues that the constraints against cross-subsidization in LBO associations are one source of their value gains. Moreover, Meyer, Milgrom, and Roberts (1992) contend that cross-subsidization results in unprofitable lines of business creating greater

Table 6

Regression estimates of the relation between overinvestment and excess value in multi-segment firms

Overinvestment is the level of capital expenditure in excess of depreciation in industries with median Tobin's q in the bottom quartile. Multi-segment firms that do not have two or more segments with different two-digit SIC codes are eliminated from the sample. The sample includes multi-segment firm observations between 1986 and 1991. P -values (in parentheses) are based on the White-adjusted standard errors.

Dependent variable: Actual/imputed value	Obs. R^2	Intercept	Over- investment ^a	Log of assets	EBIT/ sales	Capex/ sales
Using asset multiples	1282 0.074	– 0.108 ^b (0.006)	– 0.399 ^c (0.056)	– 0.022 ^b (0.000)	1.211 ^b (0.000)	0.180 (0.115)
Using sales multiples	1535 0.077	– 0.409 ^b (0.000)	– 0.924 ^b (0.008)	0.025 ^b (0.001)	0.766 ^b (0.000)	1.083 ^b (0.000)
Using EBIT multiples	966 0.016	– 0.075 (0.211)	– 0.736 ^b (0.004)	– 0.005 (0.528)		0.601 ^b (0.000)

Using asset multiples: The natural logarithm of actual value/imputed value where: actual value is total book value of debt plus market value of equity and imputed value is the sum of the imputed values of the firm's segments. Each segment's imputed value is the segment's assets multiplied by its industry median capital-to-assets ratio. *Using sales multiples:* The natural logarithm of actual value/imputed value with each segment's imputed value equal to the segment's sales multiplied by its industry median capital-to-sales ratio. *Using EBIT multiples:* The natural logarithm of actual value/imputed value with each segment's imputed value equal to the segment's EBIT multiplied by its industry median capital-to-EBIT ratio.

^aThe sum, for a firm, of capital expenditures in excess of depreciation in segments operating in industries with median Tobin's q less than 0.76, scaled by total firm sales.

^bSignificant at the 1% level.

^cSignificant at the 10% level.

value losses in conglomerates than they would as stand-alone firms. To investigate this proposition, we use negative cash flow [as measured by EBIT plus depreciation (EBITD)] as a proxy for poor performance, noting that it will be a noisy measure of poorly performing segments if managers use discretion in disclosure to disguise poorly performing units. We examine whether the presence of negative cash flow in one or more segments has a more negative effect on diversified firm value than the presence of negative cash flow has on focused firm value. Such an effect is consistent with poorly performing segments of diversified firms draining value from other lines of business.

We construct a conditional excess value measure, which uses separate multipliers to impute values for positive and negative EBIT observations (see the Appendix for additional details). The multipliers are partitioned on the basis of EBIT rather than cash flow (EBITD) because the small number of negative cash flow segments makes it very difficult to obtain enough observations within an

industry to calculate a median. Because the multipliers are partitioned based on EBIT, we redo the reported tests based on the presence of negative EBIT (rather than negative cash flow) in one or more segments. The inferences from this sensitivity test are identical to those reported below.

Excess value conditional on whether EBIT is negative is used because the cross-subsidization test assesses whether multi-segment firms with negative cash flow segments have lower values than multi-segment firms without such segments. If we conducted this test with the unconditional measure of excess value used in the rest of the paper, we would expect actual values to be less than imputed values for the negative cash flow observations if market prices are a function of discounted cash flows. Conditioning the excess value measure on the sign of EBIT allows the measure to reflect the effect of the negative cash flow itself on firm value. The imputed value of segments with positive EBIT is calculated using the industry median multiple of single-segment firms with positive EBIT and the imputed value of segments with negative EBIT is calculated using the industry median multiple of single-segment firms with negative EBIT. Segments are matched with industry multipliers at the two-digit level, if possible, and industry medians require at least three single-segment firms.

In Table 7, the coefficient estimate on the indicator for firms with one or more negative cash flow segments (for regressions using both the asset and sales multiplier as dependent variables) is insignificantly different from zero for focused businesses, but negative and statistically significant for the multi-segment firms. The insignificant difference from zero for single-segment firms shows that conditioning the excess value measure on the sign of EBIT results in excess values that do not diverge significantly from zero based on the sign of the segment's cash flow. The coefficient estimates on the negative cash flow indicator for the multi-segment firms are -11.3% using the conditional asset multiplier and -11.5% using the conditional sales multiplier. Unlike the single-segment firms, the unrelated multi-segment firms with negative cash flow segments have a large and significant value loss. We find that, in an average year, 26% of unrelated multi-segment firms have at least one negative cash flow segment (result not reported). Interpreting this as a 26% probability of engaging in cross-subsidization in a given year, and multiplying this probability by the average value loss we document when cross-subsidization does take place, we estimate the value lost from cross-subsidization by the average unrelated multi-segment firm at 2.9% to 3%. When the Table 7 tests are repeated using the completely related multi-segment firms in place of the unrelated multi-segment firms used to generate the reported results, the coefficient estimates on the indicator variables are -4.2% and -4.5% , respectively. The value lost from cross-subsidization is thus smaller in related diversifications than in unrelated diversifications. Finally, the results shown in Table 7 continue to hold when the pooled regressions are performed separately by year.

Table 7

Regression estimates of the effect of cross-subsidies from good to bad segments on diversified firm value

The regressions of excess value on a negative cash flow indicator and control variables are performed separately on single-segment and multi-segment firms. Multi-segment firms that do not have two or more segments with different two-digit SIC codes are eliminated from the sample. *P*-values (in parentheses) are based on the White-adjusted standard errors.

	Obs. <i>R</i> ²	Intercept	Negative CF indicator ^a	Log of assets	Capex/ sales
<i>Conditional excess value using asset multiples</i>					
Single-segment firms	10580 0.001	0.061 ^b (0.000)	– 0.013 (0.384)	– 0.008 ^b (0.004)	0.078 ^b (0.001)
Multi-segment firms	1973 0.024	– 0.110 ^b (0.001)	– 0.113 ^b (0.000)	– 0.004 ^b 0.447	0.334 ^b (0.000)
<i>Conditional excess value using sales multiples</i>					
Single-segment firms	10241 0.054	– 0.333 ^b (0.000)	0.017 (0.400)	0.060 ^b (0.000)	0.440 ^b (0.000)
Multi-segment firms	2493 0.096	– 0.422 ^b (0.000)	– 0.115 ^b (0.000)	0.041 ^b (0.000)	1.001 ^b (0.000)

Conditional excess value using asset multiples: The natural logarithm of actual value/imputed value where: actual value is the firm's total book value of debt plus market value of equity and imputed value is the sum of the imputed values of the firm's segments. Each segment's imputed value is the segment's assets multiplied by the relevant industry median capital-to-assets ratio. The imputed value of segments with positive EBIT is calculated using the industry median multiple of single-segment firms with positive EBIT, and the imputed value of segments with negative EBIT is calculated using the industry median multiple of single-segment firms with negative EBIT. *Conditional excess value using sales multiples:* Similar to the calculation explained above, except that the segment's sales are multiplied by the industry median ratio of capital to sales.

^a An indicator variable that equals one if the firm has at least one segment with negative cash flow (EBITD).

^bSignificant at the 1% level.

The Table 7 results are consistent with cross-subsidization explaining part of the value loss from diversification. We find that diversified firms with negative cash flow segments have significantly lower excess values than diversified firms without such segments, but only after imputing value in a manner that does not result in a difference in excess value between stand-alone segments with positive cash flow and stand-alone segments with negative cash flow. Although these results are consistent with cross-subsidization, they may also result from a signalling explanation in which the presence of one or more negative cash flow segments signals the market that the diversified firm's management is of low quality.

5.3. *Debt and taxes as advantages of diversification*

Theory suggests the value loss from diversification may be mitigated by increased debt capacity and reduced tax payments. Combining businesses with imperfectly correlated earnings streams increases debt capacity (Lewellen, 1971), and any increased borrowing that results increases interest tax shields. Diversification creates a further tax advantage by allowing the losses of some segments to be offset contemporaneously against the gains of others, rather than merely carried forward to future tax years.

Table 1's fourth row shows that, after adjusting for industry differences (see the Appendix for details on the industry adjustment), multi-segment firms have mean borrowings that are 1.4% more of their assets than those of single-segment firms. To examine whether the univariate difference in industry-adjusted leverage is driven by factors other than Lewellen's (1971) coinsurance argument, we regress the industry-adjusted leverage measure on the multi-segment indicator and on size, profitability, and growth opportunity controls. We find that multi-segment firms borrow 1% more of their assets than their segments would as separate entities. This result suggests that the majority (1%/1.4%) of the higher borrowing by diversified firms arises from coinsurance. Increasing debt by 1% of assets does not appear economically significant, suggesting that diversified firms are unlikely to achieve major savings from higher interest tax shields.

Table 1 also shows that the difference in median industry-adjusted taxes (see the Appendix for details of the industry adjustment) between focused and diversified firms is zero. The mean difference of a 0.1% reduction in taxes paid as a percentage of sales is significant statistically, although unlikely to be economically significant. Regressing the industry-adjusted taxes paid on the multi-segment indicator and the control variables produces a significant (0.10 level) coefficient estimate (not reported) of -0.1% on the multi-segment indicator, consistent with the univariate result. This result indicates that the higher interest tax shields arising from diversified firms' higher leverage are not large. In addition, the results provide little evidence that multi-segment firms save significant taxes by offsetting losses from some segments against the profits of the rest of the firm.

6. Conclusions

We study the effects of diversification on firm value by estimating the value of a diversified firm's segments as if they were operated as separate firms. In doing so, we find that diversification reduces value. We estimate that this value loss averages 13% to 15% over the 1986–91 sample period, occurs for firms of all sizes, and is mitigated when the diversification is within related industries. We

find additional support for the conclusion that diversification reduces value by documenting that the segments of diversified firms have lower operating profitability than single-line businesses.

We find that overinvestment is associated with lower value for diversified firms, and that segments of diversified firms overinvest more than single-line businesses do. These results are consistent with one source of the value loss being the greater propensity of multi-segment firms to overinvest. We also find evidence that suggests the subsidization of poorly performing segments contributes to the value loss from diversification.

Two potential benefits of diversification are increased interest tax shields resulting from higher debt capacity and the ability of multi-segment firms to immediately realize tax savings by offsetting losses in some segments against profits in others. Our estimate of the tax saving, however, is only 0.1% of sales, far too small to offset the documented value loss.

Our study confirms recent evidence documenting a significant loss of value in corporations that followed a diversification strategy during the 1980s. In addition, we provide evidence regarding possible sources of this value loss. The evidence that diversification represented a suboptimal managerial strategy raises questions about the effectiveness of the corporate control and monitoring mechanisms in place during this period. In addition, the evidence suggests that if overinvestment and cross-subsidization are properly controlled, a diversification strategy can produce small benefits in the form of increased debt capacity and tax savings.

Appendix

Multiplier estimation of imputed value and excess value: Eqs. (1) and (2) illustrate the approach:

$$I(V) = \sum_{i=1}^n AI_i * (Ind_i(V/AI)_{mf}), \quad (1)$$

$$EXVAL = \ln(V/I(V)), \quad (2)$$

where

- $I(V)$ = imputed value of the sum of a firm's segments as stand-alone firms,
- AI_i = segment i 's value of the accounting item (sales, assets, or EBIT) used in the valuation multiple,
- $Ind_i(V/AI)_{mf}$ = multiple of total capital to an accounting item (sales, assets, or EBIT) for the median single-segment firm in segment i 's industry,
- $EXVAL$ = firm's excess value,

- V = firm's total capital (market value of common equity plus book value of debt),
- n = total number of segments in segment i 's firm.

Eq. (1) shows that the firm's imputed value is the sum of segment-imputed values, which are obtained by multiplying an industry median multiplier of total capital to an accounting item by the segment's level of the accounting item. Eq. (2) shows that the firm's excess value measure is the natural logarithm of the ratio of the firm's actual value to its imputed value.

To compute excess value using the sales multiplier, we multiply the industry median multiple of capital-to-sales for the stand-alone firms in the segment's industry by the segment's sales to obtain the imputed capital of the segment. We repeat this process for each of the firm's segments and then sum to obtain the firm's imputed value. Finally, we find the firm's excess value by taking the natural logarithm of the ratio of actual to imputed value. Extreme excess values are excluded from the analysis, resulting in the loss of 790 observations (4.9%) for the sales multiplier. 'Extreme' is defined for all three multipliers as natural logarithms of actual to imputed value above 1.386 or below -1.386 (i.e., actual values either more than four times imputed, or less than one-fourth imputed).

The asset multiple imputed values are found in an analogous manner. Another issue that arises is that it is much more common for the segment asset figures from the CIS tape to disagree with the Compustat firm totals than is the case with sales. The segment sum is usually less than the firm figure, indicating that the problem arises from unallocated assets. We deal with this problem in one of two ways: If the sum of the segment asset figures for a firm deviates from the firm's asset figure by more than 25%, we exclude the observation from all analyses using the asset multiples. This results in the exclusion of 1,309 asset multiplier observations (8.1%). If the deviation is within 25%, we adjust the firm's imputed value to reflect the fact that the multipliers have been multiplied by segment asset figures that are too small or too large. Specifically, the firm's imputed value is grossed up or down by the percentage deviation between the sum of its segments' assets and total firm assets. The excess value measure based on asset multiples is then found in the same way as the measure using sales multiples, with the exclusion of extreme values reducing the asset multiplier sample by 321 observations (2%).

The earnings before interest and taxes (EBIT) multiple imputed values use the same adjustment procedures as the asset multiple imputed values, resulting in the exclusion of 2,189 EBIT multiplier observations (13.6%). One additional issue that arises with the EBIT measure is how to treat segments with negative EBITs, since multiplier approaches do not typically assign negative values to firms with negative earnings. We address this issue by replacing the EBIT multiplier imputed value with either an EBIT-plus-depreciation (EBITD) multiplier imputed value, if positive, or with the segment's sales multiplier imputed

value. The exclusion of extreme values reduces the EBIT multiplier sample by 1,031 observations (6.4%).

Revenue-based Herfindahl index: The Herfindahl index, H , is calculated across n business segments as the sum of the squares of each segment i 's sales, S_i , as a proportion of total sales:

$$H = \frac{\sum_{i=1}^n S_i^2}{\left(\sum_{i=1}^n S_i\right)^2}. \quad (3)$$

Thus, the closer H is to one, the more the firm's sales are concentrated within a few of its segments.

Industry-adjusted profitability measures: Only single-segment firms are used in calculating the industry profitability ratios. In addition, to avoid outliers having an impact on mean profitability, if the profitability measure has a value above one it is truncated to one, and if it has a value below minus one it is truncated to minus one. Very few observations require truncation. The profitability results reported in Section 4.2 are not altered if these observations are excluded.

Depreciation-adjusted capital expenditures: Segments are excluded from the capital spending analysis if the sum of the segments' capital expenditures for a firm is not within 3% of the firm's capital expenditures, or if the segment's sales are less than \$1 million.

Tobin's q : The numerator of Tobin's q , market value of total capital, is calculated as market value of common equity plus book value of debt. The denominator, replacement value of assets, is estimated using a modification of the Lindenberg and Ross (1981) algorithm. Plant and equipment are valued by setting up an acquisition schedule and adjusting for price-level changes and depreciation, as suggested by Lindenberg and Ross, while the technological change parameter of Lindenberg and Ross is, following Smirlock, Gilligan, and Marshall (1984), assumed to be zero. Specifically, we assume that the value of plant in 1970 (or the first year with available Compustat data) is equal to book value. Following Smirlock, Gilligan, and Marshall, we reduce the value of plant and equipment by 5% each year to compensate for depreciation, and then adjust it for inflation using the GNP deflator. We then apply the Lindenberg and Ross formula. For inventories, we apply the Lindenberg and Ross algorithm directly.

Conditional excess value: The conditional excess values are calculated separately for positive- and negative-EBIT firms by using separate multipliers. Only single-segment firms are used in calculating the multipliers. We attempt to

match segments with industry multipliers at the two-digit SIC level; thus 37% of the segments are assigned a two-digit industry and 63% a one-digit industry.

Industry-adjusted leverage: Segment assets are multiplied by the industry median debt-to-assets multiplier to calculate the segment's imputed debt level. Only single-segment firms are used in calculating the multipliers. The imputed debt level is divided by segment assets to obtain the segment's leverage ratio. For multisegment firms whose total assets are not equal to the sum of their segment asset figures, the imputed debt measure is grossed up (or down) by the percentage deviation. If either the imputed leverage ratio or the actual ratio is greater than one, it is truncated to one.

Industry-adjusted taxes paid: Segment EBITs are multiplied by the industry median taxes paid to EBIT multiplier to calculate the segment's imputed taxes paid. Only single-segment firms are used in calculating the multipliers. Negative-EBIT segments are excluded in calculating the industry median multiplier. Imputed taxes paid are set to zero for negative-EBIT segments, which is the amount of taxes that would be owed by a negative-EBIT single-segment firm that could not offset its losses against the gains of profitable divisions. Unrealistically high taxes-paid estimates are addressed by truncating actual, imputed, and industry median tax-to-EBIT ratios at 34%. Firms with missing tax data or with negative values of the expected or actual tax measures are omitted from the taxes-paid analysis.

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