

How risky is the debt in highly leveraged transactions?*

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This paper estimates the systematic risk of the debt in public leveraged recapitalizations. We calculate this risk as a function of the difference in systematic equity risk before and after the recapitalization. The increase in equity risk is surprisingly small after a recapitalization, ranging from 37% to 57%, depending on the estimation method. If total company risk is unchanged, the implied systematic risk of the post-recapitalization debt in twelve transactions averages 0.65. Alternatively, if the entire market-adjusted premium in the leveraged recapitalization represents a reduction in fixed costs, the implied systematic risk of this debt averages 0.40.

1. Introduction

Highly leveraged transactions such as leveraged buyouts (LBOs) and leveraged recapitalizations have grown explosively in number and size over the last several years. These transactions are largely financed with a combination of senior bank debt and subordinated lower-grade or 'junk' debt. Recently, the debt in these transactions has come under increasing scrutiny from investors, politicians, and academics. All three groups have asked in one way or another how risky leveraged buyout debt is in relation to the return it

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provides. One of the main issues in Congressional hearings in early 1989 was the banking sector's ability to withstand a recession in the face of large LBO loans.¹ Similarly, the troubles in the lower-grade bond market in the fall of 1989 (precipitated by the collapse of the Campeau transaction) magnified investors' concerns about the riskiness of high-yield bonds.²

Little academic research focuses exclusively on the risk/return characteristics of debt in highly leveraged transactions. Several recent studies, however, examine the lower-grade public bond market in some detail. These studies incorporate data from highly leveraged transactions as well as from other issuers who used lower-grade bonds to finance normal operations. Asquith, Mullins, and Wolff (1989) and Altman (1989) examine the *ex post* default experience of lower-grade bonds issued between 1977 and 1986. They find high cumulative default percentages relative to those for investment-grade bonds. Blume and Keim (1989) incorporate actual bond-default experience to calculate the returns that an investor would have realized by buying all the newly issued lower-grade bonds in 1977 and 1978. They find that the realized return on these bonds is 8.52%, approximately 1% above the return on an investment in Treasury bonds during the same period.³ As Asquith et al. point out, however, historical results represent only one draw from the distribution of possible lower-grade bond returns. Realized returns, *ex post*, may be abnormally high or low even if expected returns, *ex ante*, were normal.

Asquith et al. also point out that default risk is only one type of risk for which investors must be compensated. Returns to investments in lower-grade bonds should also compensate the investor for *ex ante* systematic risk. In this vein, Blume, Keim, and Patel (1989) present direct estimates of realized returns and systematic risk from lower-grade bond prices. They find that returns on lower-grade bonds have a beta of 0.25 relative to returns on the Standard and Poor's (S&P) 500 between 1982 and 1987, and 0.20 between 1985 and 1987. They obtain virtually identical bond betas using the returns on a portfolio of small stocks. During this period, the standard deviation of the returns on a portfolio of high-yield bonds is lower than the standard deviation of the S&P 500, a portfolio of Treasury bonds, and a portfolio of small stocks.

The junk bond market is relatively illiquid, however.⁴ So the quoted prices used by Blume, Keim, and Patel (1989) may not measure the true market

¹See the testimony of Alan Greenspan on leveraged buyouts and corporate debt before the Committee on Finance, United States Senate, January 26, 1989.

²See, for example, 'The Party's Over: Mounting Losses are Watershed for Junk-Bond Market', *Wall Street Journal*, September 18, 1989, p. 1.

³Asquith et al. report a 1.15% spread based on simulations of their data set.

⁴See, for example, 'Overstated Value in 'Junk' Funds', *New York Times*, November 2, 1989, p. 28.

prices. Estimates of systematic risk made from quoted prices would be downward biased if quoted prices do not adjust fully and immediately to changes in 'true' market values. Cornell and Green (1989) try to avoid this problem by using the returns on open-end lower-grade bond mutual funds. They find a higher beta (using the S&P 500), equal to 0.36, for an equally-weighted portfolio of lower-grade bond funds from 1977 to 1988.⁵

We take a new approach to the question of debt pricing in highly leveraged transactions. As do Blume, Keim, and Patel (1989) and Cornell and Green (1989), we focus on the systematic riskiness of debt returns. Rather than try to estimate debt riskiness directly, however, we use an 'implicit' technique in which we calculate the debt beta as a function of the difference in the systematic equity risk before and after the recapitalization. We use this technique for two reasons: first, we are concerned about the quality of bond-price data and the corresponding potential for problems when directly estimating the betas of lower-grade bonds; and second, our approach can shed some light on the question of bank-debt riskiness, which is difficult to measure because price data do not exist.⁶

Our method relies on data from public leveraged recapitalizations. Unlike a typical LBO, a public recapitalization does not involve the repurchase of all of a company's stock. Although there is a dramatic increase in leverage, public stockholders retain some interest in the company. They receive a large one-time dividend, but also keep their shares. These shares continue to trade, albeit at a reduced price that reflects the dividend payout. Recaps are often employed as defensive maneuvers by companies under takeover pressure, and result in a financial structure quite similar to that seen after an LBO. For our purposes, the key distinction is the existence of stock-price data after the completion of the deal.

Our method is most easily explained with a stylized example. Imagine that XYZ Corp. is initially all equity-financed and has a market value of \$100 and an equity beta of 1. Now suppose that XYZ undertakes a recap, borrowing \$85 from bank and lower-grade bond lenders, and using the cash to pay an \$85 dividend to shareholders. If there are no taxes or other sources of gains, the total market value of the company must still be \$100. Thus the 'stub' equity component is worth \$15. If the post-recapitalization debt has no

⁵While this approach should provide better beta estimates, it is not clear how much better such estimates will be. As Cornell and Green are careful to note, net asset values, themselves, are calculated to some extent using dealer quotes. In addition, Cornell and Green cannot measure whether the bond funds are fully invested in bonds with rating lower than Baa by Moody's or BBB by Standard and Poor's. To qualify as a lower-grade mutual fund in the Cornell and Green paper, a fund need only have two-thirds of its portfolio invested in bonds rated Baa or BBB or lower.

⁶A secondary market for highly leveraged bank loans has developed recently. However, we are unaware of any publicly available high-quality pricing data that could be used for direct estimates.

systematic risk, then conservation of systematic risk implies that the stub equity should have a new beta of 6.67 – the asset beta of 1 divided by the smaller equity-to-total-capital ratio of 0.15. Suppose, however, that we measure the stub's beta and find it to be only 2.22, or one-third of 6.67. This must mean that the remaining two-thirds of total company risk is now borne by the debtholders. If so, the debt has an 'implied beta' of 0.78 – the missing 0.67 of asset beta divided by the 0.85 ratio of debt to total capital.

We first calculate the systematic risk of pre- and post-recapitalization equity (using the market model and the value-weighted market index). We find that the average equity beta rises a surprisingly modest amount after a recapitalization. Market model estimates using daily returns rise from an average of 1.01 before to 1.38 after the recapitalization. The increase is larger, but still surprisingly small, for Scholes–Williams estimates on daily returns (from 1.00 to 1.57) and for market-model estimates of weekly returns (from 1.04 to 1.47). These estimates of equity risk provide the basis for our subsequent implicit estimates of debt betas. Because the increases in equity betas are small considering the amount of debt added in the recapitalizations, our method produces relatively high debt betas.

In our first scenario, we assume that the systematic risk of a firm's total capital – its asset beta – is unchanged after a recapitalization. Under this assumption, we find that the implied systematic risk on the debt in 12 leveraged recap transactions averages 0.65 (with a standard error of 0.06). This is the average beta for all debt, both senior and junior. Our method cannot determine the allocation of systematic risk between senior and junior debt. Under the arbitrary assumption that the junior lower-grade debt has twice the systematic risk of the senior bank debt in these transactions, we find that the lower-grade debt has an average beta of 0.89.

Next, we consider a case in which we assume the entire (market-adjusted) premium in the leveraged recapitalization represents a reduction in fixed costs. This is equivalent to assuming that firms undergoing leveraged recapitalizations experience a large decrease in their asset betas. Under this assumption, we find the implied systematic risk of total debt averages 0.40 (with a standard error of 0.05). Our estimate for the lower-grade debt (assuming lower-grade debt has twice the systematic risk of bank debt) is 0.54.

The differences between the constant and reduced asset beta cases show that the debt beta results depend on our assumptions about changes in asset beta after a recapitalization – a subject we discuss in detail in section 3. We do not attempt to make a case for a single 'best' estimate of debt betas. Given the uncertainties that inevitably surround our indirect approach, our goal is simply to establish a reasonable range of values, and to highlight the assumptions on which the different values are based.

The estimates in our constant and reduced asset beta cases are based on the equity betas estimated using the market model on daily returns to a value-weighted index. We obtain similar results using Scholes–Williams equity betas and equity betas estimated using the market model on weekly returns to a value-weighted index. We also obtain similar results using equal-weighted index returns and S&P 500 returns.

After presenting our implied beta estimates, we contrast them with direct estimates of the systematic risk of the low-grade bonds in these transactions using bond-price data provided by Morgan Stanley. Depending on the estimation technique, we find that these low-grade bonds have an average beta of at most 0.41. This is in line with the results of Cornell and Green and at the low end of the range of values suggested by our implied beta methodology.

The paper proceeds as follows. Section 2 describes our sample. Section 3 describes our methodology. Section 4 presents our implied systematic risk estimates for all debt. Section 5 discusses the allocation of systematic risk between bank and lower-grade debt. Section 6 presents our direct estimates of the systematic risk of low-grade bonds, and section 7 offers concluding comments.

2. Sample

We identify leveraged recapitalizations as those companies categorized as completed recapitalizations by the Securities Data Company merger database in July 1989 and those companies that make up the Salomon Brothers Stub Index. The companies in the Salomon Brothers Stub Index 'have all undertaken leveraged recapitalizations or buyouts that have raised debt outstanding above the historical level and caused the firm's creditworthiness to fall'.⁷ We begin with 31 companies from these two sources. However, our tests require that we restrict the sample in several ways.

We exclude three companies that were not publicly traded after the recapitalization and one that lacked publicly traded equity before the recapitalization. To ensure enough stock returns with which to compute β 's, we exclude nine companies that completed their recapitalizations in 1989.⁸ Finally, to obtain a sample of highly leveraged companies with characteristics similar to leveraged buyouts, we exclude six companies with less than 60% debt in their capital structure just after the recapitalization is consummated.

⁷See 'Stubs: Should Investors Care?' by R.S. Salomon, Jr. and Eric Sorenson, Stock Research, Investment Policy, Salomon Brothers, July 13, 1989.

⁸Of these nine, only two or three will meet the other requirements when more returns are available.

Table 1
Pre- and post-recapitalization capital structures.

Descriptive statistics for pre- and post-recapitalization capital structure for 12 leveraged recapitalizations completed from 1985 to 1988.^a

Company	Recap completed	Pre-recapitalization ^b				Post-recapitalization ^c			
		Debt (as % of total capital)	Prf'd	Common	Total capital (\$M)	Debt (as % of total capital)	Prf'd	Common	Total capital (\$M)
1. Colt Industries	10/08/86	11.3%	0.0%	88.7%	1,527	84.0%	0.0%	16.0%	2,103
2. FMC	05/29/86	14.6	0.0	85.4	1,916	74.4	0.0	25.6	2,554
3. Fruehauf	12/24/86	41.6	0.0	58.4	1,245	83.6	13.9	2.4	1,916
4. Harcourt Brace Jovanovich	07/28/87	27.7	0.0	72.3	2,488	70.2	13.0	16.7	3,656
5. Holiday	04/22/87	49.5	0.0	50.5	2,640	88.2	0.0	11.8	3,364
6. Interco	12/23/88	26.6	0.0	73.4	2,083	84.7	11.2	4.1	2,955
7. Kroger	12/05/88	28.7	6.1	65.2	4,099	87.8	0.0	12.2	6,286
8. Multimedia	10/02/85	8.6	0.0	91.4	611	81.1	0.0	18.9	1,115
9. Owens Corning Fiberglas	11/06/86	27.2	0.0	72.8	2,085	84.3	0.0	15.7	2,929
10. Shoney's	08/04/88	1.7	0.0	98.3	762	72.9	0.0	27.1	1,041
11. Swank	03/01/88	31.9	0.0	68.1	83	74.8	0.0	25.2	94
12. USG	07/14/88	37.0	0.0	63.0	2,301	89.4	0.0	10.6	3,495
Average		25.5	0.5	74.0	1,824	81.3	3.2	15.5	2,626
Median		27.5	0.0	72.5	2,025	83.8	0.0	15.9	2,742

^a Financial data were obtained from proxy and 10-K statements describing the recapitalizations.

^b Pre-recapitalization market value of equity equals the common stock price 40 trading days before the recapitalization announcement times the number of primary shares outstanding plus the book value of convertible debt. Debt equals the book value of nonconvertible debt less the excess cash used to finance the transaction. Preferred stock equals the book value of preferred stock. Debt and preferred stock are obtained from the proxy or 10-K statements describing the transaction. Total capital is the sum of (1) the market value of equity (40 trading days before the announcement), (2) debt, and (3) preferred stock.

^c Post-recapitalization market value of equity equals the closing common stock price the day the recapitalization is completed times the number of primary shares outstanding after the recapitalization. Debt and preferred stock are equal to the book value of debt and preferred stock after the recapitalization as given in the proxy or 10-K statements describing the transaction. Total capital is the sum of (1) the market value of equity (the day the recapitalization is completed), (2) debt, and (3) preferred stock.

The twelve companies that satisfy our data requirements and the dates the recapitalizations were completed are listed in table 1. For each company, we obtained the proxy statement or 10-K statement describing the recapitalization. We also obtained pre- and post-transaction financial statements for these companies. With these documents, we determined the pre- and post-recapitalization capital structures. Table 1 shows that these companies are

not highly leveraged before the recapitalization. Debt in the average company is 25.5% of total capital.

Table 2 confirms that public shareholders receive large premiums in leveraged recapitalization transactions. On average, the common-stock prices of recapitalization companies increase 57.0% from 40 trading days before the recapitalization announcement until the recapitalization is completed. This increase is 44.9 percentage points greater than the increase in the value-weighted index over the same period.

Tables 1 and 2 show that the sample companies become highly leveraged after the recapitalizations. Debt makes up 81.3% of post-recapitalization total capital on average, where post-recapitalization total capital is the sum of the market value of equity the day the recapitalization is completed, the book value of preferred stock and the book value of both convertible and nonconvertible debt.⁹ This degree of leverage is only slightly less than the 85.6% found for a sample of management buyouts by Kaplan (1989b). Thus the recapitalizations appear to be representative of buyout financial structures.

Table 2 shows that an average of 58.6% of post-recapitalization debt is newly provided by commercial banks and 25.2% newly provided by lower-grade subordinated debt. The remaining 16.2% of the post-recapitalization debt is pre-recapitalization debt that remains outstanding. In all cases, the bank debt carries a variable interest rate that is priced at a spread above the prime rate and/or LIBOR (London Interbank Offer Rate). Typically, the borrower has the option to pay the lowest of the rates available. For the 12 transactions in our sample, the average spreads are 1.48% over prime and 2.46% over LIBOR. In 1986 and 1987, the prime rate and LIBOR averaged 2.00% and 0.80%, respectively, above the six-month T-bill rates.¹⁰ This implies that LIBOR was the relevant rate during this period. The average bank loan, therefore, required an interest rate approximately 3.25% over the T-bill rate. Table 2 also shows that the lower-grade debt in these transactions promised a yield to maturity on average 5.01% above the yield on a Treasury bond of comparable maturity. Weighted by debt value, the promised return on the new debt in these recaps averages 3.78% above Treasury yields. Because of default risk, *expected returns* above Treasuries are undoubtedly lower than the promised returns.

⁹This measure of total capital should approximate market value. The book value of newly issued debt and preferred stock will equal market value just after the recapitalization is completed. (All newly issued discount debt is booked at its market value, not face value.) In addition, no old convertible debt remains outstanding after the recapitalization. Only the relatively small amount of previously issued nonconvertible debt may have a market value appreciably different from book value.

¹⁰Yields are obtained from Salomon Brothers Analytical Bond Record.

Table 2
Summary statistics for recapitalizations.

Descriptive statistics for premium, leverage, bank debt, and lower-grade debt for 12 leveraged recapitalizations completed from 1985 to 1988.^a

Variable	Mean	Median	Std. dev.	N
Premium – Return on common stock from two months before recapitalization announcement to recapitalization completion ^b	57.0%	62.2%	21.2%	12
Market-adjusted premium on common stock from two months before recapitalization announcement to recapitalization completion ^b	44.9%	47.0%	19.9%	12
Pre-recapitalization total debt as percentage of value of total capital at time of recapitalization ^c	18.3%	18.8%	10.7%	12
Post-recapitalization total debt as percentage of value of total capital at time of recapitalization ^c	81.3%	83.8%	6.5%	12
Post-recapitalization bank debt as a percentage of total post-recapitalization debt ^d	58.6%	56.6%	14.7%	12
Post-recapitalization public lower-grade debt as a percentage of total post-recapitalization debt ^d	25.2%	29.3%	11.1%	12
Interest rate on bank debt ^e				
Spread over prime rate	1.48%	1.50%	0.129%	12
Spread over LIBOR	2.46%	2.50%	0.144%	12
Yield to maturity on public lower-grade debt less yield on comparable Treasury bond ^f	5.01%	4.96%	0.969%	11
Asset sales from recapitalization announcement to six months after recapitalization completion as a percentage of total capital at time of recapitalization ^{c,g}	9.5%	7.5%	10.5%	12

^aFinancial data were obtained from proxy and 10-K statements describing the recapitalizations.

^bPremium is calculated as the percentage difference between the common stock price the day before the recapitalization is completed and the common stock price 40 trading days before the recapitalization is announced. If the recapitalization is a response to a previous hostile bid, the announcement day of the hostile bid is used. Market-adjusted premium equals the premium divided by 1 plus the return on the value-weighted market index during the same period.

^cPre-recapitalization debt equals pre-recapitalization book value of debt less excess cash used to finance the transactions. Value of total capital at the recapitalization equals the sum of (1) the final recapitalization equity value, (2) the pre-recapitalization debt, (3) the market value of common stock (using the fully diluted number of shares) the day before the recapitalization is completed, and (4) the pre-recapitalization book value of preferred stock. Convertible debt is treated as equity.

^dBank debt is debt provided by commercial banks to finance the recapitalization. Public lower-grade debt is newly issued debt used to finance the recapitalization rated Ba or below by Moody's Investor Services. One recapitalization, Swank, did not use lower-grade debt.

^eRequired interest rates on bank debt are quoted as spreads above the prime rate or LIBOR (London Interbank Offer Rate). Each period, the borrower has the option to pay the lower rate (including spread).

^fYields to maturity for Treasury bonds with similar maturities are obtained from Salomon Brothers Analytical Bond Record for the month the lower-grade bonds are issued. For issuers with more than one lower-grade bond outstanding, the average of the spreads is used.

^gAsset sales equal the proceeds from announced asset sales by the recapitalization companies.

Overall, the capital structure, the premium paid to public shareholders, and the interest rates on the debt financing in the 12 leveraged recapitalizations are similar to those found in management buyouts by Kaplan (1989b).

3. Method

3.1. Constant asset beta case

We take the following steps to estimate the implied betas of the debt. First, we estimate pre- and post-recapitalization equity betas, β_o^E (where the subscript 'o' denotes 'old') and β_n^E (where the subscript 'n' denotes new), using the market model:

$$R_{i,t} = \alpha_o + \beta_{o,i}^E R_{m,t} + \varepsilon_t, \quad (1)$$

$$R_{i,t} = \alpha_n + \beta_{n,i}^E R_{m,t} + \varepsilon_t, \quad (2)$$

where $R_{i,t}$ is the return to firm i over period t , and $R_{m,t}$ is the return to the market portfolio over period t . In both of our principal cases, β_o^E is estimated by regressing daily stock returns on the Center for Research in Security Prices (CRSP) value-weighted index from 165 trading days to 40 trading days before the recapitalization announcement; β_n^E is estimated by regressing daily stock returns on the value-weighted index from 3 trading days to 128 trading days after the recapitalization is completed.¹¹ These six-month periods represent, respectively, from eight to two months before any information about the recapitalization is known and six months after the recapitalization is completed. In the seven cases where a takeover bid or a large-block-share purchase by a hostile investor preceded the recapitalization announcement, the date of the bid or block purchase is considered the announcement date.¹²

Using our estimates of β_o^E , we calculate pre-recapitalization asset betas, β_o^A ,

$$\beta_o^A = \beta_o^E \frac{E_o}{E_o + D_o} + \beta_o^D \frac{D_o}{E_o + D_o}, \quad (3)$$

¹¹In estimating betas, we exclude returns between October 11 and October 30, 1987 because returns during the stock market crash are large and potentially unreliable. This exclusion does not affect the results. More generally, our results are also robust to different estimation intervals for equity betas.

¹²Only Colt, FMC, Holiday, Shoney's, and Swank announced the recapitalizations before other bids or block purchases.

where E_o is the market value of equity using primary shares 40 trading days before the recapitalization announcement plus the book value of preferred stock and convertible debt, and D_o is the book value of nonconvertible debt less excess cash. Excess cash is defined as the cash on hand used to finance the transaction.

Only two companies have pre-recapitalization convertible debt. (None has any convertible debt after the recapitalization.) During the estimation period before the recapitalization, the stock price exceeds the conversion price for one company and approximately equals the conversion price for the other. The convertible debt, therefore, has significant equity characteristics. To the extent that the convertibles are not entirely equity, treating them as such would overstate β_o^A and, hence, overstate the estimated post-recapitalization debt betas. However, treating pre-recapitalization convertible debt as debt leads to virtually identical results.

To calculate the pre-recapitalization asset betas, we need to make an assumption about the beta of the old debt, β_o^D . In our principal cases, we assume β_o^D equals 0.15, which is approximately equal to the beta on Treasury bonds over our sample period.¹³ If a β_o^D of 0.15 is too high, our estimates of post-recapitalization debt betas will be overstated. Below, we also present the polar case in which β_o^D equals 0.0.

In our constant asset beta case, we assume that company asset betas are the same before and after the recapitalization. This implies:

$$\beta_o^A = \beta_n^E \frac{E_n}{E_n + D_n} + \beta_n^D \frac{D_n}{E_n + D_n}, \quad (4)$$

where β_n^D is the beta or systematic risk of all debt, E_n is the market value of equity using primary shares after the recapitalization plus the book value of preferred stock, and D_n is the book value of debt after the recapitalization. This calculation does not adjust for any tax shields associated with debt.

In our calculations, we treat preferred stock as equity. This understates estimated debt betas because nonconvertible preferred stock has some debt characteristics and the sample companies have more preferred stock after the recapitalization than before. Below, we also present estimates in which we treat preferred stock as debt.

Rearranging terms, we calculate an implied debt beta:

$$\beta_n^D = \frac{E_n + D_n}{D_n} \left[\beta_o^A - \beta_n^E \frac{E_n}{E_n + D_n} \right]. \quad (5)$$

¹³See Blume, Keim, and Patel, who estimate that Treasury bonds have betas of 0.24 over the period 1982 to 1988 and 0.16 from July 1985 to the end of 1988.

3.2. Reduced asset beta case

Firms' asset betas may not be equal before and after a recapitalization. Healy and Palepu (1990) find that companies' asset betas increase after a primary issue of common stock. The large repurchase of common stock in a leveraged recapitalization could be associated with the opposite kind of news about company risk. Furthermore, the results in Kaplan (1989a, b) and Schipper and Smith (1988) suggest that companies undergoing management buyouts realize significant reductions in operating costs and taxes. If these primarily represent reductions in fixed obligations, asset betas will decline. In contrast, reductions in variable costs only will raise asset betas.

To account for a possible reduction in asset beta, we consider a reduced asset beta case in which the entire market-adjusted premium from the recapitalization represents a reduction in fixed costs. This is equivalent to assuming:

$$\beta_o^{A*} = \beta_o^A \frac{E_o + D_o + Mkt_o}{E_n + D_n}, \tag{6}$$

where β_o^{A*} is the new (reduced) asset beta and Mkt_o is the market adjustment. Mkt_o is the product of E_o and the return on the value-weighted index from 40 days before the recapitalization announcement until the recapitalization is complete.

The implicit beta on all post-recapitalization debt, β_n^{D*} , is then calculated as

$$\beta_n^{D*} = \frac{E_n + D_n}{D_n} \left[\beta_o^{A*} - \beta_n^E \frac{E_n}{E_n + D_n} \right]. \tag{5*}$$

These estimates of post recapitalization debt betas are similar to, but lower than, those that would be obtained using a tax-adjusted formula when tax benefits are riskless and permanent.¹⁴

The constant and reduced asset beta cases cover a wide range of possible post-recapitalization operating changes. As a matter of pure theory, however, post-recapitalization asset betas could end up on either side of these bounds. For example, a company that recapitalizes might realize reductions in fixed

¹⁴The tax-adjusted formula for β_n^D is

$$\frac{E_n + D_n(1 - \tau)}{D_n} \left[\frac{\beta_o^E E_o + \beta_o^D D_o}{E_o + D_o(1 - \tau)} - \frac{\beta_n^E E_n}{E_n + D_n(1 - \tau)} \right].$$

This implicitly assumes tax benefits, at a rate τ , are certain and permanent. The tax benefits from both the new and old debt are incorporated, respectively, in the pre- and post-recapitalization equity values. If τ is sufficiently high – if riskless tax benefits alone explain most of the market-adjusted premium – this formula produces results similar to those obtained from eq. (5*).

costs that are worth more than the premium, but incur increased variable costs. Alternatively, the operating improvements might alter fixed and variable costs in such a way that a company's operating leverage and its asset beta increase. Nonetheless, we believe the constant and reduced asset beta cases establish a plausible range of values for post-recapitalization asset betas.

If anything, the reduced asset beta case goes too far in reducing asset betas and the corresponding implied debt betas. Although managers clearly have an incentive to reduce costs in their highly leveraged companies, it seems likely that a portion of the typical premium represents a reduction in variable costs. First, the ability to use tax benefits depends on the amount of taxable income, which clearly has a variable or systematic component. Second, while some operating improvements undoubtedly involve the reduction of fixed costs such as headquarter employees, others, such as improved inventory management, generate gains that will vary with the scale of operations. Third, changes in the pattern of investment may actually increase systematic risk after the recapitalization. [Kaplan (1989b) finds that management buy-outs reduce capital expenditures after the buyout.] For example, suppose companies are subject to agency problems of free cash flow and are overinvesting before the recapitalization [see Jensen (1986, 1988)]. Presumably, overinvestment is greater in good times when cash flow is more plentiful. If the increase in leverage after the recapitalization lowers the tendency to overinvest, it creates new value that has positive systematic risk. A similar argument can be made where marginal investments have a positive rather than negative present value. Now the recapitalization, by forcing managers to forego valuable investments, reduces value. Since this underinvestment is likely to be more severe in bad times, the effect is, again, to increase systematic risk. Finally, if a recapitalization increases the expected costs of financial distress, there is an additional upward influence on post-recapitalization asset betas.

In light of these four considerations, we think our constant and reduced asset beta cases are plausible upper and lower bounds for estimating implied debt betas. Still, we recognize that since asset betas below those in our reduced asset beta case are at least a theoretical possibility, the surprisingly low post-recapitalization equity betas we find could be interpreted primarily as evidence of a large reduction in asset beta. Accordingly, we also calculate the asset beta reduction that would have to take place to keep post-recapitalization debt betas at a level suggested by previous research.

3.3. Other methodological issues

Our constant and reduced asset beta estimates do not explicitly account for possible asset sales. For asset sales that are planned, but not completed,

uncertainty about the sales price still exists and our method is appropriate.¹⁵ For asset sales that are completed between the recapitalization and the end of the post-recapitalization estimation period, our results may be affected. Because the proceeds of the sales represent a now-certain source of value that can be used to pay down the debt, we should not be counting all the debt outstanding immediately after the recapitalization in our measure of D_n . Some of this debt is effectively 'defeased' by the asset sale. We provide a check on this in what follows by looking at the amount of debt paid down in the year following the recapitalization. Our results are essentially unchanged. This is not surprising given the small magnitude of asset sales documented in table 2 – only six of our twelve companies sell assets before the end of the estimation period. The average company sells assets worth 9.5% of total post-recapitalization capital, with no single company selling assets worth more than 30% of total post-recapitalization capital.

Interest-rate swaps and hedges on the bank debt used to finance the recapitalizations present an additional methodological concern. When companies enter into swaps and hedges, swap or hedge counterparties bear some of the systematic risk we attribute to debt and equityholders. Although we cannot determine exactly how much systematic risk should be allocated to the swap or hedge counterparties, a quick calculation suggests that this allocation is small. In ten of the twelve transactions, the bank-loan agreement requires the company to swap or hedge at least 48% of the bank debt used to finance the transaction. At a minimum, this represents almost 30% of the post-recapitalization debt; at a maximum, 58.6% (all the bank debt). The amount of systematic risk in a swap, however, is likely to be small. Blume et al. estimate betas for long-term Treasury bonds of 0.16 during this period. The swaps or hedges are of much shorter maturity – they do not exceed seven years – and, therefore, probably have a beta of at most 0.08. Taken together, these points suggest that controlling for swaps and hedges would reduce the implicit beta estimate for an individual company's debt by at most 0.05; the reduction in the average implicit debt beta would be smaller.

4. Empirical results

4.1. Equity betas

Table 3 presents our equity beta estimates using three estimation methods (all with the value-weighted index). Panel A presents market-model estimates using daily returns. We find that the recapitalization companies have an average equity beta of 1.01 (with a standard error of 0.06) and a median

¹⁵More precisely, this is correct insofar as the sales price has the same risk characteristics as the present value of the asset to the seller.

Table 3
Pre- and post-recapitalization equity betas.

Pre- and post-recapitalization equity betas and standard errors using market-model and Scholes-Williams estimates with daily data and market-model estimates with weekly data for 12 leveraged recapitalizations completed from 1985 to 1988. All estimates use the value-weighted index of all CRSP stocks. Standard errors are in parentheses.

Company	Panel A		Panel B		Panel C	
	Market-model daily data ^a		Scholes-Williams daily data ^b		Market-model weekly data ^c	
	Pre-equity beta (S.E.)	Post-equity beta (S.E.)	Pre-equity beta (S.E.)	Post-equity beta (S.E.)	Pre-equity beta (S.E.)	Post-equity beta (S.E.)
1. Colt Industries	0.63 (0.16)	1.29 (0.26)	0.72 (0.16)	1.30 (0.26)	0.64 (0.29)	1.75 (0.65)
2. FMC	0.88 (0.17)	1.09 (0.16)	0.66 (0.17)	1.11 (0.16)	0.52 (0.33)	1.07 (0.36)
3. Fruehauf	0.76 (0.24)	0.73 (0.50)	0.46 (0.24)	1.39 (0.50)	0.53 (0.59)	1.30 (1.03)
4. Harcourt Brace Jovanovich	1.85 (0.24)	1.68 (0.24)	1.80 (0.24)	1.48 (0.24)	2.27 (0.39)	1.22 (0.69)
5. Holiday	0.75 (0.14)	1.65 (0.32)	0.78 (0.14)	1.64 (0.32)	0.72 (0.26)	0.83 (0.64)
6. Interco	0.93 (0.12)	1.96 (0.64)	0.81 (0.12)	1.53 (0.64)	0.82 (0.24)	-0.06 (1.77)
7. Kroger	1.20 (0.19)	1.41 (0.31)	1.20 (0.19)	1.82 (0.31)	0.67 (0.50)	1.89 (0.62)
8. Multimedia	0.75 (0.19)	1.22 (0.27)	1.01 (0.19)	2.18 (0.27)	1.27 (0.42)	2.25 (0.97)
9. Owens Corning Fiberglas	1.10 (0.17)	1.86 (0.31)	1.34 (0.17)	2.13 (0.31)	1.34 (0.36)	1.36 (0.74)
10. Shoney's	0.76 (0.13)	1.45 (0.34)	0.60 (0.13)	1.49 (0.34)	0.90 (0.26)	1.82 (0.56)
11. Swank	1.14 (0.30)	0.84 (0.47)	1.11 (0.30)	1.20 (0.47)	1.49 (0.62)	2.15 (1.04)
12. USG	1.37 (0.22)	1.36 (0.36)	1.47 (0.22)	1.54 (0.36)	1.31 (0.60)	2.03 (0.52)
Average	1.01	1.38	1.00	1.57	1.04	1.47
Median	0.91	1.38	0.91	1.51	0.86	1.55
S.E. ^d	0.06	0.11	0.06	0.11	0.12	0.25

^aPre-recapitalization equity betas, β_o^E , are calculated using daily returns, the market model, and the value-weighted index from 165 trading days to 40 trading days prior to the recapitalization announcement. Post-recapitalization equity betas, β_n^E , are calculated using daily returns, the market model, and the value-weighted index from 3 trading days to 128 trading days after the recapitalization is completed. All estimates are based on at least 100 observations.

^bPre-recapitalization equity betas, β_o^E , are calculated using daily returns, Scholes-Williams beta estimates, and the value-weighted index from 165 trading days to 40 trading days prior to

Table 3 (continued)

the recapitalization announcement. Post-recapitalization equity betas, β_n^E , are calculated using daily returns, Scholes–Williams estimates, and the value-weighted index from 3 trading days to 128 trading days after the recapitalization is completed. All estimates are based on at least 100 observations.

^cPre-recapitalization equity betas, β_o^E , are calculated using weekly returns, the market model, and the value-weighted index from 165 trading days to 40 trading days prior to the recapitalization announcement. Post-recapitalization equity betas, β_n^E , are calculated using weekly returns, the market model, and the value-weighted index from 3 trading days to 128 trading days after the recapitalization is completed. All estimates are based on at least 20 observations.

^dThe standard errors (S.E.s) of the individual-firm equity betas, both pre- and post-recapitalization, are calculated from the regressions used to estimate the betas. The standard errors of the average pre- and post-recapitalization equity betas are calculated as

$$\left(\sum_{i=1}^k \text{var}(\beta_i) / k^2 \right)^{0.5},$$

where β_i is the relevant β for firm i and k is the number of sample firms.

equity beta of 0.91 in the six-month period (125 trading days) before the recapitalization announcement. The equity betas in the six months after recapitalization completion average 1.38 (with a standard error of 0.11) and also have a median value of 1.38. The estimated post-recapitalization equity betas are, thus, 37% larger than the estimated pre-recapitalization betas. While significant at the 5% level, the increase is surprisingly small – the conventional unleveraging and releveraging procedure (that assumes all debt is riskless) implies that the average post-recapitalization equity beta should equal 4.25. In contrast, the highest equity beta in our sample is Interco, at 1.96. In fact, the post-recapitalization equity betas of four of our sample companies decline. None of these four declines, however, is statistically different from zero at conventional significance levels.

It is possible that our beta estimates, particularly post-recapitalization, are affected by nonsynchronous trading biases.¹⁶ To account for this possibility, panel B presents results based on the estimator suggested by Scholes and Williams (1977), again using daily returns, and panel C presents market-model estimates using weekly returns. The Scholes–Williams pre-recapitalization betas are similar to the market-model estimates, with an average value of 1.00. The Scholes–Williams post-recapitalization betas are slightly higher than the market-model estimates, averaging 1.57. For these estimates, only one company has a lower equity beta after the recapitalization than before. The weekly market-model estimates in panel C appear to be an intermediate case between panels A and B. The pre-recapitalization equity betas average

¹⁶The stock of all of the companies in our sample except for Swank traded every day before and after the recapitalization.

1.04 (slightly higher than the previous estimates) and the post-recapitalization betas, 1.47.¹⁷

In tables 4a, 4b, and 5, we base our implied debt beta calculations on the market-model estimates using daily returns. In table 6, we show that the results for implied debt betas are similar when we use the equity betas obtained from the two other techniques. Throughout, the relatively high debt betas we calculate are a direct consequence of the modest rise in equity betas after a large increase in leverage.¹⁸

4.2. Implied debt betas: Constant asset beta case

Table 4a presents our implicit debt betas under the assumption that pre- and post-recapitalization asset betas are equal. We begin by applying eq. (3) to the pre-recapitalization equity beta estimates. This unleveraging procedure assumes that the pre-recapitalization debt has a beta of 0.15. Pre-recapitalization asset betas are an average and a median of 0.78 and 0.76. To unleverage the post-recapitalization equity beta estimates, we multiply them by $(E_n/(E_n + D_n))$. This product represents the portion of the post-recapitalization asset beta contributed by the post-recapitalization equity. The mean and median asset beta contributed by post-recapitalization equity are 0.25 and 0.22.

The portion of asset beta contributed by post-recapitalization equity is small compared with the pre-recapitalization asset betas. Under the assumption that pre- and post-recapitalization asset betas are equal, we attribute the 'missing' systematic risk to the post-recapitalization debt. Applying eq. (5), we find average and median implicit betas on all post-recapitalization debt of 0.65 and 0.62, respectively. The average has a standard error of 0.06. The beta estimates for debt are larger than those found in previous work. If they are correct, they suggest that the value of debt in highly leveraged companies varies substantially with the value of the stock market.

4.3. Implied debt betas: Reduced asset beta case

Table 4b presents our results under the assumption that the market-adjusted premium represents a reduction in fixed costs. If this is the case, the

¹⁷John Hand kindly provided independent verification of the market-model and Scholes-Williams equity beta estimates. We also consulted Value Line to check our post-recapitalization estimates. Because of data requirements, Value Line has such estimates only for FMC, Multimedia, and Owens Corning Fiberglas. However, the average Value Line beta is 1.41, approximately equal to our daily market-model estimate of 1.39 for these three companies.

¹⁸Baldwin and Mason (1983) find that Massey Ferguson, a company whose leverage increased dramatically over time as a result of poor performance, actually experienced a decline in its equity beta during the period of poor performance.

Table 4a
Implied debt betas: Constant asset beta case.

Pre-recapitalization equity and asset betas, post-recapitalization equity betas, and implicit post-recapitalization debt betas assuming pre- and post-recapitalization asset betas are equal and pre-recapitalization debt beta is 0.15 for 12 leveraged recapitalizations completed from 1985 to 1988.

Company	Pre-recapitalization		Post-recapitalization		Implicit beta all debt ^d	Std. error implicit beta ^e
	Equity beta ^a	Asset beta ^b	Equity beta ^a	Asset beta from equity ^c		
1. Colt Industries	0.63	0.57	1.29	0.21	0.44	0.18
2. FMC	0.88	0.77	1.09	0.28	0.66	0.20
3. Fruehauf	0.76	0.51	0.73	0.12	0.46	0.20
4. Harcourt Brace Jovanovich	1.85	1.38	1.68	0.50	1.25	0.26
5. Holiday	0.75	0.46	1.65	0.20	0.29	0.09
6. Interco	0.93	0.72	1.96	0.30	0.50	0.16
7. Kroger	1.20	0.90	1.41	0.17	0.83	0.16
8. Multimedia	0.75	0.70	1.22	0.23	0.58	0.23
9. Owens Corning Fiberglas	1.10	0.84	1.86	0.29	0.65	0.16
10. Shoney's	0.76	0.75	1.45	0.39	0.49	0.22
11. Swank	1.14	0.83	0.84	0.21	0.82	0.31
12. USG	1.37	0.92	1.36	0.14	0.86	0.16
Average	1.01	0.78	1.38	0.25	0.65	0.06
Median	0.91	0.76	1.38	0.22	0.62	

^aPre-recapitalization equity betas, β_o^E , are calculated using the market model and the value-weighted index from 165 trading days to 40 trading days before the recapitalization announcement. Post-recapitalization equity betas, β_n^E , are calculated using the market model and the value-weighted index from 3 trading days to 128 trading days after the recapitalization is completed.

^bPre-recapitalization asset betas adjusted for reduction in fixed costs, β_o^A , equal

$$\beta_o^A = \left[\beta_o^E \frac{E_o}{E_o + D_o} + \beta_o^D \frac{D_o}{E_o + D_o} \right] \frac{E_o + D_o + Mk\tau_o}{E_n + D_n}$$

where β_o^E is the pre-recapitalization equity beta, E_o is the market value of equity using primary shares 40 trading days before the recapitalization announcement plus the book value of preferred stock and convertible debt, D_o is the book value of nonconvertible debt less excess cash used to finance the transaction, obtained from the financial statement describing the recapitalization, β_o^D is the pre-recapitalization debt beta, which is assumed to equal 0.15, $Mk\tau_o$ is the product of E_o and the value-weighted market return from 40 trading days before the recapitalization announcement to recapitalization completion, E_n is the market value of equity using primary shares after the recapitalization is completed plus the book value of preferred stock, and D_n is the book value of debt after the recapitalization is completed.

^cPost-recapitalization asset betas from equity are calculated as $\beta_n^E(E_n/(E_n + D_n))$, where β_n^E is the post-recapitalization equity beta.

^dImplicit beta on all post-recapitalization debt, β_n^D , assumes the post-recapitalization asset beta, β_n^A , equals the pre-recapitalization asset beta. β_o^D is calculated as

$$\beta_n^D = \frac{E_n + D_n}{D_n} \left[\beta_o^A - \beta_n^E \frac{E_n}{E_n + D_n} \right]$$

^eThe variance of the implicit debt beta for firm i , $\text{var}(\beta_{n,i}^D)$, is calculated as

$$\begin{aligned} \text{var}(\beta_{n,i}^D) &= S_o^2 + S_n^2 \\ \text{where } S_o^2 &= [E_o/(E_o + D_o)]^2 [(E_o + D_o + Mk\tau_o)/D_n]^2 S_{E_o}^2 \\ S_n^2 &= (E_n/D_n)^2 S_{E_n}^2 \end{aligned}$$

$S_{E_o}^2$ and $S_{E_n}^2$ are the estimated variances of the pre- and post-recapitalization equity betas.

The average standard error of 0.05 is the standard error of the average implied debt beta. This is calculated as

$$\left(\sum_{i=1}^k \text{var}(\beta_{n,i}^D) / k^2 \right)^{0.5}$$

where k is the number of sample firms.

Table 4b
Implied debt betas: Reduced asset beta case.

Pre-recapitalization equity and asset betas, post-recapitalization equity betas, and implicit post-recapitalization debt betas assuming total market-adjusted premium represents reduction in fixed costs and pre-recapitalization debt beta is 0.15 for 12 leveraged recapitalization completed 1985 to 1988.

Company	Pre-recapitalization		Post-recapitalization		Implicit beta all debt ^d	Std. error implicit beta ^e
	Equity beta ^a	Asset beta adjusted ^b	Equity beta ^a	Asset beta from equity ^c		
1. Colt Industries	0.63	0.42	1.29	0.21	0.26	0.13
2. FMC	0.88	0.70	1.09	0.28	0.57	0.19
3. Fruehauf	0.76	0.36	0.73	0.12	0.29	0.16
4. Harcourt Brace Jovanovich	1.85	0.96	1.68	0.50	0.66	0.20
5. Holiday	0.75	0.40	1.65	0.20	0.23	0.08
6. Interco	0.93	0.55	1.96	0.30	0.30	0.14
7. Kroger	1.20	0.59	1.41	0.17	0.48	0.11
8. Multimedia	0.75	0.40	1.22	0.23	0.21	0.14
9. Owens Corning Fiberglas	1.10	0.61	1.86	0.29	0.38	0.12
10. Shoney's	0.76	0.63	1.45	0.39	0.32	0.19
11. Swank	1.14	0.65	0.84	0.21	0.59	0.26
12. USG	1.37	0.65	1.36	0.14	0.57	0.12
Average	1.01	0.58	1.38	0.25	0.40	0.05
Median	0.91	0.60	1.38	0.22	0.35	

^aPre-recapitalization equity betas, β_o^E , are calculated using the market model and the value-weighted index from 165 trading days to 40 trading days before the recapitalization announcement. Post-recapitalization equity betas, β_n^E , are calculated using the market model and the value-weighted index from 3 trading days to 128 trading days after the recapitalization is completed.

^bPre-recapitalization asset betas adjusted for reduction in fixed costs, β_o^A , equal

$$\beta_o^A = \left[\beta_o^E \frac{E_o}{E_o + D_o} + \beta_o^D \frac{D_o}{E_o + D_o} \right] \frac{E_o + D_o + Mkt_o}{E_n + D_n}$$

where β_o^E is the pre-recapitalization equity beta, E_o is the market value of equity using primary shares 40 trading days before the recapitalization announcement plus the book value of preferred stock and convertible debt, D_o is the book value of nonconvertible debt less excess cash used to finance the transaction, obtained from the financial statement describing the recapitalization, β_o^D is the pre-recapitalization debt beta, which is assumed to equal 0.15, Mkt_o is the product of E_o and the value-weighted market return from 40 trading days before the recapitalization announcement to recapitalization completion, E_n is the market value of equity using primary shares after the recapitalization is completed plus the book value of preferred stock, and D_n is the book value of debt after the recapitalization is completed.

^cPost-recapitalization asset betas from equity are calculated as $\beta_n^E(E_n/(E_n + D_n))$, where β_n^E is the post-recapitalization equity beta.

^dImplicit beta on all post-recapitalization debt, β_n^D , assumes the post-recapitalization asset beta, β_n^A , equals the adjusted pre-recapitalization asset beta. β_n^D is calculated as

$$\beta_n^D = \frac{E_n + D_n}{D_n} \left[\beta_o^A - \beta_n^E \frac{E_n}{E_n + D_n} \right]$$

^eThe variance of the implicit debt beta for firm i , $\text{var}(\beta_{n,i}^D)$, is calculated as

$$\text{var}(\beta_{n,i}^D) = S_o^2 + S_n^2$$

where $S_o^2 = [E_o/(E_o + D_o)]^2 [(E_o + D_o + Mkt_o)/D_n]^2 S_{E_o}^2$, $S_n^2 = (E_n/D_n)^2 S_{E_n}^2$, $S_{E_o}^2$ and $S_{E_n}^2$ are the estimated variances of the pre- and post-recapitalization equity betas.

The average standard error of 0.05 is the standard error of the average implied debt beta. This is calculated as

$$\left(\sum_{i=1}^k \text{var}(\beta_{n,i}^D) / k^2 \right)^{0.5}, \quad \text{where } k \text{ is the number of sample firms.}$$

Table 5
Change in asset betas implied by fixing debt betas.

Pre-recapitalization equity and asset betas, post-recapitalization equity and asset betas, and change in and percentage change in asset betas, assuming pre-recapitalization debt beta is 0.15 and post-recapitalization debt beta is 0.25 for 12 leveraged recapitalizations completed from 1985 to 1988.

	Pre-recapitalization		Post-recapitalization		Change in asset beta	Std. error change in asset beta ^d	Percentage change in asset beta
	Equity beta ^a	Asset beta ^b	Equity beta ^a	Asset beta ^c			
Average	1.01	0.78	1.38	0.46	-0.32	0.05	-41%
Median	0.91	0.76	1.38	0.42	-0.29		-45%

^aPre-recapitalization equity betas, β_o^E , are calculated using the market model and the value-weighted index from 165 trading days to 40 trading days before the recapitalization announcement. Post-recapitalization equity betas, β_n^E , are calculated using the market model and the value-weighted index from 3 trading days to 128 trading days after the recapitalization is completed.

^bPre-recapitalization asset betas, β_o^A , equal

$$\beta_o^A = \beta_o^E \frac{E_o}{E_o + D_o} + \beta_o^D \frac{D_o}{E_o + D_o},$$

where β_o^E is the pre-recapitalization equity beta, E_o is the market value of equity using primary shares 40 trading days before the recapitalization announcement plus the book value of preferred stock and convertible debt, D_o is the book value of nonconvertible debt less excess cash used to finance the transaction, obtained from the financial statement describing the recapitalization, and β_o^D is the pre-recapitalization debt beta, which is assumed to equal 0.25.

^cPost-recapitalization asset betas are calculated as

$$\beta_n^A = \beta_n^E \frac{E_n}{E_n + D_n} + \beta_n^D \frac{D_n}{E_n + D_n},$$

where β_n^E is the post-recapitalization equity beta, E_n is the market value of equity using primary shares after the recapitalization is completed plus the book value of preferred stock, D_n is the book value of debt after the recapitalization is completed, and β_n^D is the post-recapitalization debt beta, which is assumed to equal 0.25.

^dThe variance of the change in asset beta for firm i , $\text{var}(\beta_{o,i}^A - \beta_{n,i}^A)$, is calculated as

where

$$\text{var}(\beta_{o,i}^A - \beta_{n,i}^A) = S_c^2 + S_n^2,$$

$$S_c^2 = [E_o / (E_o + D_o)]^2 S_{E_o}^2,$$

$$S_n^2 = [E_n / (E_n + D_n)]^2 S_{E_n}^2.$$

$S_{E_o}^2$ and $S_{E_n}^2$ are the estimated variances of the pre- and post-recapitalization equity betas. The average standard error of 0.05 is the standard error of the average implied debt beta. This is calculated as

$$\left(\sum_{i=1}^k \text{var}(\beta_{o,i}^A - \beta_{n,i}^A) / k^2 \right)^{0.5},$$

where k is the number of sample firms.

post-recapitalization asset beta is smaller than the pre-recapitalization beta. Table 4b begins with the same pre-recapitalization equity betas calculated for the constant asset beta case in table 4a. As in the constant beta case, we calculate the asset beta of the pre-recapitalization company using eq. (4). Then, we adjust the pre-recapitalization beta for a reduction in fixed costs by using eq. (7). This adjusted asset beta averages 0.58 and has a median of 0.60, a decrease of approximately 25% from the constant asset beta case values. The calculations used to obtain post-recapitalization equity betas and asset betas from equity are the same as those for the constant asset beta case.

With the adjusted total asset beta and the portion of the asset beta contributed by post-recapitalization equity, we calculate the implicit beta on all debt using eq. (5*). The average and median implicit betas are 0.40 and 0.35. The average has a standard error of 0.05. Even in this reduced asset beta case, the estimates exceed the 0.25 found by Blume, Keim, and Patel (1989). In making this comparison, however, two points should be noted: (1) their estimates focus on all outstanding lower-grade debt, which may be less risky than the lower-grade debt in highly leveraged transactions; and (2) our estimates, in contrast, include a combination of bank and lower-grade debt, which should be less risky than the lower-grade debt alone. We discuss the distinction between bank and lower-grade debt risk in section 5.

4.4. *Implied asset betas assuming fixed debt betas*

Asset betas, in theory, could be reduced below the levels assumed in table 4b, and the low observed post-recapitalization equity betas could primarily be evidence of this reduced risk, rather than of high debt betas. Table 5 turns eq. (4) around, fixing β_n^D at 0.25 and calculating the implied post-recapitalization asset beta. A beta of 0.25 is roughly in line with the estimates by Blume, Keim, and Patel (1989) for the sample period.

Table 5 shows that a β_n^D of 0.25 implies an average post-recapitalization asset beta of 0.46 (median of 0.42) down from 0.78 (0.76) before the recapitalization. The decrease in the average asset beta is 41%. Thus, under the assumption of debt riskiness compatible with previous research, our results imply that highly leveraged transactions are associated with very large reductions in asset betas.

4.5. *Further sensitivity analysis*

The constant and reduced asset beta cases provide two estimates of implicit debt betas. These estimates, however, rely on other assumptions and estimation choices that may affect the results. Table 6 presents implicit debt betas under several alternative estimation methods and data choices.

Rows 1 and 2 replace the assumption that its pre-recapitalization debt has a systematic risk of 0.15 with an assumption that its systematic risk is 0.0.

This change reduces the average implicit beta on all debt from 0.65 to 0.61 and from 0.40 to 0.37 in the constant and reduced asset beta cases, respectively. Using a beta of 0.0 on pre-recapitalization debt has a large effect on Fruehauf and Holiday because both companies have a relatively large amount of pre-recapitalization debt. In the constant asset beta case, their betas drop from 0.46 and 0.29 to 0.27 and 0.21. Thus, for these two companies, the assumption of β_0^D equal to 0.0 seems particularly inappropriate.

Row 3 repeats the constant asset beta case, but treats preferred stock as debt rather than equity. This change has a moderate effect, increasing the average implicit debt beta to 0.70. In reality, preferred stock in these transactions is probably closer to debt than to equity, although it clearly has characteristics of both. This suggests that our decision to treat preferred stock as equity in the earlier analysis is somewhat conservative.

We use the value-weighted index for most of our analyses because it gives a better measure of the total economy and the returns that all investors will earn. Nevertheless, it is possible that our results do not hold for the CRSP equal-weighted index or for the S&P 500. To check this, we present the implicit beta on all debt using returns on the equal-weighted index in row 4 and returns on the S&P 500 (without dividends) in row 5. The equal-weighted index returns lead to somewhat higher implicit debt beta estimates (average of 0.85, median of 0.77), the S&P 500 returns to slightly lower estimates (average of 0.57, median of 0.56). These results suggest that the choice of index does not have a large effect on our implicit beta estimates.

The estimates in rows 6 and 7 use the alternative equity beta estimation techniques described in section 4.1 (with returns on the value-weighted index). When we use the Scholes–Williams (1977) estimates on daily data, the implied beta on all debt decreases moderately from 0.65 to 0.60. When we use the market-model estimates on weekly returns, the implicit beta on all debt averages 0.67, slightly higher than the average obtained when we use the market-model estimates on daily returns. The results in rows 6 and 7 suggest that nonsynchronous trading does not have a large effect on our implicit beta estimates.¹⁹

Because stock prices vary, it is possible that the prices used to calculate the total market value of common stock in the leveraging formulas are not representative of prices during the estimation period. As a rough check on this possibility, row 8 presents estimates using equity values 165 trading days before the recapitalization announcement (rather than 40 trading days before) and 128 trading days after the recapitalization is completed (rather than 3 trading days after). This change causes a moderate decrease in the implicit beta from 0.65 to 0.61.

¹⁹The robustness of our results to variations in beta estimation technique should not be surprising, given the small amount of equity that remains after the recapitalization. An alternative estimator would have to produce substantially higher post-recapitalization equity betas to have much influence on the implied debt betas.

Table 6
Sensitivity analysis for implied debt betas.

Means and medians [in brackets] of pre-recapitalization equity and asset betas, post-recapitalization equity betas, and implicit post-recapitalization debt betas under different assumptions for 12 leveraged recapitalizations completed from 1985 to 1988.

	Pre-recapitalization		Post-recapitalization		Implicit beta all debt	Std. error implicit beta
	Equity beta	Asset beta	Equity beta	Asset beta from equity		
1. Constant asset beta case with beta of 0.0 on old debt ^{a, b}	1.01 [0.91]	0.74 [0.75]	1.38 [1.38]	0.25 [0.22]	0.61 [0.58]	0.06
2. Reduced asset beta case with beta of 0.0 on old debt ^{c, d}	1.01 [0.91]	0.55 [0.57]	1.38 [1.38]	0.25 [0.22]	0.37 [0.33]	0.05
3. Constant asset beta case with preferred stock treated as debt ^c	1.01 [0.91]	0.77 [0.76]	1.38 [1.38]	0.21 [0.21]	0.70 [0.66]	0.06
4. Constant asset beta case with market-model betas using equal-weighted index ^f	1.49 [1.22]	1.13 [1.05]	2.45 [2.40]	0.44 [0.42]	0.85 [0.77]	0.10
5. Constant asset beta case with market-model betas using S&P 500 index ^g	0.85 [0.78]	0.67 [0.66]	1.11 [1.13]	0.21 [0.20]	0.57 [0.56]	0.05
6. Constant asset beta case with Scholes-Williams betas ^h	1.00 [0.91]	0.77 [0.73]	1.57 [1.51]	0.29 [0.26]	0.60 [0.59]	0.06
7. Constant asset beta case using market model and weekly returns ⁱ	1.04 [0.86]	0.81 [0.76]	1.47 [1.55]	0.28 [0.25]	0.67 [0.62]	0.12
8. Constant asset beta case using market value of common stock eight months before announcement and six months after completion ^j	1.01 [0.91]	0.77 [0.77]	1.38 [1.38]	0.28 [0.26]	0.61 [0.50]	0.06
9. Constant asset beta case with debt one year after the transaction ^k	1.01 [0.91]	0.78 [0.76]	1.38 [1.38]	0.26 [0.25]	0.65 [0.61]	0.06

^aUnder constant asset beta case assumptions:04

1. Pre-recapitalization equity betas, β_o^E , are calculated using the market model and the value-weighted index from 165 trading days to 40 trading days before the recapitalization announcement. Post-recapitalization equity betas, β_n^E , are calculated using the market model and the value-weighted index from 3 trading days to 128 trading days after the recapitalization is completed.

2. Pre-recapitalization asset betas, β_o^A , equal

$$\beta_o^A = \beta_o^E \frac{E_o}{E_o + D_o} + \beta_o^D \frac{D_o}{E_o + D_o},$$

where β_o^E is the pre-recapitalization equity beta, E_o is the market value of equity using primary shares 40 trading days before the recapitalization announcement plus the book value of preferred stock and convertible debt, D_o is the book value of nonconvertible debt less excess cash used to finance the transaction, obtained from the financial statement describing the recapitalization, and β_o^D is the pre-recapitalization debt beta, which is assumed to equal 0.15.

3. Post-recapitalization asset betas from equity equal $\beta_n^E (E_n / (E_n + D_n))$, where E_n is the market value of equity using primary shares after the recapitalization is completed plus the book value of preferred stock and D_n is the book value of debt after the recapitalization is completed.

Table 6 (continued)

4. Implicit beta on all post-recapitalization debt, β_n^D , assumes the post-recapitalization asset beta, β_n^A , equals the pre-recapitalization asset beta, β_o^A . β_n^D is calculated as

$$\beta_n^D = \frac{E_n + D_n}{D_n} \left[\beta_o^A - \beta_n^E \frac{E_n}{E_n + D_n} \right].$$

^bSame as constant asset beta case except pre-recapitalization debt assumed to have a beta of 0.0, not 0.15.

^cReduced asset beta case is same as constant asset beta case except pre-recapitalization asset betas adjusted for reductions in fixed costs, $\beta_o^{A^*}$, equal

$$\beta_n^{A^*} = \beta_o^A \frac{E_o + D_o + Mkt_o}{E_n + D_n},$$

where Mkt_o equals the product of E_o and the value-weighted market return from 40 trading days before the recapitalization announcement to recapitalization completion.

^dSame as reduced asset beta case except pre-recapitalization debt assumed to have a beta of 0.0, not 0.15.

^eSame as constant asset beta case except preferred stock is treated as debt.

^fSame as constant asset beta except equity betas are estimated using the equal-weighted index.

^gSame as constant beta case except equity betas are estimated using the S&P 500 index (without dividends).

^hSame as constant asset beta case except Scholes-Williams technique is used to estimate equity betas.

ⁱSame as constant asset beta case except equity betas are calculated using weekly returns.

^jSame as constant asset beta case except using market value of common stock calculated eight months before announcement (i.e., the start of the estimation period) for pre-recapitalization capital structure and market value of common stock six months after completion for post-recapitalization capital structure (i.e., the end of the estimation period).

^kSame as constant asset beta case except post-recapitalization book value of debt taken (when available) from financial statement after beta estimation period. Post-estimation book value of debt not available for two companies.

Finally, the debt outstanding just after the recapitalization may not be representative of debt levels during the estimation period since asset sales and/or operating improvements can reduce debt quickly. The estimates in row 9 replace total debt when the recapitalization is completed with total debt at the time of the first financial statement after the recapitalization. In the ten available cases, the first financial statement is dated after the end of the equity beta estimation period. The average implicit beta on all debt is unchanged from the 0.65 for the constant asset beta case.²⁰

The alternative methods and assumptions for calculating the implicit beta on all post-recapitalization debt presented in table 6 have relatively minor effects. Starting from the constant asset beta case assumption, none of these

²⁰The row 9 estimate is for the beta on the debt still outstanding after the asset sale. If the asset sale was agreed to early in the estimation period, the average beta on all the debt outstanding at the time of the recapitalization would be somewhat lower. Given the size of the asset sales in our sample, however, this effect is small.

alternatives reduces the average estimated implicit beta on all debt to less than 0.57.²¹ Overall, the results in table 6 suggest that the most important unresolved issue in determining the implicit beta on all debt is the extent to which, if at all, the asset beta of the post-recapitalization company is lower than that of the pre-recapitalization company.²²

5. Division of systematic risk between bank and lower-grade debt

Our method does not allow us to measure the systematic risk of bank and lower-grade debt separately. It is likely, however, that the systematic risk of the bank debt in highly leveraged transactions is lower than that of public lower-grade bonds for several reasons. First, the bank debt has a claim senior to that of the lower-grade debt, and is likely to receive more in periods of financial distress. Second, the interest rate on the bank debt in nine of the twelve transactions is contractually related (positively) to the financial strength of the company. The interest-rate spread over the reference rate decreases when the company does well and increases when the company does badly. Third, the bank debt has a shorter maturity than the lower-grade debt. Because principal is returned sooner, the relative riskiness of bank debt is reduced further.²³

Although it is likely the bank debt has less systematic risk than the lower-grade debt, it is impossible to know exactly how much less. In table 7, we present estimates for the betas on bank debt and lower-grade debt under three alternative assumptions. In the analysis, we classify all nonbank debt in the post-recapitalization company as lower-grade debt. This overstates the

²¹We considered, but do not report, two additional adjustments to equity value. These adjustments have trivial effects on the constant asset beta case results. First, we used fully diluted shares rather than primary shares outstanding to calculate market values for equity. This essentially considers management and employee stock options as common stock. Second, we considered convertible debt to be debt, not equity.

²²Even if our implicit beta estimates correctly measure the sensitivity of debt to a stock-market factor, other factors may also be relevant to the pricing of debt. Blume, Keim, and Patel (1989) and Cornell and Green (1989), for example, consider interest rate risk. They find that lower-grade bond returns are sensitive to interest rates as well as to stock returns. We can generalize our implied risk approach to a two-factor setting by regressing pre- and post-recapitalization equity returns on both the daily return for an index of long-term Treasury bonds and the return for the value-weighted stock index. The equity returns are less sensitive to interest rates after the recapitalization than before, suggesting that the debt bears a small amount of interest-rate risk above that reflected in the stock-market factor. The average coefficient on the Treasury bond index return is 0.02 (standard error of 0.08) for the pre-recapitalization estimates and -0.09 (standard error of 0.17) for post-recapitalization estimates.

²³It has been suggested that the bank loans may be more risky because they are subject to fraudulent conveyance claims on the theory that bank lenders made secured loans knowing that the firm was insolvent. We do not yet know how such claims will turn out. More generally, bankruptcy proceedings give rise to a number of complex legal issues that have as yet unclear implications for the division of value between senior and junior creditors in highly leveraged transactions.

Table 7
Implied betas of bank debt and lower-grade debt.

Implicit betas on bank and lower-grade debt if (1) lower-grade debt has the same systematic risk as bank debt,^a (2) lower-grade debt has twice the systematic risk of bank debt,^b and (3) bank debt has no systematic risk^c assuming pre-recapitalization debt beta is 0.15, for constant and reduced asset beta cases for 12 leveraged recapitalizations completed 1985 to 1988.

	Implicit betas same systematic risk ^a		Implicit betas lower-grade debt twice the systematic risk ^b		Implicit betas lower-grade debt all systematic risk ^c	
	Bank debt	Lower grade debt	Bank debt	Lower grade debt	Bank debt	Lower grade debt
A. Constant asset beta case						
Average	0.65	0.65	0.45	0.89	0.00	1.57
Median	0.62	0.58	0.42	0.84	0.00	1.40
Std. error	0.06	0.06	0.04	0.08	0.00	0.16
B. Reduced asset beta case						
Average	0.40	0.40	0.29	0.54	0.00	0.93
Median	0.35	0.32	0.27	0.49	0.00	0.78
Std. error	0.05	0.05	0.03	0.06	0.00	0.12

^aImplicit beta on all post-recapitalization debt, β_n^D , in the constant asset beta case assumes the post-recapitalization asset beta, β_o^A , equals the pre-recapitalization asset beta, β_o^A . β_n^D is calculated as

$$\beta_n^D = \frac{E_n + D_n}{D_n} \left[\beta_o^A - \beta_n^E \frac{E_n}{E_n + D_n} \right],$$

where pre-recapitalization asset betas, β_o^A , equal

$$\beta_o^A = \beta_o^E \frac{E_o}{E_o + D_o} + \beta_o^D \frac{D_o}{E_o + D_o}.$$

The implicit beta on all post-recapitalization debt in the reduced asset beta case is calculated as

$$\beta_n^D = \frac{E_n + D_n}{D_n} \left[\beta_o^{A*} - \beta_n^E \frac{E_n}{E_n + D_n} \right],$$

where post-recapitalization asset betas, β_o^{A*} , equal pre-recapitalization asset betas adjusted for reduction in fixed costs, β_o^{A*} ,

$$\beta_o^{A*} = \left[\beta_o^E \frac{E_o}{E_o + D_o} + \beta_o^D \frac{D_o}{E_o + D_o} \right] \frac{E_o + D_o + Mkt_o}{E_n + D_n}.$$

E_o is the market value of equity using primary shares 40 trading days before the recapitalization announcement plus the book-value of preferred stock and convertible debt, D_o is the book value of nonconvertible debt less excess cash obtained from the financial statement describing the recapitalization, Mkt_o is the product of E_o and the value-weighted market return from 40 trading days before the recapitalization announcement to recapitalization completion, E_n is the market value of equity using primary shares after the recapitalization is completed plus the book value of preferred stock, and D_n is the book value of debt after the recapitalization is completed. Pre-recapitalization equity betas, β_o^E , are calculated using the market model and value-weighted index from 165 trading days to 40 trading days before the recapitalization announcement. Pre-recapitalization debt betas, β_o^D , are assumed to equal 0.15. Post-recapitaliza-

Table 7 (continued)

tion equity betas, β_n^E , are calculated using the market model from 3 trading days to 128 trading days after the recapitalization is completed.

^bBeta on lower-grade debt, β_n^{LG} , when lower-grade debt has twice the systematic risk of bank debt, is calculated as

$$\beta_n^{LG} = \beta_n^D \frac{D_n}{D_n^{LG} + 0.5D_n^B},$$

where D_n^{LG} is the amount of lower-grade debt and D_n^B is the amount of bank debt after the recapitalization. Classifies all nonbank debt as lower-grade debt, i.e., $D_n^{LG} = D_n - D_n^B$.

^cBeta on lower-grade debt, β_n^{LG} , when lower-grade debt has all systematic risk, is

$$\beta_n^{LG} = \beta_n^D \frac{D_n}{D_n^{LG}}.$$

amount of public lower-grade debt outstanding for the post-recapitalization company and, thus, will understate the estimated beta on the lower-grade debt. Panel A presents results for the constant asset beta case; panel B, for the reduced asset beta case.

The first two columns of panel A essentially repeat the results in table 4a by assuming that the betas for bank debt and lower-grade debt are the same. (The average betas for bank and lower-grade debt differ slightly, however, because Swank has no public lower-grade debt outstanding.) The estimates in the second two columns assume that the lower-grade debt has twice the systematic risk of the bank debt. Under this assumption, the average implicit beta is 0.89 for lower-grade debt and 0.45 for bank debt. The estimates in the final two columns of panel A assume that the bank debt bears no systematic risk. In this case, the average beta on the lower-grade debt is 1.57, which is (implausibly) greater than the calculated systematic risk of the equity. Put another way, the constant asset beta case estimates imply that bank debt must bear systematic risk. Because bank debt has a floating interest rate, this systematic risk must reflect credit risk, not interest-rate risk.

Overall, the results in panel A suggest that lower-grade bonds in highly leveraged transactions bear more systematic risk than found in previous studies of lower-grade bonds. They also suggest that the loans made by commercial banks to highly leveraged transactions bear a reasonable amount and, possibly, a great deal of systematic risk.

The second two columns of panel B show that in the reduced asset beta case, the assumption that the lower-grade debt has twice the systematic risk of the bank debt leads to a lower-grade debt beta of 0.54. Even in this case, the value is somewhat larger than the 0.36 found by Cornell and Green (1989) for lower-grade bonds. The estimates in the final two columns of panel B assume that the bank debt bears no systematic risk. This places a systematic risk of 0.93 on the lower-grade debt. Unlike the estimates for the constant asset beta case, this assumption yields an average beta estimate on the lower-grade debt that is lower than the average equity beta estimate.

Overall, the reduced asset beta case estimates suggest that lower-grade bonds in highly leveraged transactions bear somewhat more systematic risk than found in previous studies of lower-grade bonds. The results of this case are less conclusive about the riskiness of commercial bank loans in these transactions.

6. Direct beta estimates for lower-grade bonds

To compare our method with more conventional techniques, we also directly estimate the beta of the lower-grade bonds in our recapitalization sample. Morgan Stanley provided weekly desk prices for the bonds of eight companies in our sample for the six months after the completion of the recapitalization. These prices are not necessarily transaction prices, but, instead, are the prices Morgan Stanley's high-yield group believed to be in effect at the close of business on each Tuesday. They do not include accrued interest. Like others who have studied lower-grade bonds, we assume that interest on the bonds accrues at a fixed rate with certainty over our estimation period. This allows us to ignore interest payments in our beta calculations.

For each of the eight bonds, we estimate betas using weekly returns on the bonds and on the value-weighted index for the six months after the recapitalization. Table 8 presents the results of these estimates. The average and median betas for these eight bonds are 0.21 and 0.28, with a standard error of 0.05. The maximum beta estimate is only 0.32 for Owens Corning Fiberglas. These estimates are lower than the betas estimated for all debt in the constant and reduced asset beta cases.

Because it is possible that the delayed adjustment of bond prices creates a downward bias on the beta estimates, we also estimate betas using the estimator suggested by Scholes and Williams (1977). The Scholes-Williams estimates have a large effect on the beta estimates, increasing the average debt beta to 0.41.²⁴ The direct Scholes-Williams beta estimates in table 8 are not significantly different from the implicit betas on all debt in the reduced asset beta case. The highest direct estimates, therefore, correspond to the bottom of the range of betas for lower-grade bonds implied by our method – those assuming *both* a reduced asset beta and bank debt that is as risky as the lower-grade debt.

As soon as either of these assumptions is relaxed, our implicit betas for lower-grade debt exceed the direct estimates. For example, if we maintain the reduced asset beta assumption, but assume that lower-grade debt has twice the systematic risk of bank debt, we estimate an average implicit beta

²⁴Market-model estimates using monthly returns and estimates using the Dimson (1979) technique produce similar results.

Table 8
Direct lower-grade debt beta estimates.

Market-model and Scholes-Williams debt betas calculated directly from weekly bond prices compared with implicit betas for all debt and for lower-grade debt calculated from equity betas for eight leveraged recapitalizations completed from 1985 to 1988.

Company	Direct beta estimates				Implicit beta estimates			
	Market-model beta of bond ^a	Scholes- Williams beta of bond ^a	Std. error of market- model estimates ^a	N (weeks)	Constant asset beta		Reduced asset beta	
					All debt ^b	Lower grade ^c	All debt ^d	Lower grade ^c
1. Colt Industries	0.30	0.19	0.11	26	0.44	0.59	0.26	0.34
2. FMC	0.26	0.20	0.07	26	0.66	0.90	0.57	0.77
3. Fruehauf	0.18	0.87	0.13	26	0.46	0.65	0.29	0.40
4. Holiday	0.30	0.59	0.11	26	0.29	0.35	0.23	0.28
5. Interco	-0.21	0.00	0.27	25	0.50	0.70	0.30	0.42
6. Kroger	0.24	0.41	0.16	21	0.83	1.17	0.48	0.68
7. Owens Corning Fiberglas	0.32	0.55	0.09	26	0.65	0.84	0.38	0.49
8. USG	0.30	0.47	0.09	26	0.86	1.16	0.57	0.75
Average	0.21	0.41	0.05		0.59	0.80	0.38	0.52
Median	0.28	0.44			0.58	0.77	0.34	0.46

^aMarket-model debt betas calculated using the market model and the value-weighted index from one week to 26 weeks (when possible) after the recapitalization is completed. Standard errors are for beta estimates from market-model regressions. Scholes-Williams betas calculated according to Scholes and Williams (1977), using weekly returns and the value-weighted index. Weekly bond prices are desk prices for lower-grade bonds for eight recapitalizations provided by Morgan Stanley.

^bSame as implicit beta on all post-recapitalization debt, β_n^D , presented in panel A of table 4. β_n^D assumes the post-recapitalization asset beta, β_n^A , equals the pre-recapitalization asset beta. β_n^D is calculated as

$$\beta_n^D = \frac{E_n + D_n}{D_n} \left[\beta_o^{A*} - \beta_n^E \frac{E_n}{E_n + D_n} \right],$$

where pre-recapitalization asset betas, β_o^A , equal

$$\beta_o^{A*} = \beta_o^E \frac{E_o}{E_o + D_o} + \beta_o^D \frac{D_o}{E_o + D_o}.$$

^cAssumes that lower-grade debt has twice the systematic risk of bank debt for the constant asset beta case.

^dSame as implicit beta on all post-recapitalization debt, β_n^D , presented in panel B of table 4. β_n^D assumes the market-adjusted premium to public shareholders represents a reduction in fixed costs that reduces the post-recapitalization asset beta, β_n^A , in relation to the pre-recapitalization asset beta. β_n^D is calculated as

$$\beta_n^D = \frac{E_n + D_n}{D_n} \left[\beta_o^{A*} - \beta_n^E \frac{E_n}{E_n + D_n} \right],$$

where pre-recapitalization asset betas adjusted for reduction in fixed costs, β_o^{A*} , equal

$$\beta_o^{A*} = \left[\beta_o^E \frac{E_o}{E_o + D_o} + \beta_o^D \frac{D_o}{E_o + D_o} \right] \frac{E_o + D_o + Mkt_o}{E_n + D_n}.$$

^eAssumes that lower-grade debt has twice the systematic risk of bank debt for the reduced asset beta case.

on the lower-grade debt of 0.52 for the eight companies with direct beta estimates.

One possible explanation for the difference between the indirect and direct estimates is data-quality problems with the direct estimates. The substantial increase in the direct estimates when we use the Scholes–Williams estimator lends some credence to the notion that data-quality problems can lead to downward biases, at least at weekly return horizons. The higher direct estimates based on longer horizons may be themselves downward biased, if the quoted prices do not accurately reflect true market values.

7. Conclusion

We have presented indirect estimates of the systematic risk of debt in public leveraged recapitalizations, which we calculate as a function of the difference between pre- and post-recapitalization equity risk. Equity risk (using the value-weighted index) rises surprisingly little after a recapitalization – by 37% to 57%, depending on the estimation method. The small increase in equity betas can be attributed to high debt riskiness and/or reductions in asset betas. Under the assumption that asset beta is unchanged, we find the implied beta of the post-recapitalization debt in twelve transactions averages 0.65 (with a standard error of 0.06). Under the alternative assumption that the entire market-adjusted premium in the leveraged recapitalization represents a reduction in fixed costs, we find the implied beta of total debt averages 0.40 (with a standard error of 0.05). Under the assumption that lower-grade debt has twice the beta of bank debt, these estimates translate into lower-grade debt betas of 0.89 and 0.54 – significantly higher than reported in previous research on lower-grade debt. (Again, we note that the debt in highly leveraged transactions may have different risk characteristics than other lower-grade debt.)

Our results are best thought of as yielding a reasonable range of values for debt riskiness, rather than a single ‘best’ estimate. It is certainly plausible that changes occur in the management of recapitalized companies that lead to reductions in fixed costs, although it is difficult to verify this empirically. Existing research on highly leveraged management buyouts points to increases in cash flow and reductions in taxes paid as sources of value. Both of these may have substantial fixed components. [See Kaplan (1989a, b).]

Alternatively, debt betas at the upper end of our range raise questions about the role of debt pricing in explaining the premiums in highly leveraged transactions. Given the amount of debt used in such transactions, modest variations in its pricing, *ex ante*, can have a large effect on stockholder wealth. For example, consider a firm with 90% (permanent) debt borrowed at 12%. Each 1% mispricing of the interest rate on the debt would allow a buyer to bid up to 7.5% more than the true value of the firm ($1\% \times 0.9/0.12$).

Thus each 1% of debt mispricing might explain almost one-fifth of the typical buyout premium of 40%. (Of course, if the debt is not permanent, the effect will be smaller.)

If the constant asset beta scenario is appropriate, the resulting debt beta of 0.65 (combined with conventional estimates of the market premium of 5% to 8%) implies that the debt should have an expected return at least 3.25% above the risk-free rate. Overall, the new debt in our sample promises an average return (weighted by debt value) of 3.78% over Treasuries of comparable maturities. Expected returns, however, will be lower than promised yields. If defaults are expected to cut more than 0.53% off the promised yields, our constant asset beta estimates suggest that debtholders in our sample do not receive adequate compensation for the risk they bear.

It should be stressed that if mispricing exists, it need not reflect investor irrationality per se. Rather, a variety of incentive problems could be responsible. For example, a large portion of debt in the transactions is provided by commercial banks with access to federally insured deposits. Bryan (1988) has argued that overcapacity in the banking industry, combined with the lack of capital market discipline inherent in deposit insurance, has led commercial banks to systematically undertake negative net present value investments – an argument analogous to the free cash flow theory used by Jensen (1986) to explain overinvestment by industrial corporations. If this hypothesis is correct, aggressive bank lending to highly leveraged transactions could be one manifestation of a broader phenomenon.

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