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Estimating the Divisional Cost of Capital: An Analysis of the Pure-Play Technique

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ABSTRACT

This paper suggests that the pure-play technique can be used in conjunction with the capital asset pricing model to determine the cost of equity capital for the divisions of a multidivision firm. Since the beta for a division is unobservable in the marketplace, a proxy beta derived from a publicly traded firm whose operations are as similar as possible to the division in question is used as the measure of the division's systematic risk. To provide empirical support for using the pure-play technique, a sample of multidivision firms and pure-plays associated with each division is examined. It is shown that an appropriately weighted average of the betas of the pure-play firms closely approximates the beta of the multidivision firm.

IN A RECENT SURVEY, Brigham [6] found that nearly one-half of a sample of U.S. industrial firms used a single hurdle rate, or cost of capital, to evaluate capital investment proposals.¹ Such a criterion is inappropriate for a project if its systematic risk differs significantly from that of the firm.² The major consequence of using a single cut-off criterion for all projects is an intrafirm misallocation of capital since the acceptance rule is biased in favor of the acceptance of high-risk projects. Thus, low-risk divisions may be starved for capital in spite of their ability to generate proposals offering returns in excess of those required for the systematic risk involved. The ultimate consequence of such misallocations of capital is a reduction of shareholder wealth.

What is needed to correct this allocation bias is a system that apportions capital on a risk-adjusted basis. Such a system has been proposed by Weston [27]

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¹ Specifically, Brigham [6] discovered that 62 percent of the respondent firms used a hurdle rate based on the cost of capital, and only 53 percent used more than one hurdle rate in spite of admitted risk differentials among projects.

² Throughout this paper, we assume that the assumptions underlying the capital asset pricing model are valid and applicable to real assets as well as financial securities, in which case only the systematic risk of a project should influence the hurdle rate. Obviously this assumption may not be valid, in which case the project's residual risk would also have to be considered. See Myers and Turnbull [21] and Fama [8] for a discussion of some problems in using the CAPM in capital budgeting.

and involves the calculation of a separate hurdle rate for each individual project. While commendable in principle, such an approach is difficult to use in practice since systematic risk must be estimated for each project. An alternative to individual hurdle rates is to evaluate all projects undertaken by a division with a divisional hurdle rate.³ This procedure relies on the implicit assumption that intradivision projects are homogeneous with respect to systematic risk.

The divisional cost of capital has been analyzed by, among others, Hamada [12], Gordon and Halpern [10], Bower and Jenks [4], Brigham [7], Van Horne [26], and Weston and Lee [28]. Two approaches to estimating a divisional cost of capital have been proposed; one approach is analytic, the other approach uses analogies. The analytic approach starts with historical operating data or data developed from simulation. These data are related to market estimates of systematic risk and debt capacity via some linking mechanism. For example, Gordon and Halpern [10, p. 1158] estimated the systematic risk of a division by assuming that the unobservable beta of the division was highly correlated with the slope coefficient from a regression of changes in divisional earnings on changes in total U.S. corporate profits.

In contrast, the analogy or "pure-play" approach attempts to identify firms with publicly traded securities which are engaged solely in the same line of business as the division.⁴ Once the pure-play firm is identified, its cost of capital is determined and then used as a proxy for the required divisional cost of capital. The presumption, of course, is that the systematic risk and capital structure of the pure-play are the same as those of the division. It is the purpose of this paper to evaluate empirically the pure-play method for estimating the divisional cost of capital.

I. Pure-Play Technique: Problems and Rationale

The basis of the pure-play technique for determining divisional screening rates is the assumption that a pure-play's cost of capital is equal to the unobservable cost of capital for a division. Given the inherent difficulties of the matching process, it would be naive to suppose that the cost of capital of the pure-play would correspond precisely to that of the division. Differences in systematic risk and capital structure may combine to threaten the validity of the pure-play methodology. However, before dismissing out of hand what may be a promising technique for determining a divisional screening rate, empirical testing of the procedure is in order.

To provide a theoretical foundation for the pure-play technique, we assume a perfectly competitive market in which information is costless and available to all, transaction costs do not exist, and assets are infinitely divisible. Under such conditions, and in the absence of synergism, it follows from the value additivity

³ It could be argued that a particular division might not be homogeneous with respect to risk and thus the level of analysis should be reduced to product-lines or types of service. While there is merit to such an argument, we would prefer to base our analysis on divisions since the pure-play technique for calculating hurdle rates would rarely be possible on a product-line basis.

⁴ The "pure-play" method is described by Van Horne [26, pp. 214–15] and Brigham [7, pp. 884–93]. However, to our knowledge, such a technique has not been empirically evaluated using market data.

principle (VAP)⁵ that the market value of a multidivision firm is equal to the sum of the market values of its divisions:

$$V_j = \sum_i V_{ij} \quad (1)$$

where V_j is the market value of a multidivision firm and V_{ij} is the market value of the i^{th} division of the j^{th} multidivision firm.

According to the capital asset pricing model (CAPM), the cost of equity capital for a firm (R_j) is a linear function of its systematic risk (beta). That is,

$$R_j = \gamma_0 + \gamma_1 \beta_j \quad (2)$$

where γ_0 in the traditional Sharpe [24], Lintner [16] CAPM is equal to the risk-free rate, γ_1 is equal to the expected return on the market portfolio minus the risk-free rate, and β_j is a measure of the multidivision firm's systematic risk. In this case, the only *firm* characteristic one needs to know to determine R_j is the firm's beta and it can be shown that the beta for a multidivision firm approximates a weighted average of its divisional betas. That is,

$$\beta_j \cong \sum_i (S_{ij}/S_j) \beta_{ij} \quad (3)$$

where β_{ij} is the beta associated with the equity of the i^{th} division of the multidivision firm, and S_j and S_{ij} represent the market value of the equity of the multidivision firm and its i^{th} division respectively.

Of course V_{ij} , S_{ij} and β_{ij} are not directly observable for divisions since divisions are not traded in the marketplace. The pure-play technique assumes that each pure-play firm is a near-perfect proxy for its corresponding division. Under this assumption, (3) can be rewritten as

$$\beta_j \cong \sum_i (\hat{S}_{ij}/S_j) \hat{\beta}_{ij} \quad (3a)$$

where the hats ($\hat{}$) denote pure-play metrics used as proxies for V_{ij} , S_{ij} , and β_{ij} .

Equation (3a) is the principal relationship investigated in this paper. In addition, we also examine the debt ratios of the multidivision firms. If, despite market imperfections and the incongruities resulting from the pure-play matching process, these relationships hold reasonably well, then this will support the use of a pure-play's cost of capital as a proxy for a divisional screening rate.

II. The Sample

Essentially, the pure-play technique involves matching-up each division of a multidivision firm with a publicly traded company having only one business line which is as similar as possible to the business line of the division in question. Obviously no "perfect" pure-plays exist, since no two firms or divisions have exactly the same operating and financial characteristics. However, for this study,

⁵ Originally developed by Myers [20] and Schall [23] and formalized in Haley and Schall [11], the value additivity principle (VAP) also initially assumed homogeneous expectations and no personal tax bias on the part of investors. These assumptions can be relaxed, however. For an excellent summary of VAP see: Haley and Schall [11, pp. 202-8, 230-37].

considerable care was taken to ensure that there was a good match-up between divisions and pure-plays.⁶

All the multidivision firms followed by *Value Line* as of the end of each year for 1976, 1977, and 1978 were screened and a firm was included in the sample if

- (1) The firm had clearly identifiable business lines;
- (2) These business lines accounted for 100% of the firm's revenues, i.e., there was no miscellaneous revenue;
- (3) There were no unconsolidated subsidiaries; and
- (4) A pure-play could be identified for each business line.

For each division a pure-play was selected from the stocks followed by *Value Line*, based on the following criteria:

- (1) The firm had only one business line and no miscellaneous revenues. (There were some minor exceptions to this);
- (2) The pure-play was in the same industry or business line as the division in question;
- (3) The revenues of the pure-play were roughly the same as those of the division in question. (There were some exceptions to this);
- (4) When geographical factors were deemed important to the business line, pure-plays were selected which operated in the same geographical area as the division in question; and
- (5) When more than one firm could be identified as a potential pure-play, the firm with the median beta was chosen as the pure-play.

Note that the pure-play selection criteria concentrate on the operating characteristics of the firm and do not consider financial leverage. There are two reasons for this. First, an additional criterion of similar financial structure would have severely reduced the size of the sample and betas can be adjusted for differences in leverage using a technique developed by Hamada [12]. Second, by not controlling for leverage, one can make comparisons of the debt ratios of multidivision firms versus single-product firms.

Of the approximately 1,700 companies followed by *Value Line*, a total of 60 multidivision firms and their associated pure-plays which met the above criteria were identified.⁷ There were 22 multidivision firms in 1976, 23 in 1977, and 15 in 1978. Of the 60 multidivision firms in the sample, 40 had 2 divisions, 18 had 3 divisions, and 2 had 4 divisions. Thus, there are a total of 142 pure-plays involved.

Table I lists summary statistics for the multidivision and pure-play firms. The multidivision firms tend to be larger in terms of total capital and have somewhat

⁶ The process of identifying pure-plays is essentially a security analysis problem. The operating characteristics of each division and each potential pure-play have to be carefully analyzed to ensure the best possible match-ups. An alternative approach might be to identify pure-plays by computer using SIC codes, or some other mechanical method. However, in our opinion, the security analysis approach, while it introduces subjective judgment into the process and probably results in smaller sample sizes, produces more reliable match-ups. We should also note that the actual application of the pure-play method to real-world problems would be both easier to implement and applicable to more situations than the sample size for this study might suggest since the manager of a multidivision firm will have an intimate knowledge of the division's competitors.

⁷ A listing of the multidivision firms, the pure-plays, and some characteristics describing these firms is available from the authors.

Table I
Summary Statistics for Sample Firms

	Total Capital ^a		Debt Ratio ^b		Beta	
	Multi-division Firms	Pure-play Firms	Multi-division Firms	Pure-play Firms	Multi-division Firms	Pure-play Firms
No. of Observations	60	142	60	142	60	142
Median	165,600	109,300	.329	.299	1.00	1.00
Mean	402,093	207,807	.336	.295	1.03	1.02
Standard Deviation	522,412	251,021	.157	.184	.25	.24
Minimum	34,900	14,300	.000	.000	.60	.50
Maximum	2,751,700	1,491,000	.676	.836	1.80	1.75

^a Total capital is based on the book value of long-term debt and stockholders' equity.

^b The debt ratio is the ratio of long-term debt to total capital.

larger debt ratios. The distribution of betas is nearly identical across the two groups.

III. Analysis of Betas

The cost of equity is typically the largest component of the overall cost of capital. Since, in the framework of the CAPM the cost of equity of a firm is a function of its beta, the relationship in (3a) was examined first. If a weighted average of the pure-play betas closely approximates the multidivision firm's beta, then it appears the pure-play technique can be used to estimate the beta and, in the framework of the CAPM, the equity cost of capital for the various divisions of multidivision firms.

To evaluate the pure-play technique, the beta for each firm was taken from *Value Line*,⁸ and the weight for each division ($\hat{W}_{ij}$) was specified as the division's sales divided by the sales of the entire firm.⁹ The difference between the observed beta of the multidivision firm (β_j) and its weighted average pure-play proxy was calculated as

$$\Delta_j(\beta) = \beta_j - \sum_i \hat{W}_{ij} \hat{\beta}_{ij} \quad (4)$$

⁸ Our results are not particularly sensitive to the method of calculating beta. In Fuller and Kerr [9] we compared the results obtained when using betas as calculated by Merrill Lynch and found them to be essentially the same as the results obtained using *Value Line* betas. (*Value Line* and Merrill Lynch differ in calculating betas in their choice of the market index, adjustments for extremely low and extremely high betas, method of rounding, and differencing interval.)

⁹ *Value Line* reported only sales, and in some cases pretax profits, by division. For the 1977 subsample, the results were nearly identical regardless of whether sales weights or pretax income weights were used. In addition, based on the suggestion of a referee for this *Journal*, we experimented with imputing a value for each division by determining the value/sales ratio of the pure-play and multiplying the division's sales by this ratio. These imputed values were then used in determining a value weight for each division—the results using these imputed value weights were similar, but slightly inferior to the results using sales weights. From the viewpoint of the financial manager of the firm, the proper choice of weights would present fewer problems, since management would have access to divisional balance sheets and, better still, may have good estimates of the market value of each division.

and the absolute relative difference ($AR\Delta$) was calculated as

$$AR\Delta_j(\beta) = \frac{|\Delta_j(\beta)|}{\beta_j} \times 100 \quad (5)$$

Table II lists summary statistics for the differences between the multidivision firm betas and their proxy betas. First note that for the total sample there are 29 positive $\Delta_j(\beta)$'s and 31 negative differences. Note also that the sign of the mean differences, $\bar{\Delta}(\beta)$, for the 1976 and 1978 subsamples is positive, while for the 1977 subsample it is negative. Thus, the pure-play technique does not appear to systematically underestimate or overestimate the beta for a multidivision firm.

For the total sample, the mean $AR\Delta(\beta)$ of 8.9% for the pure-play method indicates that, on average, the proxy betas were within plus or minus 9% of the observed multidivision firm betas.¹⁰ A regression of the observed multidivision firm betas on their pure-play proxies produced results quite close to what one, a priori, might expect—the intercept was close to zero, the regression coefficient was close to one, and the r^2 was .78. Taken as a whole, these results clearly support the hypothesis that the beta for a multidivision firm is a weighted average of the betas which would be associated with its divisions if the divisions operated as independent entities. While this hypothesis seems intuitively plausible and is supported theoretically by the VAP, it has not been empirically verified before.

IV. Adjusting for Leverage

Table III presents correlation coefficients for the variables considered in this study. Notice from the first column of Table III that the only variable significantly correlated with $\Delta_j(\beta)$ is β_j . This correlation appears to be the result of the problem of order bias.¹¹

No other variable has a high correlation with $\Delta_j(\beta)$. Neither the size of the multidivision firm (V_j), nor the size of its debt ratio (DR_j), had a systematic impact on $\Delta_j(\beta)$. Perhaps most interesting is the fact that $\Delta_j(DR)$, the difference between the multidivision firm's debt ratio and a weighted average of the pure-play's debt ratios, did not have an impact on $\Delta_j(\beta)$, as indicated by the correlation coefficient of 0.066. This is of particular interest since capital structure was not taken into account when the pure-plays were selected.

One approach to analyzing the impact of ignoring capital structure when selecting pure-plays is to use a methodology similar to that proposed by Hamada [12]. Specifically, this approach involves unlevering the pure-play beta and then relevering the unlevered beta according to the capital structure of the multidivision firm. (The observed beta, $\hat{\beta}_{ij}$, is referred to as the equity beta; the unlevered beta, β_{ij}^u , denotes the asset beta; and, β_{ij}^a is termed the adjusted beta). Specifically, let

$$\beta_{ij}^u = \hat{\beta}_{ij} \left(\frac{\hat{S}_{ij}}{\hat{V}_{ij} - \hat{T}_{ij} \cdot \hat{D}_{ij}} \right) \quad (6)$$

¹⁰ This is considerably better than the results from a "naive" forecast of simply assuming the multidivision firm beta is 1.0. This "naive" forecast produced a mean $AR\Delta(\beta)$ of 18.2%.

¹¹ A demonstration that this correlation is a result of order bias is available from the authors.

Table II
Summary Statistics for Differences in Betas

	1976 Sample	1977 Sample	1978 Sample	Total Sample
Multidivision Beta (β_j): Mean	1.036	1.030	1.020	1.030
Standard Deviation	0.153	0.333	0.234	0.251
Pure-Play Proxy Beta ^a : Mean	1.011	1.046	0.981	1.017
Standard Deviation	0.083	0.294	0.183	0.208
Mean Difference, $\bar{\Delta}(\beta)$	0.025	-0.015	0.039	0.013
Standard Deviation of $\Delta_j(\beta)$	0.132	0.105	0.113	0.118
Number of Positive $\Delta_j(\beta)$	9	11	9	29
Number of Negative $\Delta_j(\beta)$	13	12	6	31
Mean $AR\Delta(\beta)$	9.5%	7.9%	9.4%	8.9%
Median $AR\Delta(\beta)$	7.7%	5.3%	9.1%	6.7%
Number of Observations	22	23	15	60
Regression (based on 60 observations)	$\beta_j = -0.055 + 1.067 \text{ (Pure-Play Proxy)}$ $r^2 = .78$			

^a Pure-Play Proxy Beta = $\sum_i \hat{W}_{ij} \hat{\beta}_{ij}$.

Table III
Selected Correlation Coefficients

	$\Delta_j(\beta)$	$AR\Delta_j(\beta)$	β_j	Proxy Beta	DR_j	$\Delta_j(DR)$	V_j	$\Delta_j(V)$
$\Delta_j(\beta)$	1.000							
$AR\Delta_j(\beta)$	-0.093	1.000						
β_j	0.568**	-0.056	1.000					
Proxy Beta	0.119	-0.015	0.885**	1.000				
DR_j	0.202	0.017	-0.012	-0.128	1.000			
$\Delta_j(DR)$	0.066	0.102	0.061	0.038	0.606**	1.000		
V_j	0.118	-0.194	-0.038	-0.112	0.103	-0.010	1.000	
$\Delta_j(V)$	0.127	-0.168	-0.060	-0.144	0.108	-0.001	0.942**	1.000

** Significant at the .01 level.

V_j = the value, or total capitalization, of the j^{th} multidivision firm, calculated as the book value of long-term debt plus equity.

$\Delta_j(V) = V_j - \sum_i \hat{W}_{ij} \hat{V}_{ij}$, where $\hat{V}_{ij}$ is the value of the appropriate pure-play.

DR_j = the debt ratio for the j^{th} multidivision firm, calculated as the book value of the firm's long-term debt divided by V_j .

$\Delta_j(DR) = DR_j - \sum_i \hat{W}_{ij} \hat{DR}_{ij}$, where $\hat{DR}_{ij}$ is the debt ratio of the appropriate pure-play.

$$\beta_{ij}^a = \beta_{ij}^u \left(\frac{V_j - T_j \cdot D_j}{S_j} \right) \quad (7)$$

where

$\hat{\beta}_{ij}$ = the observed beta (equity beta) for the i^{th} pure-play for the j^{th} multi-division firm;

β_{ij}^u = the unlevered beta (asset beta) for the i^{th} pure-play for the j^{th} multi-division firm;

β_{ij}^a = the adjusted beta for the i^{th} pure-play for the j^{th} multidivision firm;

V_j , $\hat{V}_{ij}$ = the market value of the total capital of the multidivision firm and the pure-play proxy respectively;

- $S_j, \hat{S}_{ij}$ = the market value of the equity of the multidivision firm and the pure-play proxy respectively;
 $D_j, \hat{D}_{ij}$ = the market value of the debt of the multidivision firm and the pure-play proxy respectively; and
 $T_j, \hat{T}_{ij}$ = the tax rate of the multidivision firm and the pure-play proxy respectively

This adjustment should account for differences in capital structure between pure-plays and multidivision firms—thus the adjusted proxy beta should more closely approximate β_j . To test this, market value data¹² were collected for the 1977 subsample and the adjusted betas, β_{ij}^a , were determined.

To illustrate, consider the case of Norlin, a multidivision firm in the 1977 subsample. The relevant data for Norlin are (dollar amounts in 000's): $V_j = \$91,386$; $S_j = \$44,306$; $D_j = \$47,080$; $T_j = .40$. For Wurlitzer, the pure-play associated with Norlin's first division: $\hat{\beta}_{1j} = .80$; $\hat{V}_{1j} = \$29,665$; $\hat{S}_{1j} = \$16,409$; $\hat{D}_{1j} = \$13,256$; $\hat{T}_{1j} = .45$. Using these data, the adjusted pure-play beta is calculated as follows:

$$\beta_{1j}^u = \hat{\beta}_{1j} \left(\frac{\hat{S}_{1j}}{\hat{V}_{1j} - \hat{T}_{1j} \cdot \hat{D}_{1j}} \right) = .80 \left(\frac{16,409}{29,665 - (.45)(13,256)} \right) = .55$$

$$\beta_{1j}^a = \beta_{1j}^u \left(\frac{V_j - T_j \cdot D_j}{S_j} \right) = .55 \left(\frac{91,386 - (.40)(47,080)}{44,306} \right) = .91$$

For this example, the process of unlevering and relevering resulted in increasing the observed pure-play beta from .80 to .91.

Hamada found that leverage adjustments based on market values of equity and debt determined at one point in time did not work particularly well, presumably because market value ratios of debt and equity are subject to dramatic changes as security prices rise and fall over time. Since book value ratios are more stable, the pure-play betas were also adjusted for leverage based on book values of debt and equity.

The top half of Table IV presents results for the 1977 subsample for the unadjusted proxy betas, for the proxy betas adjusted for leverage using book value ratios and for the proxy betas adjusted for leverage using market value ratios. For the 1977 subsample, unadjusted proxy betas provided better approximations of the multidivision firm betas than either of the leverage adjusted proxies. Due to the amount of work involved in determining market values (especially for nonpublic debt and preferred stock), and since adjusting the proxies using book value ratios worked better for the 1977 subsample than using market value ratios, only book value adjusted proxies were computed for the total sample—total sample comparisons are presented in the bottom half of Table IV. Again, the unadjusted pure-play betas provided better approximations of the

¹² The market value of each firm's bonds, preferred stock, and common stock was determined simply as the number of bonds (shares) outstanding times the market price per bond (share) as of 31 December 1977. The average tax rates were calculated from the firm's 1977 financial statements. Appropriate adjustments were made for the cases where the firm had nonpublic debt or preferred stock, capitalized leases, and no effective tax rate because of deficit earnings. These adjustments are described in detail in Fuller and Kerr [9].

Table IV
Leverage Adjustment

	Based on 1977 Sample		
	Unadjusted	Adjusted (Book Value)	Adjusted (Market Value)
β_j : Mean	1.031	—	—
Standard Deviation	0.333	—	—
Proxy Beta: Mean	1.045	1.108	1.200
Standard Deviation	0.294	0.388	0.529
Mean Difference, $\bar{\Delta}(\beta)$	-0.015	-0.077	-0.169
Std. Dev. of $\Delta_j(\beta)$	0.105	0.233	0.453
Number of Positive $\Delta_j(\beta)$	11	8	7
Number of Negative $\Delta_j(\beta)$	12	15	16
Mean $AR\Delta(\beta)$	7.9%	17.1%	31.8%
Median $AR\Delta(\beta)$	5.3%	15.8%	16.6%
Regression r^2	.91	.64	.28

	Based on Total Sample	
	Unadjusted	Adjusted (Book Value)
β_j : Mean	1.030	—
Standard Deviation	0.251	—
Proxy Beta: Mean	1.017	1.078
Standard Deviation	0.208	0.313
Mean Difference, $\bar{\Delta}(\beta)$	0.013	-.049
Std. Dev. of $\Delta_j(\beta)$	0.118	.238
Number of Positive $\Delta_j(\beta)$	29	28
Number of Negative $\Delta_j(\beta)$	31	32
Mean $AR\Delta(\beta)$	8.9%	16.6%
Median $AR\Delta(\beta)$	6.7%	11.9%
Regression r^2	.78	.44

multidivision firm betas than did the leverage adjusted pure-play betas. The mean $AR\Delta(\beta)$ was smaller (8.9% vs. 16.6%) and the r^2 was higher (.78 vs. .44).¹³

Having examined the equity component of the overall cost of capital, we now proceed to analyze the debt component. More specifically, we concentrate on whether or not the borrowing capacity (debt ratios) of the pure-plays is equivalent to the borrowing capacity of the multidivision firms. In Fuller and Kerr [9], using market values for the 1977 subsample only, we found that differences between the multidivision firm's overall cost of capital, K_j , and the pure-play proxy cost of capital, $\sum_i \hat{W}_{ij} \hat{K}_{ij}$, were due almost entirely to differences in debt ratios—differences in betas were not significant (just as the previous sections of this paper indicate), nor were differences in the cost of debt, cost of preferred stock or tax rates significant.

¹³ Adjusting betas for leverage using (6) and (7) is consistent with a Modigliani and Miller [18] world with corporate taxes in which the unobservable value of the unlevered firm is equal to the value of the levered firm (V) minus the value of the tax shield ($T \cdot D$). We also adjusted betas for leverage by assuming the value of the tax shield is zero, which is consistent with Miller [17]. This latter method produced even poorer results. The mean $AR\Delta(\beta)$ was 22.3%.

The debt ratio of the entity (firm or division), DR , is defined as the book value of the entity's long-term debt divided by its long-term debt plus stockholders' equity. To test if a sales-weighted average of pure-play debt ratios provides a good proxy for the observed debt ratios of the multidivision firms in the sample, let

$$\Delta_j(DR) = DR_j - \sum_i \hat{W}_{ij} \hat{D}R_{ij} \quad (8)$$

and

$$AR\Delta_j(DR) = \frac{|\Delta_j(DR)|}{DR_j} \times 100 \quad (9)$$

where $\Delta_j(DR)$ is the difference between the observed debt ratio for the j^{th} multidivision firm and its pure-play proxy debt ratio, and $AR\Delta_j(DR)$ is the absolute, relative difference, expressed as a percentage.

The procedure for analyzing debt ratios is essentially the same as that used for analyzing betas and the results are reported in Table V. First note that the mean difference in debt ratios, $\bar{\Delta}(DR)$, was positive for each of the three subsamples and quite similar in terms of magnitude and standard deviation. For the total sample, there were 37 positive differences versus 23 negative differences and the mean difference was a positive 0.041. Thus it appears that the multidivision firms consistently utilized more debt in their capital structure than did their corresponding pure-plays.

A pair-wise t statistic was calculated for the differences in debt ratios since there is no a priori reason to suspect that the mean debt ratios of the multidivision firms and the mean debt ratio of the pure-plays would be the same, unlike the case for betas. The formal hypothesis is

$$H_0: \bar{\Delta}(DR) = 0$$

Table V
Comparison of Debt Ratios
(Based on Book Values)

	1976 Sample	1977 Sample	1978 Sample	Total Sample
DR_j : Mean	.298	.337	.390	.336
Standard Deviation	.123	.179	.162	.158
Pure-Play Proxy Debt Ratio: Mean	.256	.290	.358	.295
Standard Deviation	.099	.164	.137	.140
Mean Difference, $\bar{\Delta}(DR)$	0.041	0.047	0.031	0.041
Standard Deviation of $\Delta_j(DR)$	0.139	0.168	0.174	0.157
Pair-wise t test:				
t statistic	1.39	1.34	0.70	2.02
P -value	.09	.10	.25	.025
Number of Positive $\Delta_j(DR)$	14	14	9	37
Number of Negative $\Delta_j(DR)$	8	9	6	23
Mean $AR\Delta(DR)$	17.4%	22.8%	21.7%	21.9%
Median $AR\Delta(DR)$	14.3%	18.6%	18.6%	18.4%
Number of Observations	22	23	15	60
Regression (based on 60 observations)				
	$DR_j = .187 + .506 (\text{Pure-Play Proxy})$			$r^2 = .20$

$$H_a: \bar{\Delta}(DR) > 0$$

For the total sample, the pair-wise t statistic was 2.02 which is significant at the .025 level under the alternative hypothesis that multidivision firms use more debt than their associated pure-plays. Thus, the results in Table V suggest that the pure-play's debt ratio is not a particularly good proxy for the division's debt ratio.

While this evidence provides some support for the argument that multidivision firms have greater borrowing power, it is certainly not conclusive evidence because, in effect, we are testing joint hypotheses—the two hypotheses being that $\bar{\Delta}(DR) = 0$ and that the pure-plays are perfect proxies for the divisions in question. Since the pure-plays are surely not perfect proxies, the results in Table V are not conclusive and should be viewed as simply another piece of evidence in the controversy regarding the concept of financial synergism—in this case, as evidence supporting the argument that diversification across business lines increases the firm's borrowing power.

V. Conclusion

While the pure-play technique is frequently suggested as a method for estimating the unobservable cost of capital for a division, this technique has not been empirically validated before. For our sample, a weighted average of pure-play betas closely approximated the observed beta of the multidivision firm in question. This result suggests that the pure-play technique is, in fact, a valid procedure for estimating the beta of a division. In the framework of the CAPM, the cost of equity capital of a division can then be estimated by Equation (2), using the pure-play beta as a proxy for the divisional beta and appropriate estimates of the market parameters γ_0 and γ_1 . Our results also suggest that differences between the division's and the pure-play's capital structure can be disregarded when estimating the divisional beta since the pure-play proxy betas (unadjusted for differences in leverage) provided better estimates of the multidivision firm betas than did the leverage adjusted proxy betas. However, since many previous studies¹⁴ have empirically verified the general positive relationship between systematic risk and leverage, this statement should be viewed with caution and may require additional testing.

On the other hand, our findings indicate that a weighted average of pure-play debt ratios consistently underestimated the observed debt ratio of the multidivision firm. However, this should not present serious problems to the financial manager attempting to estimate the overall cost of capital of a division since the manager probably already has in mind a divisional target debt ratio that is consistent with the firm's debt ratio. This target debt ratio may or may not be constant across divisions of the firm.

In a previous paper (Fuller and Kerr [9]), we reported that we did not find any significant difference between the pure-play proxy cost of debt and the cost of debt for the respective multidivision firms. Thus, it appears that an acceptable procedure for estimating the overall cost of capital for a division would be to: (1)

¹⁴ See, for example, Boness, Chen, and Jatusipitak [4], Hamada [12], Rosenberg and Guy [22], and Thompson [25].

use a pure-play beta to estimate the divisional beta and thus the divisional cost of equity capital; (2) use the overall cost of debt for the firm as the divisional cost of debt; and (3) use an internally-generated target debt ratio as the divisional debt ratio.

Finally, the fact that the debt ratios of multidivision firms were consistently larger than the debt ratios of their associated pure-plays provides some weak support for the argument that diversifying across business lines increases the borrowing power of the firm.

REFERENCES

1. Marshall E. Blume. "On the Assessment of Risk." *Journal of Finance* (March 1971), pp. 1-10.
2. ———. "Betas and Their Regression Tendencies." *Journal of Finance* (June 1975), pp. 785-95.
3. ———. "Betas and Their Regression Tendencies: Some Further Evidence." *Journal of Finance* (March 1979), pp. 265-7.
4. A. J. Boness, A. H. Chen, and S. Jatusipitak. "Investigations of Nonstationarity in Prices." *Journal of Business* (October 1974), pp. 518-37.
5. Richard S. Bower and Jeffrey Jenks. "Divisional Screening Rates." *Financial Management* (Autumn 1975), pp. 42-49.
6. Eugene F. Brigham. "Hurdle Rates for Screening Capital Expenditure Proposals." *Financial Management* (Autumn 1975), pp. 17-26.
7. ———. *Fundamentals of Financial Management*. New York: Holt, Rinehart and Winston, 1977.
8. Eugene F. Fama. "Risk-Adjusted Discount Rates and Capital Budgeting Under Uncertainty." *Journal of Financial Economics* (August 1977), pp. 3-24.
9. Russell J. Fuller and Halbert S. Kerr. "Divisional Cost of Capital Based on the Capital Asset Pricing Model and the Pure-Play Technique." Working Paper No. 79-5, Washington State University.
10. Myron J. Gordon and Paul J. Halpern. "Cost of Capital for a Division of a Firm." *Journal of Finance* (September 1974), pp. 1153-63.
11. Charles W. Haley and Lawrence D. Schall. *The Theory of Financial Decisions*, 2nd ed. New York: McGraw-Hill, 1979.
12. Robert S. Hamada. "The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stocks." *Journal of Finance* (May 1972), pp. 435-52.
13. Robert A. Haugen and Terence C. Langetieg. "An Empirical Test for Synergism in Merger." *Journal of Finance* (September 1975), pp. 1003-14.
14. Roger G. Ibbotson and Rex A. Sinquefeld. *Stocks, Bonds, Bills and Inflation: The Past (1926-1976) and the Future (1977-2000)*. Charlottesville, VA: The Financial Analysts Research Foundation, 1977.
15. Robert A. Levy. "On the Stationarity of Beta Coefficients." *Financial Analysts Journal* (November-December 1971), pp. 55-62.
16. John Lintner. "Security Prices, Risk and Maximal Gains from Diversification." *Journal of Finance* (December 1965), pp. 587-615.
17. Merton Miller. "Debt and Taxes." *Journal of Finance* (May 1977), pp. 261-76.
18. Franco Modigliani and Merton Miller. "The Cost of Capital, Corporation Finance and the Theory of Investment." *American Economic Review* (June 1958), pp. 261-97.
19. ———. "Corporate Income Taxes and the Cost of Capital: A Correction." *American Economic Review* (June 1963), pp. 433-43.
20. Stewart C. Myers. "Procedures for Capital Budgeting under Uncertainty." *Industrial Management Review* (Spring 1968), pp. 1-15.
21. ——— and Stuart M. Turnbull. "Capital Budgeting and the Capital Asset Pricing Model: Good News and Bad News." *Journal of Finance* (May 1977), pp. 321-52.
22. Barr Rosenberg and James Guy. "Prediction of Beta from Investment Fundamentals." *Financial Analysts Journal* (May-June and July-August 1974), pp. 60-72 and 62-70 respectively.
23. Lawrence D. Schall. "Asset Valuation, Firm Investment, and Firm Diversification." *Journal of Business* (January 1972), pp. 11-28.

24. William F. Sharpe, "Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk." *Journal of Finance* (September 1964), pp. 425-42.
25. Douglas J. Thompson. "Sources of Systematic Risk in Common Stocks." *Journal of Business* (April 1976), pp. 173-88.
26. James C. Van Horne. *Financial Management and Policy*. New York: Prentice-Hall, 1977.
27. J. Fred Weston. "Investment Decisions Using the Capital Asset Pricing Model." *Financial Management* (Summer 1973), pp. 25-33.
28. J. Fred Weston and Wayne Y. Lee. "Cost of Capital for a Division of a Firm: Comment." *Journal of Finance* (December 1977), pp. 1779-80.