This PDF is a selection from an out-of-print volume from the National Bureau of Economic Research

Volume Title: Corporate Capital Structures in the United States

Volume Author/Editor: Benjamin M. Friedman, ed.

Volume Publisher: University of Chicago Press

Volume ISBN: 0-226-26411-4

Volume URL: http://www.nber.org/books/frie85-1

Publication Date: 1985

Chapter Title: Capital Structure and the Corporation's Product Market Environment

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Chapter URL: http://www.nber.org/chapters/c11426

Chapter pages in book: (p. 353 - 382)

10 Capital Structure and the Corporation's Product Market Environment

A. Michael Spence

10.1 Introduction

This paper is a report on my attempts to explore the relationship between the capital structure choices firms make and the characteristics of the product market environments in which they operate. The hypothesis with which I began and which will serve to structure the initial exposition was quite simple. If optimizing a corporation's capital structure is a way of reducing total costs (or equivalently of raising the total market value of the firm), then firms under competitive pressure in the product markets might "optimize" their capital structures more carefully than firms that occupy positions in the product market sheltered to some extent from competition.

I was led to hypotheses of this type by observing, in a number of instances, that firms with strong product market positions appeared to have widely divergent approaches to capital structure policy. Some, like IBM, had little debt for extensive periods of time. Others, like Tandy Corporation, were highly leveraged and readjusted their capital structures periodically by issuing debt and buying in stock. Other corporations, operating in highly competitive environments, seemed to me to exhibit less variability in the amounts of debt they issued (in relation to total assets). Cases of this type, of course, are not necessarily selected randomly. Nor do they establish that capital structure has a significant effect on total costs or firm value. This research is therefore an attempt to explore these hypotheses with a larger and less potentially biased sample of firms.

I should say at the outset that I agree with scholars who argue that

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corporations are subject to pressure from both product and capital market sources. External product market pressures operate directly on profitability and on returns to investment. Capital markets, through withholding investment funds by bidding down the price of the equity or through takeovers, may intervene when the operations, investment decisions, or financing decisions of the corporation are mismanaged.

By focusing on the product market side, I do not mean to imply that capital market influences are unimportant. On the other hand, to pursue this line of research, as a matter of logic I do have to maintain as a hypothesis that the capital market pressure is not always sufficient to remove all but short-run deviations from optimal financial policies. If this were not true, there would be no deviations to explain. I shall say more about this later in the context of the statistical results.

The capital and product markets are not mutually exclusive constraining forces. A takeover could be the mechanism by which a failure to minimize costs is removed. The hypothesis here is that capital markets do not remove all deviations, and that management, with or without capital market intervention, react to pressure on profits from a competitive environment by trying to reduce costs further. Therefore, if capital structure affects costs, then intensely competitive product market environments will, on average, reduce deviations from optimal capital structure for corporations operating in that kind of environment.

The paper in outline is as follows. Section 10.2 sets out the formal statement of the hypotheses just discussed. Section 10.3 describes the variables used to characterize the product market environment of the firm. Section 10.4 presents the preliminary results of testing the hypothesis. In sections 10.5 and 10.6, I explore two related questions using the same database. One concerns the relationship between a corporation's product market position and its profitability. The other deals with the extent to which the product market variables and certain financial variables are capable of explaining the corporation's *actual* capital structure. I emphasize "actual" here to distinguish these results from those reported in section 10.4, where the issue is the divergence between actual and a calculated optimal capital structure. Section 10.7 summarizes the results and draws some conclusions. An appendix details the sources of the data.

It may be useful to provide a brief statement of the results in advance. I can find very little evidence that deviations of actual from calculated optimal capital structures are influenced at all by the product market environment. These results are consistent with the view that there are no optimal capital structures. I do find that the product market environment explains a substantial amount of the variance across firms in returns on total investment. Thus the product market variables cannot be dismissed as poor descriptions of the product market environment. In addition, I find that the product market variables and measures of profitability are correlated with actual capital structures, and in regressions "explain" a substantial amount of the variance in the ratio of debt to assets.

These results do not establish that the corporation's capital structure influences its costs or its total market value. It is possible that either management or investors have preferences with respect to capitalization that are reflected in what we see in the data, but which are not exclusively preferences for higher as opposed to lower value. On the other hand, the fact that variables describing the product market environment and the firm's profitability "explain" variations in capital structure is certainly not strong evidence that would lead one to accept the hypothesis that capital structure and value are unrelated.

It is difficult to know exactly where these preferences arise. Corporations like IBM and Polaroid with profitable market positions and high levels of investment in research and product development appear to shy away from debt except when financial resource constraints require it. Even then, equity financing has often been preferred. There are numerous examples of firms that avoid debt because they have had what they regard as bad experiences with banks. Historically, Crown Cork and Seal is an example. On the other hand, some corporations like Tandy Corporation persistently readjust their capital structures to keep leverage up. In Tandy's case, those decisions are described by management in annual reports as optimizing the capital structure. Tandy's original growth was financed in part by substantial loans from a few banks. It is likely that there was a somewhat unusual partnership between the corporation and the banks in this case.

Diverse capital structures within an industry could result from tax clienteles.[1] Moreover, investors probably do have industry preferences as part of their strategies for diversification. That would produce capital market pressure for heterogeneity in capital structure at the industry level. If that were the only force operating on capital structure, then one would expect to see deviations of actual from average capital structures that are random with respect to industry characteristics and competitive pressure. That is to say, there would be a nonzero variance in capital structure, but it would not be systematically related to the industry's characteristics. The statistical model below does not require that the variance in the deviation of actual from average capital structure be zero if competitive pressure has no effect.

10.2 The Statistical Model of Deviations of Actual from Optimal Capital Structures

The underlying hypothesis is that firms have optimal capital structures which depend on the industries in which they compete. For the moment, let us assume that each industry i has an optimal capital structure u_i. Let

s_{ji} be the share of the jth firm's assets in industry i. I assume that the optimal capital structure for firm j is

$$f_j = \sum_i s_{ji} u_i . \tag{1}$$

The actual capital structure of firm j is d_j. Capital structure here is measured by the ratio of debt, both current and long term, to total assets. Let $\boldsymbol{x}_j$ be a vector of attributes of firm j, describing the industries in which it operates and its competitive position in those industries. (I describe what are useful measures of these attributes in the next section.)

The main hypothesis is that the actual capital structure, d, is a random variable with a mean of f and a variance of v^2. The variance is a function of $\boldsymbol{x}$:

$$v^2 = H(\boldsymbol{x}) . \tag{2}$$

The hypothesis is that as product market pressure declines, the variance v^2 increases.

There is an assumption implicit in this formulation of the hypothesis. It is that the degree to which the optimal capital structure is indeed optimal is constant across industries. Or, to put it another way, the cost of being away from the optimal capital structure does not vary from one industry to the next. This assumption is unlikely to be strictly true. But to circumvent it, one would need to reinsert an explicit model of the determinants of optimal capital structure, a problem that, as the reader can see, I was trying to avoid. It is perhaps worth noting that similar problems confront most empirical work on industry structure and profitability due to incomplete data on the behavior of the cost functions. In the model tested here, to the extent that industry and firm characteristics are correlated with the costs of being away from optimal capital structure, these variables will pick up that effect. But it will not be identified distinctly from the effects of competitive pressure.

It would be preferable to generalize this model to allow the optimal capital structure to depend on the firm's position in the industries in which it competes, and also on the mix of businesses that it is in. That is to say, it is arguable that optimal capital structure as well as deviations from it depend on $\boldsymbol{x}$. For reasons that will be apparent shortly, that approach is not computationally feasible at the present time. In fact, the present approach strains resources as it is.

If we assume that d or its log is normally distributed, the probability of observing the sample, conditional on the parameters, is

$$L = \pi_j (2\pi)^{(-½)} \sigma_j^{-1} \exp[(-½\sigma^2)(d_j - \sum_i s_{ji} u_i)^2] . \tag{3}$$

The log of the likelihood function, the minimum of which yields the maximum likelihood estimates of the parameters, is

(4) $$S = (n/2)\log(2\pi) + \sum_j \log(\sigma_j) + \sum_j (\tfrac{1}{2}\sigma_j^2)(d_j - \sum_i s_{ji}u_i)^2 .$$

The dependence of the variance on the firm's characteristics is parameterized as follows:

(5) $$v = \exp(-b \cdot x).$$

This ensures that the likelihood function is convex in b and that v is positive.

The conditions for an optimum are in two groups. First the optimal capital structures for industries. Given $v_j^2, j = 1, \ldots, n$, the maximum likelihood estimate of $u = (u_1, \ldots, u_m)$ is the weighted regression coefficients

(6) $$u = (S^T D^{-1} S)^{-1} S^T D^{-1} d,$$

where $d = (d_1, \ldots, d_n)$, D is a diagonal matrix with $D_{jj} = v_j^2$, and S is the $n \times m$ matrix whose elements are the s_{ji}. There are practical problems with performing this regression because the number of four-digit industries is 450. We have data on 403 of those. A regression with 403 variables is a nontrivial problem in straight calculation. Nevertheless, the problem is conceptually simple.

The second set of conditions are essentially conditions for the optimal estimates of the determinants of the variances across firms, given the deviations of optimal from actual capital structure. Let

(7) $$e_j = d_j - \sum_i s_{ji}u_i .$$

Given u, the maximum likelihood estimates of b satisfy

(8) $$\sum_j [\exp(2bx_j)e_j^2 - 1]x_j = 0 .$$

Solutions to these equations in b give the effects of firm and industry characteristics on the variance, that is, the tendency to deviate from the optimal capital structure.

At several points in what follows, I refer to the optimal capital structure for the firm and/or industry. These terms always refer to the calculated optimal structure (6) for the industry and (7) for the firm. Both can be thought of as "suitable" averages of actual capital structures, where the weights in the averages are developed from the shares of each firm's sales (and by calculation assets) in each industry.

We note in passing that

(9) $$d^2S/db^2 = 2\sum_j \exp(2bx_j)e_j^2 x_j x_j^T .$$

This second derivative is positive semidefinite. As a result, an extremum in the b's will be a minimum of the objective function.

The second set of conditions entails a nonlinear estimation problem, although a relatively easy one. To find the global maximum, one can solve these two sets of conditions sequentially for u and b. If the process converges, it converges to the maximum likelihood estimates. As I noted above, there are some practical computational problems in implementing this. Nevertheless, this is the conception of the problem with which I began the statistical work.

In section 11.4, I have used somewhat simpler preliminary regressions that retain the content of the model described above. Since the results do not suggest large deviations of actual from optimal capital structures explainable by product market and profitability variables, I have not felt the effort of the nonlinear estimation in step 2 of the maximum likelihood procedure had a sufficiently high payoff to justify the effort and cost.

10.3 The Product Market Environment

The hypothesis outlined above is that firms that are relatively free of competitive pressure will use that freedom in part to maintain capital structures that they prefer. These preferences may or may not be for optimal capital structures. In general, we expect the deviation of actual from optimal to be larger when the competition is less. All of this is of course conditional on there being an optimal capital structure.

There are two ways to measure "competitiveness" in the environment. One is to use various measures of return on investment or assets, perhaps with adjustments for risk. (In this first pass, I have not used security market data to adjust returns for risk, though I plan to do so in future work, particularly in the ROA equations.) Returns measure the *effect* of insulation from competition in the market environment. The second method is to employ product market characteristics, specifically, variables that directly and indirectly measure entry barriers, potential oligopolistic consensus, or both. Further, one can combine certain entry barrier variables that are based on scale advantages with share of market data to obtain measures of the firm's competitive position in the various markets in which it operates. I have used both approaches together on the ground that the entry barrier measures are imperfect, and hence that the return data contain additional information not available in the product market data.

Attaching to each firm are two kinds of variables. One group consists of financial variables, the other of industry variables. For diversified firms, each variable in the latter group is a weighted average across the industries in which the firm operates, with the weights being the share of the firm's sales in each of the relevant industries. For example, if $CI4_i$ is the four-firm concentration ratio for industry i, and $C4_j$ is the four-firm concentration variable for firm j, then

$$\text{(10)} \qquad C4_j = \sum_i s_{ji}\, CI4_i ,$$

where, as before, s_{ji} is the fraction of firm j's sales (or assets) in industry i. Thus the product market environment of each firm is measured by a collection of variables each of which is a weighted average of the attributes of the industries in which the firm participates.

Table 10.1 summarizes the variables that have been used thus far to describe the firm. Product market data are for 1972. Financial data are 5-year averages for 1970–74, the period bracketing 1972. The variables in table 10.1 are the variables I labeled x in the preceding section. They are the hypothesized determinants of the variance.

The definition of capital structure, DEBT/A, includes short-term debt. I included short-term debt because (*a*) some of it is maturing longer-term debt and (*b*) some of the rest (principally bank debt), while formally short term, is often short term only in name. The bank does have options with respect to constraining corporate decisions that are not available to bondholders. So there are important differences. But I felt it would be misleading to label all short-term bank debt "short-term financing," when it is often part of the longer-term capitalization of the corporation.

The financial variables here are all based on book value. In the case of rates of return on assets and equity, there is a good reason for this. We need measures of above- and below-average profitability. Stock market returns reflect risk but not market power except in the period when the market becomes aware of the firm's market power and capitalizes it in the stock price. This is not to say that the book rates of return data are ideal. In fact, there are numerous sources of noise which produce a disconcerting increase in the unexplained variance.

For capital structure, the use of market values would be preferable. But it is costly and difficult to assemble accurate market value data for debt. This study is a cross-section study, so the problems of inflation and interest rate changes that contaminate intertemporal comparisons of leverage using book values do not arise in a severe form here.

I will not review the entire contents of the literature in industrial organization to develop the argument that these variables are pertinent product market characteristics from the standpoint of determining profitability. However, some brief comment is in order. The industry variables are largely industry's characteristics that affect barriers to new competition. That would apply to MES, CDR, A/S, and P/VA as a measure of labor intensity (or absence of capital intensity). Capital intensity is associated with sunk costs and irreversibility that to some extent deters entry. The share of market variable is correlated with relative costs in industries with substantial scale economies. I have interacted market share with several of the entry barrier variables because the latter capture industry attributes that cause there to be scale-related advantages at the firm level.

The firm-specific variables measure capital structure (DEBT/A) and profitability (ROA and ROE). Because ROE is influenced by capital structure, I have used the return before tax and interest on total assets as the main measure of profitability, that is, the one that is most likely to be

Table 10.1

Symbol	Variable	Type
ROE	Return on book value of equity	f
CA/CL	Ratio of current assets to current liabilities	f
ROA	Return on book value of assets (ebit divided by assets)	f
MXR-MO	The max of ROA minus the mean (M) of ROA and zero	f
MXR-SO	The max of ROA minus (M + S) where S is the standard deviation of ROA, and zero	f
MXM-RO	The max of M minus ROA and zero	f
MXS-RO	The max of (M − S) minus ROA and zero	f
DEBT/A	Current plus long-term debt divided by assets	f
PPE/A	Property plant and equipment divided by total assets	f
HERF	The sum of the squared shares of the firm across all industries	f
A	Total assets of the firm	f
OPTIM	The calculated optimal capital structure	f
C4	4-firm concentration ratio	I
C8	8-firm concentration ratio	I
C20	20-firm concentration ratio	I
MES	Minimum efficient scale of plant	I
CDR	Cost disadvantage ratio for small est's	I
A/S	Advertising to sales ratio	I
P/VA	Payroll divided by value added: a measure of labor intensity	I
VA/A	Value added divided by assets	I
SOM	Share of industry sales	I
SOM*A/S	Market share times advertising to sales ration	I
SOM*MES	Market share times minimum efficient scale plant	I
SOM/CDR	Market share divided by cost disadvantage ratio	I
SOM/C4	Market share divided by share of top four firms	I

determined directly by the firm's competitive position in the various industries in which it operates. The ratio CA/CL is a measure of the resources the firm has for investment. The data and tests below strongly suggest that firms with substantial resources use them and tend not to use debt. The variable PPE/A is included in order to test the hypothesis that debt is used more readily if there are durable assets to collateralize the debt. Finally, I have calculated the Herfindahl index of diversification across product markets for each firm. This was done for two reasons. One is that it may directly affect capital structure decisions. The other is that I have used this index to segregate relatively undiversified firms from the full sample of 1,183 firms and have run several of the statistical tests on the more limited sample. In terms of the preceding notation, the Herfindahl index is

$$H_j = \sum_i s_{ji}^2 . \tag{11}$$

A firm with a Herfindahl index of .625 must have at least 75% of its sales in a single industry.[2] This is the cutoff I have used in the subsequent analysis to identify relatively undiversified firms.

Finally, an explanation of the variables derived from ROA is required. These are an attempt to separate profitability into four categories: high, very high, low, and very low. The easiest way to explain the variables is to draw a picture of them. Figure 10.1 shows each variable as a function of ROA itself.

10.4 The Results for Deviations of Actual from Optimal Capital Structures

Because of the cost of some of the computations, I ran some preliminary regressions to obtain an indication of the explanatory power of the product market variables. These preliminary results are described below.

One step in the maximum likelihood estimation procedure is the calculation of the weighted regression coefficients,

$$\hat{u} = (S^T D^{-1} S)^{-1} S^T D^{-1} d . \tag{12}$$

This regression has to be repeated (with 403 variables on the right-hand side) each time new estimates of the firm-specific variances are derived. Instead, I estimated the unweighted coefficients

$$\bar{u} = (S^T S)^{-1} S^T d . \tag{13}$$

These are unbiased but not minimum variance estimates of industry optimal capital structures.[3] It is also the first step in the maximum likelihood sequence. Given the estimates $\bar{u}$, I calculate

$$e_j = \sum_i s_{ji} \bar{u}_i - d_j . \tag{14}$$

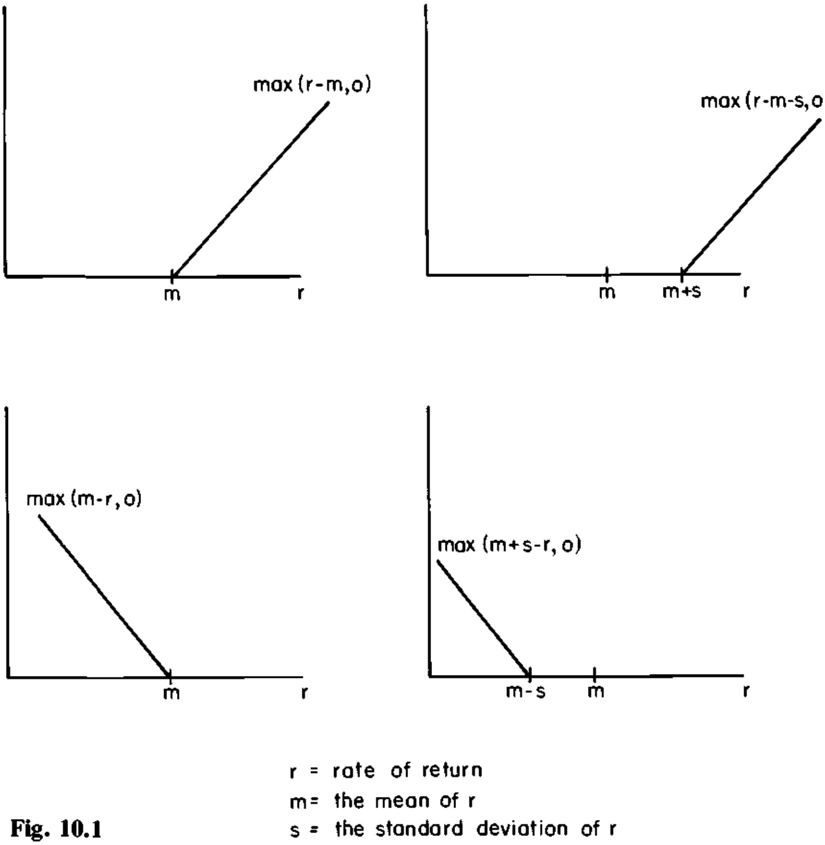

Fig. 10.1

for each firm $j = 1, \ldots, n$. These are the deviations of the actual from the estimated optimal capital structures for each firm.

The second step in the maximum likelihood algorithm is a nonlinear estimation problem. I replaced it for exploratory purposes with a simple regression. The dependent variable is the absolute value of e_j, or e_j^2, or the natural log of the absolute value of e_j. The regression is

$$v_j = bx_j + r_j, \tag{15}$$

where the r_j are independently identically distributed normal random variables (we hope). I eliminated observations with missing data and in addition excluded observations for which any of the following were satisfied:

1) The deviation from optimal capital structure was outside the range $[-1, 1]$.

2) The value of ROA was outside the range $[-.5, .5]$.

3) In most cases, I eliminated firms with DEBT/A outside the range $[0, .7]$. The reason for this was that I discovered that in the regressions

explaining deviations of optimal from actual capital structure, the variable DEBT/A explained most of the variance and that was because of a few very high values of DEBT/A. It is worth noting that those outliers are there, but I felt that they made the regression results misleading. Collectively these restrictions reduced the sample of firms by about 200 firms.

The regressions that follow are run with each variable normalized so that its standard deviation is one. Therefore the regression coefficient is the change in the dependent variable measured as a fraction of the standard deviation of that variable that results from a 1 S.D. change in the associated independent variable. The tables reporting the results give the coefficient estimate and the standard error. I will generally refer to a variable as significant if the probability that it is zero is below 10%.

Table 10.2, column 1, contains the estimates for the log of the absolute value of the deviations. The collective explanatory power of these variables is not great. The R^2 is .054. Focusing on the significant coefficients would lead one to the following conclusions. High-return firms have lower than average deviations, while very high-return firms have higher than average differences between actual and optimal capital structure. I did not find this surprising since the motivation for the hypothesis originally was that very high-return firms, protected in the product markets, were subject to less pressure, and hence were more likely to pursue independent capital structure policies.

Table 10.2, column 2, is the same regression with the absolute value of the deviation as the dependent variable. The results are qualitatively similar, and the fit is somewhat better. Here one can see that in addition to the effects mentioned above, low-return firms have above average deviations while very low-return firms are closer to the optimal levels. Corporations with resources in the form of a high CA/CL tend to have larger deviations though the relationship is not statistically strong in this regression. The concentration numbers are best interpreted as coming from a specification of the form

$$\hat{a}c_4 + \hat{b}(c_8 - c_4)\,. \tag{16}$$

In these terms $\hat{a}$ would be $-.119$ and $\hat{b}$ would be $-.313$. Thus both high four-firm concentration and high incremental concentration between four and eight firms lower the deviations. This is counter to the hypothesis that freedom from product market pressure increases the deviation. Labor-intensive firms are nearer to the optimal levels. Generally such firms are less protected by entry barriers. And firms with high absolute levels of DEBT/A have higher deviations, even though the upper tail of the distribution of DEBT/A was removed from the sample.

Table 10.2, column 3, is once again the same regression with the square of the deviation as the dependent variable. The results here are quite close to those for the absolute value of the deviation.

Table 10.2 Determinants of Deviations of Actual from Calculated Optimal Capital Structures

Number of Dependent Variables	Logdev (1)	Abs. Dev. (2)	Dev^2 (3)	Abs. Dev. (4)	Abs. Dev. (5)
SOM	−.038(.032)	−.026(.031)	−.012(.068)		−.063(.07)
CA/CA	−.001(.038)	.037(.037)	.084(.037)		.042(.037)
C4	.094(.126)	.194(.124)	.301(.125)		.19 (.125)
C8	−.232(.135)	−.313(.134)	−.408(.134)		−.305(.134)
AIS	−.004(.05)	−.007(.049)	−.008(.049)		.002(.048)
P/VA	−.061(.049)	−.061(.048)	−.059(.048)		−.051(.048)
VA/A	.032(.042)	.012(.04)	−.002(.042)		.013(.041)
CDR	.017(.035)	.003(.035)	−.014(.035)		.023(.036)
MES	.010(.061)	−.005(.06)	.065(.06)		−.003(.060)
DEBT/A	.093(.041)	−.204(.04)	.236(.04)		.213(.04)
SOM*A/S	−.08 (.05)	−.081(.05)	−.071(.05)		−.067(.049)
SOM*MES	−.078(.061)	−.037(.061)	−.062(.061)		−.021(.061)
SOM*CDR	.175(.111)	.178(.11)	.18 (.11)		.149(.111)
SOM/C4	−.117(.075)	−.149(.074)	−.148(.074)		−.129(.074)
HERF	−.009(.035)	.037(.035)	.067(.035)	−.016(.033)	.055(.035)
PPE/A	−.020(.039)	.024(.039)	.039(.039)	.017(.032)	.016(.039)
MXR-MO	−.176(.107)	−.124(.105)	−.09 (.105)	−.216(.103)	−.127(.101)
MXR-SO	.269(.097)	.277(.096)	.223(.096)	.292(.096)	.278(.092)
MXM-RO	.083(.071)	.132(.070)	.157(.071)	.157(.071)	.130(.07)
MXS-RO	−.034(.063)	−.089(.063)	−.128(.063)	−.088(.063)	−.09 (.063)
OPTIM					
A					
R^2	.054	.0258	.0744	.0286	.0819
df	939	939	939	953	935
F	2.68	3.85	3.77	4.67	3.97

	(6)	(7)	(8)	(9)
SOM	−.03 (.223)	−.046(.225)	−.079(.229)	
CA/CL	.019(.074)	.100(.075)	.136(.076)	.119(.073)
C4	−.065(.268)	.310(.271)	.619(.276)	
C8	−.153(.277)	−.501(.280)	−.763(.285)	
AIS	−.062(.097)	−.122(.098)	−.105(.100)	
P.VA	−.121(.10)	−.144(.101)	−.117(.103)	
VA/A	.179(.09)	.161(.091)	.071(.093)	
CDR	.048(.075)	.003(.076)	−.026(.077)	
MES	.073(.149)	.094(.151)	.234(.153)	
DEBT/A	.055(.077)	.119(.077)	.125(.079)	
SOM*A/S	−.139(.115)	−.074(.116)	−.057(.118)	
SOM*MES	−.204(.167)	−.119(.169)	−.198(.172)	
SOM*CDR	.164(.255)	.154(.257)	.182(.261)	
SOM/C4	−.147(.137)	−.16 (.139)	−.121(.141)	
HERF	.034(.068)	.048(.069)	.064(.070)	.035(.067)
PPE/A	−.007(.084)	.036(.085)	.069(.086)	−.037(.068)
MXR-MO	−.258(.238)	−.278(.240)	−.142(.244)	−.151(.234)
MXR-SO	.288(.215)	.378(.217)	.239(.221)	.269(.213)
MXM-RO	.117(.145)	.189(.147)	.204(.149)	.203(.146)
MXS-RO	−.086(.125)	−.159(.126)	−.175(.128)	−.145(.125)
OPTIM				
A				
R^2	.1503	.1314	.1036	.0575
df	213	213	213	225
F	1.88	1.61	1.23	1.72

I ran the regression for ABSDEV with the product market variables removed in order to determine whether the financial variables explained most of the variance in the deviations. The results are in table 10.2, column 4. The R^2 falls significantly and the influences of the remaining financial variables remains the same. It is perhaps worth noting that in the squared deviation regression (col. 3) the Herfindahl index has a positive and significant influence on the deviation. The interpretation is that large deviations are more likely if the firm is undiversified. Recall that diversification declines as the Herfindahl index increases.

Column 5 in table 10.2 includes total assets as a right-hand side variable, as a measure of firm size.[4] It is positive in its effect on deviations of actual from optimal capital structure and significant. A related result reported later (table 10.4, col. 26) is that firm size has a negative and significant effect on actual capital structure. As I had expected size to increase the attractiveness of leverage, I do not, at the moment, have an explanation for this result. Note, however, that the Herfindahl measure of diversification is in both equations. It is negative in inference, i.e., high diversification does increase leverage.

The principal point that needs to be made is that the differences between actual and weighted average optimal capital structures are related to certain financial and product market variables but the latter do not explain much of the variation in the deviations. These results are consistent with two different views of capital structure. One is that capital structure does not strongly influence costs or total value for reasons that recent general equilibrium theories predict. The other is that firms do not deviate much from optimal capital structures in ways that are systematically related to their profitability, their diversification and their product market environments. But these results could not be taken as strong disconfirmation of the modern forms of the Modigliani-Miller propositions. Later I will argue that actual capital structures are quite strongly related to financial and product market characteristics of the firm and to the optimal levels of DEBT/A. I will return to this general question when we get to those results.

10.4.1 Undiversified Firms

It would seem desirable to confirm these results by conducting the analysis on a subsample of undiversified firms.[5] There are two aspects to this problem. One involves estimating the optimal industry capital structures using undiversified firms. That would certainly reduce the complexity of the first part of the estimation process. But with this sample of 1,183 firms, it is not possible to do this. There are only 112 single-industry firms, not sufficient with 403 industries. If we take only firms with Herfindahl indices in excess of .625 so that they must have at least 75% of sales in some industries, the number of firms with that set of characteristics is 384 and they only cover 326 industries. The completely undiversified firms cover only 85 industries, and there are not enough observations on each industry to be confident of the results.

On the other hand, I did test all hypotheses including those above using the restricted sample of firms with HERF in excess of .625. For these regressions, the deviations are calculated using the estimated industry optimal capital structures, which in turn were calculated using the full sample of firms, including the diversified ones.

Table 10.2, columns 6, 7, 8, and 9 duplicate columns 1, 2, 3, and 4, but the regressions were run on the restricted sample. The results are similar, the most interesting difference being that the explained variance is roughly doubled in each case. It seems fairly clear that the diversified firm sample contains more noise in the relation between optimal and actual capital structure.

10.5 The Determinants of Rate of Return

The product market variables have a reasonable amount of explanatory power with respect to the rate of return on assets for the corporation. Table 10.3, column 10 is the regression of ROA on the product market variables and certain firm-specific variables. Table 10.3, column 10 contains only the product market variables: specifically, CA/CL and DEBT/A have been excluded. The product market variables themselves explain about 10% of the variance, with labor intensity being the most powerful influence (in the downward direction) on profitability. When the financial variables are added the R^2 jumps to 35%. Clearly there is a very high correlation between high returns, on the one hand, and high liquidity and low debt, on the other. Similar results hold if one substitutes MXR-MO (the high returns) as a dependent variable. The numbers are in table 10.3, columns 11 and 18. Column 11 contains the full set of explanatory variables, and column 18 is confined to the product market variables.

Column 12 shows the explanatory variables for low-return firms. These are broadly similar to the ROA regression, with signs reversed since the variable is mean of ROA—ROA id ROA is less than the mean. Column 13 contains the firm-size variable (total assets). It is not significant as a determinant of ROA.

The financial variables should not be construed as *causes* of high returns on investment except perhaps as a second-order effect. Therefore the coefficients on CA/CL and DEBT/A should be regarded as interesting partial correlations, but the variables are not determinants of ROA. The product market variables do not explain as much of the variance in ROA as they should. One possible reason is that the market share data contain substantial measurement errors. I reran ROA equations for undiversified firms with Herfindahl indices in excess of .625. As noted before, this ensures that there is at least one market in which the firm has

Table 10.3 Determinants of Rates of Return

Number of Dependent Variables	ROA (10)	MXR-MO (11)	MXM-RO (12)	ROA (13)	ROA (14)
SOM	.072(.056)	.072(.057)	.038(.064)	.08 (.058)	.003(.198)
CA/CL	.174(.03)	.155(.031)	−.13 (.035)	.173(.031)	.166(.065)
C4	.073(.103)	.036(.104)	−.144(.118)	.078(.105)	.174(.237)
C8	−.106(.111)	−.058(.112)	.154(.127)	−.111(.112)	−.214(.245)
AIS	.016(.041)	.023(.041)	.006(.047)	−.013(.04)	.115(.085)
P/VA	−.216(.039)	−.18 (.04)	.185(.045)	−.221(.04)	−.215(.086)
VA/A	−.011(.034)	.052(.034)	.134(.039)	−.014(.034)	.069(.078)
CDR	−.007(.029)	−.019(.029)	−.019(.033)	−.012(.03)	.017(.066)
MES	−.037(.05)	−.041(.050)	.012(.057)	−.039(.05)	−.086(.132)
DEBT/A	−.436(.03)	−.432(.031)	.235(.035)	−.442(.031)	−.342(.064)
SOM*A/S	.052(.041)	.092(.042)	.056(.047)	.03 (.041)	−.137(.101)
SOM*MES	.028(.051)	.027(.051)	−.016(.058)	.023(.051)	.001(.149)
SOM/CDR	−.114(.091)	−.181(.092)	−.076(.104)	−.082(.095)	−.185(.225)
SOM/C4	.077(.061)	.084(.062)	−.028(.070)	.065(.062)	.032(.122)
HERF	−.061(.028)	.009(.028)	.174(.032)	−.072(.029)	−.034(.059)
PPE/A	.032(.032)	.038(.032)	−.003(.036)	.035(.033)	.107(.073)
MXR-MO					
MXR-SO					
MXM-RO					
MXS-RO					
OPTIM					
A				−.026(.031)	
R^2	.3558	.3471	.1637	.3447	.3118
df	943	943	943	939	217
F	32.6	31.3	11.5	29.1	6.15

	MXR-MO (15)	MXM-RO (16)	ROA (17)	MXR-MO (18)	ROA (19)
SOM	.004(.198)	.001(.216)	−.047(.066)	−.046(.066)	−.157(.216)
CA/CL	.174(.065)	−.07 (.071)			
C4	.150(.237)	−.148(.258)	.198(.122)	.160(.121)	.305(.263)
C8	−.142(.245)	.277(.267)	.271(.131)	−.220(.130)	−.442(.270)
AIS	.157(.085)	.031(.093)	.089(.048)	.094(.048)	.129(.094)
P/VA	−.122(.086)	.324(.094)	−.24 (.047)	−.205(.046)	−.277(.095)
VA/A	.131(.078)	.101(.085)	−.062(.04)	.003(.04)	.051(.087)
CDR	−.025(.066)	−.103(.072)	.003(.034)	−.01 (.034)	.034(.073)
MES	−.104(.132)	.008(.144)	−.025(.059)	−.03 (.059)	−.047(.147)
DEBT/A	−.349(.064)	.168(.07)			
SOM*A/S	−.092(.101)	.176(.11)	.01 (.049)	.052(.049)	−.172(.113)
SOM*MES	.015(.149)	.031(.162)	.026(.06)	.026(.06)	.011(.165)
SOM*CDR	.089(.225)	−.315(.245)	.053(.107)	−.015(.107)	.355(.248)
SOM/C4	.054	.032(.133)	.08 (.072)	.087(.072)	.042(.136)
HERF	.024(.059)	.149(.064)	.029(.033)	.097(.033)	−.019(.065)
PPE/A	.098(.073)	−.079(.08)	−.041(.037)	−.029(.036)	.058(.078)
MXR-MO					
MXR-SO					
MXM-RO					
MXS-RO					
OPTIM					
A					
R^2	.3130	.1827	.0972	.1034	.1403
df	217	217	945	945	219
F	6.18	3.03	7.27	7.78	2.55

Table 10.3 (continued)

Number of Dependent Variables	MXR-MO (20)
SOM	−.158(.217)
CA/CL	.8
C4	.285(.265)
C8	−.377(.272)
AIS	.170(.095)
P.VA	−.187(.096)
VA.A	.111(.087)
CDR	−.007(.074)
MES	−.063(.147)
DEBT/A	
SOM*A/A	−.128(.113)
SOM*MES	.025(.166)
SOM*CDR	.263(.249)
SOM/C4	.064(.136)
HERF	.039(.066)
PPE/A	.046(.079)
MXR-MO	
MXR-SO	
MXM-RO	
MXS-RO	
OPTIM	
A	
R^2	.1309
df	219
F	2.36

at least 75% of its sales. The results are contained in in table 10.3, columns 14, 15, 16, and 19. Column 19 was only product market variables. Finally, column 20 is like column 19 but the dependent variable is the return for high-return firms. Generally the explained variance is higher, suggesting that the purely product market determinants of ROA are more precise variables for undiversified firms and that the modest showing of the product market variables in the full sample is due in part to noise in the share data or in the rate-of-return figures themselves.

10.6 Actual Capital Structure

Let me now turn to the capital structure. In the case of return on assets, one would expect the product markets to be the principal determinants of ROA. The explanatory power of the financial variables, while interesting, is not causal. For capital structure, it is more likely that an abundance of financial resources would cause the firm to limit its use of debt. I have explored the determinants of capital structure using these data and a sequence of regressions which are reported below. Table 10.4, column 21, is a regression of capital structure on the full complement of product and financial variables, with one exception which I shall come to shortly. The regression explains 40% of the variance. There is a lengthy list of significant variables. Liquidity as measured by CA/CL has a strong negative effect on debt. Apparently, on average corporations use debt as a low-cost source of capital when they need it. High returns reduce debt, and low returns increase it. However, very low returns reduce debt. The Herfindahl index reduces debt. Remember that a high Herfindahl index is associated with the absence of diversification. Thus diversified firms have a pronounced tendency to hold more debt.

Column 22 removes the product market variables and column 23 takes out CA/CL in addition. The explained variance is not reduced dramatically. The capital structure decision appears to be strongly influenced by profitability, financial resources, and diversification.

In preceding sections I calculated an optimal capital structure for each firm, based on the estimated optimal capital structures at the industry level. I put the calculated optimal capital structure for the firm on the right-hand side in the equation explaining actual capital structure. Table 10.4, columns 25 and 26, contain the results: in 26, the product market variables are missing, while in 25 the full complement of variables is included. In both cases the optimum capital structure has a strong positive influence on the actual capital structure, and it increases the explained variance by about 10 percentage points. The explained variance is in the neighborhood of 50%. Thus it appears that the calculated optimal capital structures capture features of the industry environment that influence capital structure decisions.

Table 10.4 Determinants of Actual Capital Structue

Number of Dependent Variables	Debt/A (21)	Debt/A (22)	Debt/A (23)	Debt/A (24)	Debt/A (25)
SOM	.254(.034)			.281(.056)	.168(.05)
CA/CL	−.276(.029)	−.264(.028)		−.277(.029)	−.194(.077)
C4	−.207(.100)			−.202(.101)	−.176(.091)
C8	.199(.108)			.192(.108)	.181(.098)
AIS	−.078(.04)			−.085(.039)	−.039(.036)
P.VA	−.041(.039)			−.049(.039)	−.059(.035)
VA/A	.043(.033)			.043(.033)	.041(.030)
CDR	.032(.028)			.017(.029)	.026(.025)
MES	.007(.048)			.006(.049)	.033(.044)
DEBT/A					
SOM*AIS	.075(.04)			.065(.040)	.065(.036)
SOM*MES	−.022(.049)			−.034(.049)	−.022(.045)
SOM*CDR	−.345(.088)			−.323(.089)	−.260(.080)
SOM/C4	.004(.06)			−.010(.060)	.008(.054)
HERF	−.143(.028)	−.143(.026)	−.148(.027)	−.156(.028)	−.109(.025)
PPE/A	−.047(.031)	−.038(.027)	.034(.027)	−.04 (.031)	.011(.028)
MXR/MO	−.457(.084)	−.508(.084)	−.59 (.087)	−.416(.081)	−.396(.076)
MXR/SO	.087(.077)	.128(.078)	.139(.081)	.045(.074)	.090(.070)
MXM-RO	.107(.057)	.119(.057)	.143(.06)	.109(.057)	.065(.052)
MXS-RO	−.027(.051)	−.029(.051)	−.024(.053)	−.027(.051)	−.009(.046)
OPTIM					.370(.026)
A				−.071(.030)	
R^2	.3962	.3699	.3129	.3971	.5041
df	940	952	953	936	939
F	32.5	79.8	72.3	30.8	47.7

	(26)	OPTIM (27)	(28)	(29)	(30)
SOM		.272(.066)	.543(.196)		
CA/CL	−.189(.026)		−.287(.063)	−.274(.061)	
C4		−.016(.120)	−.115(.24)		
C8		−.001(.127)	.186(.247)		
AIS		−.152(.048)	−.02 (.087)		
P/VA		.117(.047)	.042(.089)		
VA/A		.061(.036)	.025(.081)		
CDR		.003(.034)	−.016(.067)		
MES		−.038(.059)	−.011(.133)		
DEBT/A					
SOM*AIS		.044(.049)	.029(.102)		
SOM*MES		−.013(.06)	−.138(.149)		
SOM*CDR		−.261(.168)	−.437(.275)		
SOM/C4		−.007(.073)	−.081(.123)		
HERF	−.099(.024)		−.047(.060)	−.024(.058)	−.018(.06)
PPE/A	.013(.025)		−.081(.075)	−.041(.059)	.032(.06)
MXR-MO	−.431(.076)		−.366(.211)	−.425(.202)	−.501(.210)
MXR-SO	.133(.07)		.029(.192)	.062(.186)	.071(.193)
MXM-RO	.069(.052)		.013(.13)	.038(.127)	.062(.132)
MXS-RO	−.010(.046)		.030(.112)	.016(.109)	−.002(.113)
OPTIM	.377(.025)				
A					
R^2	.4882	.0786	.3184	.2813	.2175
df	952	947	214	226	277
F	113	6.74	5.26	12.6	10.5

Table 10.4 (continued)

Number of Dependent Variables	Debt/A (31)	Debt/A (32)
SOM	.338(.287)	
CA/CL	−.199(.103)	−.178(.095)
C4	−.455(.358)	
C8	.465(.369)	
AIS	−.101(.124)	
P.VA	−.048(.139)	
VA/A	.129(.128)	
CDR	−.121(.102)	
MES	.081(.236)	
DEBT/A		
SOM*AIS	−.178(.122)	
SOM*MES	−.214(.293)	
SOM*CDR	.195(.378)	
SOM/C4	−.282(.256)	
HERF	−.037(.095)	.052(.086)
PPE/A	.126(.119)	.127(.092)
MXR-MO	−.134(.386)	−.193(.355)
MXR-SO	−.149(.355)	−.101(.327)
MXM-RO	.100(.200)	.051(.186)
MXS-RO	−.005(.166)	.035(.151)
OPTIM	.249(.100)	.338(.089)
A		
R^2	.5058	.4161
df	76	88
F	3.89	7.84

Column 27 is a regression of the calculated optimal capital structure for the firm on variables describing its product market environment. The R_2 is .079, which is modest. The significant variables are market share, advertising intensity, and value added as a fraction of assets.

Columns 28, 29, and 30 are similar regressions run on the sample with HERF > .625. These results accord with the full sample results.

For reasons suggested earlier, I limited the sample to firms with Herfindahl indices in excess of .85. This is the largest value of HERF which leaves the sample size at a hundred firms. If this sample were used to estimate industry capital structures for the industries which have at least one firm, the industry optimal capital structures would be very close to the firm's actual capital structures. With HERT = .85, a firm would have to have at least 92% of its sales in a single industry. Table 10.4, columns 31 and 32, contains the results. In column 32 the product market variables are left out, the effect being to lower the R^2 by 10 from 50 to 40. The results are similar to those for the full sample. Of course the explanatory power of HERF is reduced. The principal difference is that in the small sample, the rate of return variables have lost their statistical significance.

It seems reasonable to ask whether the product market variables explain any of the variance in the calculated optimal capital structure variable. The answer is yes, about 8%. The results are in table 10.4, column 27. Here the right-hand-side variables are confined entirely to product market variables.

10.7 Conclusions

Several conclusions are suggested by these data analyzed in this way. The product market and financial variables explain a significant amount of the interfirm variability in capital structure (i.e., the use of debt). Particularly striking is the propensity of firms with financial resources, high profitability, or both to substitute those resources for debt. Diversified firms use more debt and large firms (as measured by assets) use less, other things equal. Labor intensive firms use less debt. The capital structure therefore appears to be systematically related to the characteristics of the product market environment and to the financial condition of the firm.

The tests for determinants of deviations of actual from calculated optimal capital structures lead to negative results. The deviations were not systematically related to the product market, the competitive conditions, or the financial condition of the firm. There are two possible explanations for these results. One is that there is no optimal capital structure for the firm. The other is that there is an optimal capital structure but that deviations from it are either small or unsystematic. Is there any basis for choosing between these views? It is useful to remember that actual capital is systematically related to the product market environment and the financial condition of the firm. That suggests, but does not prove, that there are optimal capital structures. But it is also consistent with the view that managers have preferences, and that these preferences are to some extent shared. To the extent that they are shared, they will tend to show up systematically in the actual capital structures and then get built into the calculations of the optimal capital structure by the techniques described above. I mention this because it would explain why competitive pressure has so little explanatory power with respect to deviations of the actual from the average capital structure. I have been referring to the average as the optimum. But if the argument just outlined is true, the optimal and the average would not be the same. And one would not expect that product market pressure would be systematically related to differences between actual and average levels of leverage.

The rates of return figures are only moderately well explained by the product market data. This is somewhat disappointing. The data provide a reasonably complete characterization of the product market environment, but it is still not complete enough. It lacks the capacity to explain a large fraction of the variability in rates of return. On the other hand, both product market and financial data seem to explain a substantial portion of the variation in capital structure.

This leads me to conjecture that there is a substantial amount of "noise" not only in the market share data but also in the rate of return data themselves. By noise I mean elements of variation that are related to measurement differences across firms but that are extrinsic to the fundamental relationship between competitive position and profitability. Future research will focus on the determinants of relative profitability across firms and on the related measurement problems.

My overall reaction is as follows. There seems little doubt that the financial condition of a firm (the return on its assets, and liquid assets for investment purposes) influences its capital structure decisions. The product market exhibits a strong influence as well. The question is whether these influences are reflections of differences in optimal leverage or not. The alternative is that they reflect preferences that are shared and hence systematic. Note that if the preferences were random around an optimum, as I conjectured originally, then the product market and financial variables would "explain" actual capital structures because they affect optimal capital structures.

If the deviations of actual from hypothesized optimal capital structures had been well explained by competitive pressure, then one would have been inclined to accept the view that there are optimal capital structures. But they were *not* well explained by competitive pressure or financial condition. Hence one is left with two possibilities: (1) that there are not capital structures, and (2) that there are no systematic deviations from them. If one opts for the latter, then the fact that actual capital structures vary with product market and financial conditions comes as no surprise. If one opts for the former, then some alternative explanation of the actual leverage regressions seems needed. One such alternative is shared or partially shared preferences. One example, which is consistent with the data, would be "Don't use debt if the earnings flow is generous enough to make it unnecessary."

In either case, these data do not permit us to differentiate between these two views. In order to distinguish them, one would need an accurate empirical model of the determinants of market value for firms. If one had that, then the test would be whether the leverage was an influence by seeing whether its coefficient in such a model was significant.

The product market data are moderately successful in accounting for interfirm differences in return on assets, particularly for undiversified firms. For diversified firms, their explanatory power is reduced. I believe that is in part because of noise in market share data. Market shares are notoriously difficult to assess accurately.

Notes

1. This research was supported by the National Bureau of Economic Research. Extensive support in the form of data and computer services was provided by the Project in Industry and Competitive Analysis at the Harvard Business School. I am grateful to both organizations for this support. Benjamin M. Friedman gave me numerous useful ideas and some very helpful critical comments on earlier drafts. I should like to thank him for his help.

1. Robert Taggart made this useful point, for which I am grateful.

2. To see this, suppose that s is the largest share for the firm. Its Herfindahl index is largest if all the rest of its sales are in a single other industry, in which case its share in the second industry is $(1 - s)$. Its index is therefore $2s^2 - 2s + 1$. This function is monotonic on the interval [.5, 1], and has the value .625 when $s = .75$. Thus if $H > .625$, then s must be greater than .75. This is how the index is used to pick off firms with sales concentrated in a single industry.

Performing regressions with 403 right-hand-side variables is not a trivial task, and cannot be undertaken with standard programs. It is not possible simply to invert a 403 $\times$ 403-square matrix with standard algorithms. These estimates are derived by directly minimizing the sum of squared residuals using a gradient descent method.

4. This variable was included as a result of a suggestion and comment by Stephen Ross.

5. Checking the results by restricting the sample was suggested by several members present at the first conference.

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Comment John T. Scott

A difficulty in using data to determine if capital structures are optimal in an economically meaningful sense is that firms conceivably choose capital structures for noneconomic reasons. A structure might be chosen because it is, let us say, "fashionable" rather than because it is a value-maximizing one. One way around this is to build and test models to see if observed capital structures are responsive to factors which various theories of capital structure imply are important. The work of Taggart, Auerbach, and others at this conference is in that spirit. An attractive aspect of Michael Spence's approach to the capital structure question is that, by looking not only at average chosen capital structures but also at the dispersion of such structures, an alternative interesting way to get at the question of whether there is anything economically meaningful in observed capital structures is provided as long as there is a sufficiently strong direct relation between value-maximizing behavior and the competitiveness of product markets. The hypothesis about value-maximizing and competitive conditions is an important one, and its statistical conceptualization is stimulating and of broader usefulness than the issue of capital structure. I do, however, have concerns about the *present* application of the innovative part of the methodology.

I am concerned that the optimal capital structures calculated by Spence's approach will be wrong, even though fairly highly correlated with actual structures, because I do not believe the model that fits them is consistent with capital theory. A premise of the paper is that optimal capital structure for a firm is its assets-weighted average of the optimal capital structures for the industries in which it produces. I think various theories of capital structure offer reasons to question the premise that the value-maximizing capital structure for assets deployed in an industry is unique regardless of the firm controlling the assets. For examples, tax shields would to a large extent be firm specific and imply different optimal leverage for two firms financing assets in the same industry category given different losses in other categories, and tax clienteles could conceivably be different for firms operating in some of the same industry categories. I would like to focus briefly on well-known implications of "bankruptcy costs" for capital structure, to provide a clear explanation of why I am uncertain of the appropriateness of the underlying premise of industry-specific optimal capital structures.

The Modigliani-Miller theorem teaches that, if financial markets work reasonably well, a firm's capital structure will matter only if aspects, about which investors care, of the probability distributions over operating earnings are not invariant to capital structure. A priori, the variance

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in the effect of leverage on the probability of incurring costs of getting into trouble with debt might be a cause of significant variance across firms in optimal capital structure. Such costs of trouble have probability zero if there is no debt in the capital structure. They are incurred when realized earnings available for both stockholders and creditors are insufficient to service the contractual interest obligations of debt and when downward capital market revaluations wipe out the value of equity.

If we decompose the randomness of the periodic earnings available for the stockholders and creditors of the firm into a short-run component for a given state and a long-run component measuring the likelihood of the transition to a less desirable state, the probability of "getting into trouble" with a given amount of debt in the capital structure should vary directly with those sources of randomness. Thus, I believe the theory of capital structure teaches us that if there *were* an optimal capital structure for a firm, an important determinant of the variance in the optimal structure across firms would be the variance across firms in the characteristics of the randomness of operating earnings. In short, on the simple issue of bankruptcy costs, I would expect differences in business risk across firms to correlate with the amount of leverage they can achieve before exposing themselves to "too much financial risk," since ceteris paribus more business risk increases the probability of getting into trouble with debt. The relevant risk here is a total risk of the firm which depends on the correlation of returns across the firm's various activities even in the absence of any synergies in production across the firm's lines of business. In other words, pure financial diversification affects the probability of incurring bankruptcy costs. For a simple heuristic example, consider two industries with operating earnings having expected values O_1 and O_2, standard deviations σ_1 and σ_2, and simple correlation coefficient $\rho_{12} = -1$. A firm that deploys a share α_1 of the assets in industry 1 and α_2 in industry 2 has earnings with standard deviation $\alpha_1\sigma_1 - \alpha_2\sigma_2$, which would be zero if $\alpha_1/\alpha_2 = \sigma_2/\sigma_1$. Such a firm could promise all of its expected earnings of $\alpha_1 O_1 + \alpha_2 O_2$ as interest on debt yet have no probability of incurring bankruptcy costs. In general its optimal leverage would not be its assets-weighted average of optimal leverages for single-product firms in industries 1 and 2. Once we relax the assumption of no industry-specific production effects from diversification, it is possible that we would find single-product firms alongside multiple-product firms with the former avoiding real diseconomies of multiproduct operations but incurring some penalty in the form of greater concern with bankruptcy costs while the latter offset diseconomies of multi-industry production with lower expected bankruptcy costs.

One way to test the inappropriateness of the underlying specification would be to take the residuals from the industry-specific effect model and correlate them with various characteristics of firms. One would want to use *algebraic* values, so the tests in the paper using absolute values or squared deviations will not do for a check of firm-specific effects. I would still be unconvinced by the exercise, though, because I do not think there has been enough modeling of what those firm-specific effects and hence the explanatory variables should be.

My concern with the paper's underlying premise does not presume there *is* an optimal capital structure, but just that to allow rejection of that possibility or to calculate estimates of such optimal structures, the model specified must be consistent with the theory of optimal capital structure. Even to get the industry-specific effects, in general we need the whole model that includes the industry-specific effects but does not exclude other effects. Industry effects need to be part of a coherent model that is consistent with the theoretical reasons for optimal capital structure. I do believe that a variant of the model could allow rejection of the hypothesis that there is *no* optimal capital structure, yet rejection of the alternative or estimates of its parameters does not seem conclusive given the premises.

Since the question of whether and to what extent we can reject a null hypothesis of no optimal capital structure is of interest, I would like to contribute two simple tests.

First, if capital structure were utterly irrelevant, having neither economic nor noneconomic motivation, we could say that all capital structures were equally likely. The ratio of debt to assets for a firm would be a random variable, x, with uniform distribution over the range 0–1. Thus, $f(x) = 1$ for $x = [0, 1]$ and zero otherwise; $F(x) = \int_0^x f(x)dx = x$. For any firm, leverage would then have expected value of .5 and variance 1/12. The average leverage for a sample of N firms would have expected value of .5 and standard deviation of $.289/\sqrt{N}$. One is then tempted to reject the null hypothesis of complete irrelevance (conditional, of course, on the factors determining the sample) by observing the several tables in Robert Taggart's contribution to this volume (table 1.1, Cols. 3 and 6; table 1.2, cols. 1, 2, 4, and 5; table 1.3, cols. 1, 2; table 1.4, col. 1). Only for table 1.1, column 6, which shows book value balance sheet ratios of debt to assets during the 1970s for U.S. manufacturing firms, do we find anything looking like an average of .5. But it turns out even that is not consistent with total irrelevance because of underdispersion in the data. For my own sample of 376 *large* U.S. manufacturing firms examined below, COMPUSTAT book values show their average leverage, defined broadly as total liabilities divided by total assets over the years 1974, 1975, 1976, was .501, but the unbiased and consistent estimate of the variance was .0140, which is far less than .0833. Defined narrowly as total debt divided by total assets, the average COMPUSTAT leverage for my sample is .246 with variance of .01245. This suggests, incidentally, that the well-reported differences in this period between debt-to-assets ratios of about .25 using market values and those of about .50 using book values may reflect sample selection rather than the use of market instead of book values. Evidently, there is at any point in time at least one "fashionable" capital structure, and one might suspect the average has some economic significance.

Second, although for the reasons above I do not believe industry-specific "optimal capital structures" are invariant to the firm in which they are embedded, I do believe such a fixed-coefficient model would allow rejection of the hypothesis that there is only one "fashionable" capital structure.

Let n denote the nth company and j denote the jth of 37 activity categories (20 two-digit manufacturing, 14 nonmanufacturing, miscellaneous, domestic regulated, and foreign categories). Let $A = [a_{nj}]$ be the 376 × 37 matrix with representative element a_{nj}, $a_{nj} = A_{nj}/\Sigma_j A_{nj}$, where A_{nj} denotes the assets of the nth firm in the jth category.

If in fact there is only one "fashionable" capital structure characterized by α such that

$$\alpha_j = \frac{D_{nj}}{D_{nj} + E_{nj}} = \alpha ,$$

where D denotes debt and E denotes equity, then observed capital structure will equal the "optimal" or "fashionable" plus error:

$$\frac{D_n}{D_n + E_n} = \sum_j \alpha a_{nj} + e_n ,$$

where $\sum_j a_{nj} = 1$, and

$$a_{nj} = \frac{D_{nj} + E_{nj}}{\sum_j (D_{nj} + E_{nj})}$$

and I assume e_n is (close to) a normally distributed random variable with mean zero and the same variance for all n. If there were only one "fashionable" (perhaps "optimal") capital structure, then the model $D/(D + E) = \alpha + e$ is theoretically equivalent to the model $D/(D + E) = \Sigma_j \alpha_j a_j + e$, since the latter reduces directly to the former. Statistically, if we fit the two models, by choosing α and the α_j to minimize the sum of squared residuals, reduction in the sum of squared residuals as we move from the former to the latter model will be insignificant if the null hypothesis is true.

For the 376 companies for which I could obtain complete data, using both COMPUSTAT and data available at the Federal Trade Commission's Line of Business Program, to compute for each company each variable over the 3-year period 1974–76, the [reduction of residual sum of squares as we go from the restricted to unrestricted model/36] divided by [the residual sum of squares for the unrestricted model/339] is under the null hypothesis distributed as F with 36 and 339 degrees of freedom. I have fit the two models, computed the sums of squared residuals, and finally the F-ratio (and equivalently the F-ratio for the model which drops one column from A and fits an intercept). The probability of getting an F as large as observed would be far less than .01 if the null hypothesis were true, for both the broad and narrow definitions of leverage.

Evidently there are significant differences in capital structures. To make progress in understanding this alternative to the null hypotheses (both rejected) of utter irrelevance or only one relevant structure except for random error, we need to specify and test alternative theories of how product-market structure affects optimal capital structures. From the tests above, I am fairly sure there is at least significant variance in "fashionable" capital structures, and I suspect these differences have economic significance, but I await conclusive evidence.

Regarding the paper's profitability results, I have concerns about two major factors that have been left out. As Spence recognizes, it would be desirable to sweep out the variance across firms in normal rates of return. That is, a priori, I would expect a normal rate of return to be higher for some firms than for others, whether one subscribes to CAPM or some other model of equilibrium rates of return.

Second, I think a large part of the explainable (i.e., nonrandom) information in profitability has to do with multimarket interdependence of firms—because of its effects on conjectural variations within markets and on entry conditions across markets. I would expect these factors might be correlated in the sample with included variables, some of which may be irrelevant and yet the expected value of their coefficients will not be zero if they are correlated with the left-out variables. In any case I believe the two excluded considerations are a priori important.

Regarding the regressions of debt to assets on various explanatory variables, (1) I do not think the u_i's estimated can be "optimal" for the reasons above. That is, they are estimated in a model that I do not believe is consistent with theories of optimal structure. (2) I would like to see explicit development of why particular variables would be important, entering them to test various theories of how product market characteristics might explain capital structures that maximize value. For example, an R&D-intensive environment might be an indicator of an environment with a high probability of an undesirable transition to another state. Thus, a strong negative correlation of R&D intensity with leverage could be taken as evidence in favor of the bankruptcy cost theory of optimal structure. Then again, it could be interpreted otherwise as in the contribution of Long and Malitz (chap. 9 "Investment Patterns and Financial Leverage"). We need careful modeling of our statistical tests to sort out these possibilities.