AN INTER-INDUSTRY ANALYSIS OF CAPITAL STRUCTURE POLICY

by

Michael Martin Kaiser
B.A. Brandeis University
1975

Jonathan Patrick Moynihan
B.A. Oxford University
1969
M.A. Oxford University
1970
M.S. North London Polytechnic
1975

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Signature of Authors . . . .
Department of Finance, May 11, 1977

Certified by . . . .
Thesis Supervisor

Accepted by . . . .
Chairman, Department Committee

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ABSTRACT

One of the central problems addressed, but not yet answered by modern finance theory is the determination of the optimal capital structure of the firm. Since publication of the original Miller-Modigliani hypothesis, there have been several papers identifying costs or benefits of debt which would impel the debt-equity ratio downward or upward; most have been concerned with identifying costs of debt.

One such theory is that of Myers (1976) who applies the theory of options pricing to show how the presence of growth opportunities should limit the amount of debt a firm takes into its capital structure. Not only is this theory novel and interesting --it is also, with the help of the Capital Asset Pricing Model --testable. The test would not only support or not support the theory, it would also in the event that the results were positive, lend some quantification to the theory.

This thesis accordingly specifies and carries out a test of the Myers theory. The results provide strong support of the theory, while at the same time, subsidiary tests suggest that alternative theories do not accord with what firms do in practice.

Thesis Supervisor : Stewart C. Myers

Title : Professor of Finance

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Introduction

One of the central problems remaining to be solved by modern finance theory is the determination of the optimal capital structure of the firm. Theory can demonstrate that a firm should add to its stock of capital as long as the marginal rate of return on investments exceeds the required rate of return, but it is not able to demonstrate which of the various instruments of financing should be used. In particular, what proportion of debt to equity should be used in the capital structure; it is usually assumed that the choice of particular types of debt instrument or forms of equity is of secondary importance compared to the main question.

Discussion of the debt-equity problem more usually tends to the presecriptive rather than the descriptive, although occasional attempts are made to reconcile what ought to be with what is. For example, Miller and Modigliani [1966] examine the debt policies of various firms in particular industries and attempt to reconcile their behaviour with what certain finance theorists have suggested that behaviour should be.

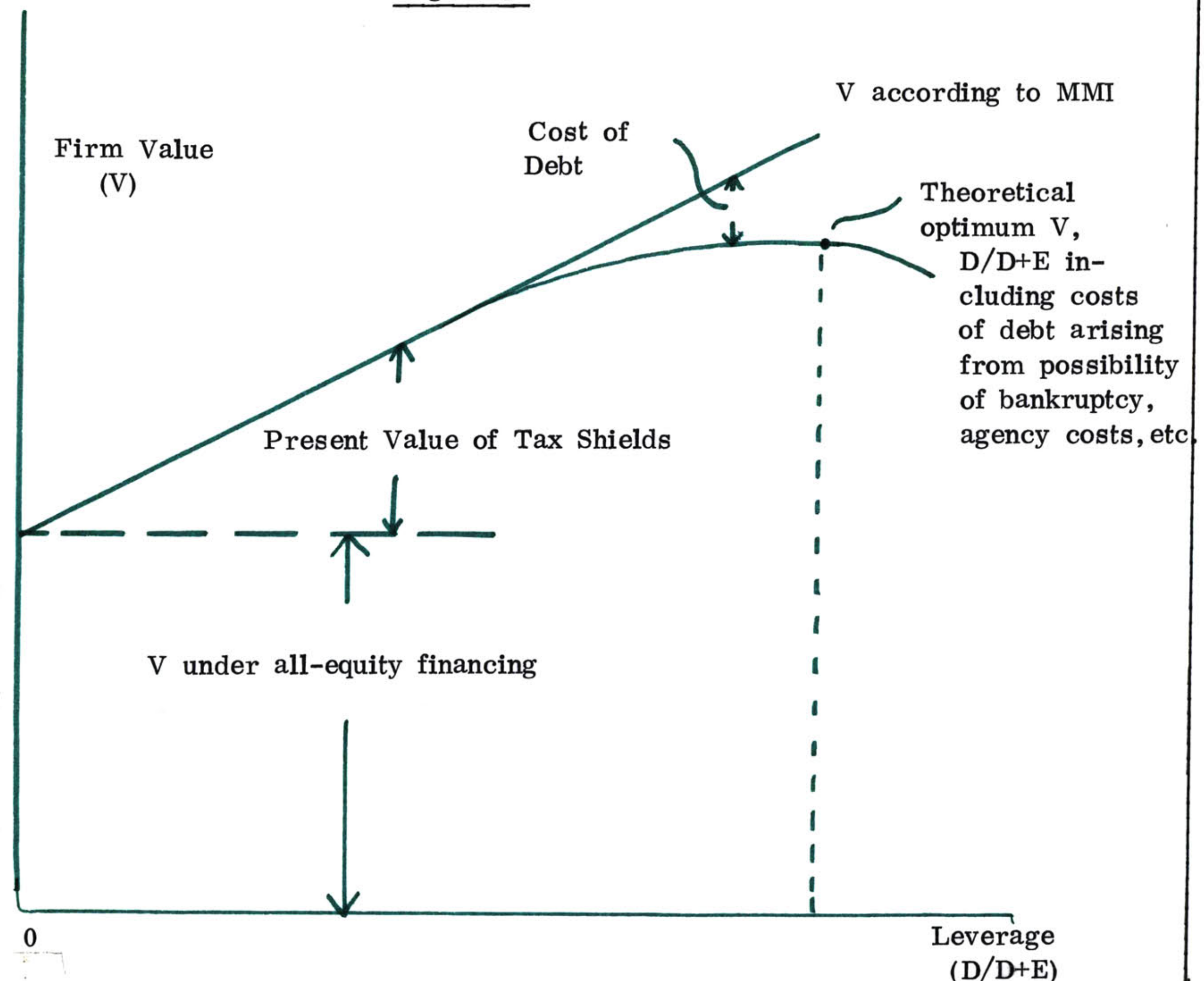
Before discussing the work of these theorists, however, it should be helpful in developing the general thrust of this paper to briefly review the history of ideas contributed by others in this field. The first breakthrough in understanding the problem came from the now-famous paper by Miller and Modigliani [12] , in which the authors demonstrated that, given perfect capital markets, and ignoring the effect of taxes, the value of a firm would be independent of its capital structure (Proposition 1). In their 1963 article, these same authors extended their theory to include the effect of taxation on the firm, positing that the addition of debt to the capital structure increased the value of the firm on account of the tax shields generated by the interest payments on the debt; thus a quantity of debt, D, held in perpetuity, increases the value of the firm by the amount tD, where t is the corporate tax rate.

The power and elegance of the Miller-Modigliani propositions make them intuitively appealing, and indeed, were we to believe that the condition of perfect financial markets obtained, it would be difficult to refute Proposition 1. However, the real world situation is radically different from that implied by theory; the Miller-Modigliani theory indicates that firms should take on as much debt as possible (i.e. the ratio $D/(D + E)$ should approach 1.0), in order to derive as much value from the tax shields as possible--while in actual practice, we see firms tend to keep their debt levels to 20% or 30% of the total value of their firm. We must conclude either that corporate financial officers are prepared to ignore, en masse, large profit opportunities (which seems unlikely), or that there are pwerful financial factors at work which will counteract the effect of the tax shields.

The majority of recent work in this area has, indeed, been concerned with identifying those factors which will cause a firm to limit the amount of debt it wishes to issue. Without going into detail quite yet, we may refer to the work of Kraus and Litzenberger [9] who demonstrate that the value of the firm declines as the probability of bankruptcy increases (and increased debt heightens the liklihood of ban kruptcy), to the work of Jensen and Meckling [8] who discuss the agency costs of debt which arise out of the fact that the owners and managers of a firm may not behave optimally from the point of view of the bondholders, and to the work of Myers [15], who discusses the effect that the presence of future growth opportunities may have on the debt policy of the firm. While the majority of finance textbooks concentrate on the possibility of bankruptcy as the most important of these costs, the thrust of the argument presented by any or all of these authors is essentially the same: a firm will continue to add debt to its capital structure until the costs arising out of the factors mentioned above outweigh the incremental gain from leverage. The argument is best presented graphically in Figure 1.

Unfortunately, using this approach still leaves a gap between the descriptive and the normative. The value to the firm added by the tax shields is so large, and we would argue that the costs of debt arising from the considerations enumerated above are so small, that the kind of balance suggested by Figure 1 should still lead to high debt ratios,

Figure 1



so that the value for $D/(D + E)$ should still be quite high; we say that the tax shield has a first-order effect, while the opposing cost factors have only a second-order effect: always assuming, of course, that the behaviour of corporate financial officers has some rationale behind it.

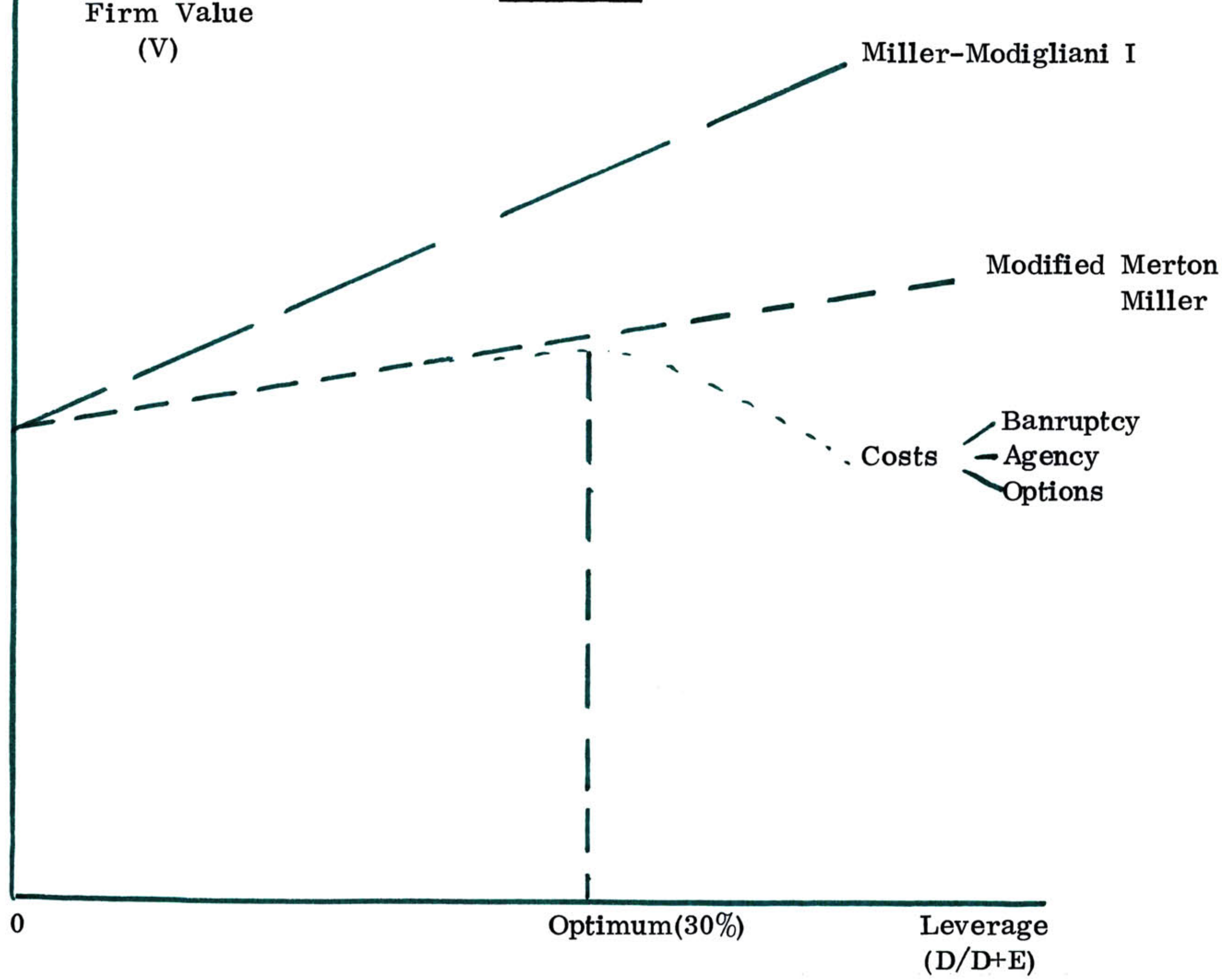
A possibility of a solution to this dillemna is indicated in the most recent paper by Merton Miller on this subject[11]. Miller extends the symmetry inherent in the risk-return argument of the Modigliani-Miller proposition I to include the possibility of individual leverage, utilizing tax shields, as an alternative to corporate leverage. By examining the borrowing possibilities open to the individual, and the relationship existing between the personal income tax, the corporate tax and the capital gains tax, Miller claims to demonstrate that on the margin, the individual will be indifferent to the tax shields generated by corporate debt, since he can as easily generate these shields himself. Hence the value of the firm will not increase as a result of leverage, and on the margin, the MM proposition I holds, even in the presence of tax shields.

It can be seen that were this literally to be the case, a discrepancy would have arisen in the opposite direction to that indicated before: that is, in view of the costs to debt enumerated by the various authors mentioned above, since there is no tax shield advantage to be gained from leverage, it would appear that the optimum debt-equity is indeterminant for individual firms (but definitely less than 1). Since this is manifestly not the case as practised (the ANOVA test described in Appendix D demonstrates a systematic difference in debt levels between industries), we must assume that, as before, either one finance professor or many corporate officers are incorrect, and, as before, we may guess that it is the theory which needs to be modified.

Modifications to Miller's theory are, in fact, not difficult to justify; for example, the particular relationship which the theory requires between the corporate, personal income and capital gains taxes may not hold; firms may be able to borrow at more advantageous rates than individuals; or total borrowings which a firm and a shareholder may accomplish together (i.e. corporate leverage plus individual leverage on that firm's shares) may be greater than the borrowings which the shareholder might be able to accomplish on the shares of the unlevered firm. Accordingly, we may assume that there will still be some increase in the firm's value arising out of the tax shields, but it will not, by any means, be as great as the original MM proposition I asserted. In the parlance that was used above, if the various costs of debt already mentioned are 'second-order' effects, then the tax shield effect is also second-order, and there will thus be some trade-off point between the gains and costs which could quite rationally be seen as lying inside the range which firms have placed their capital structures.

Thus we can see that, by modifying the arguments used most recently by Merton Miller, and comparing the (small) gains which the tax shields are now supplying to the value of the firm with the (small) costs arising out of the use of debt in the capital structure of the firm, we can develop a theoretical analysis of what the optimum capital

Figure 2



structure should be which corresponds reasonably closely with what the capital structures of the majority of firms are. (See Figure 2) In doing so, however, we have not come very far; we have only assembled a structure of forces and counterforces which seem to be of the right order of magnitude to provide a reasonable explanation of the real world situation. As soon as we try to quantify the effect of these various factors, the complexity and innumerability of the disparate variables involved in the determination of the degree of their effect makes any attempt at precise measurement impossible.

Given, however, that the general hypothesis as assembled above seems workable and worthy of investigation, there is an intermediate step which can be taken between the statement of the hypothesis and quantification of it; this involves taking the various factors which different authors have suggested as being contributors to the cost of debt, and testing the behaviour of firms to see whether, indeed, the presence of any of these factors affects what the firm does. If we are to do this, we need, first of all, to examine in greater detail exactly what the various authors propose.

Bankruptcy Costs of Debt:

The first indirect cost of debt to be specified (mentioned by Miller-Modigliani, but first emphasized by Robichek and Myers) was the cost of bankruptcy. Kraus and Litzenberger [9] have shown that the costs which would arise were the firm to go bankrupt must be included in the valuation of the firm (in all states of nature). The relevant costs, however, must be fully understood. If bankruptcy involved merely the transition of power from the stockholders to the creditors, without any influence on the firm's costs and revenues, the value of the firm would not be affected by bankruptcy. However, three factors do influence the cash flows of the firm:

a.) Reorganization Costs--costs of changing management, investment policies, etc.

b.) Administrative Costs--cost of legal fees, referee's fees, trustee's fees. The major component, legal fees, are subject to the approval of the court and are a declining percentage of the level of assets realized.

c.) Embarrassment Costs--Baxter [2] suggests that the major cost to the bankrupt firm is negative effect on the earnings stream of the bankruptcy proceedings. In particular, trade credit will be difficult to obtain as customers will be uncertain about the reliability of the firm.

Of course, quantifying the effects of these three phenomena is extremely difficult, if not impossible. (Warner [17] argues that these costs are minimal) One must examine not only the probable costs if the firm were to go bankrupt, but also the probability of bankruptcy as a function of the level of debt. Up to this point in time, no major study of the true costs of bankruptcy has been published (perhaps because of the nonavailability of consistent data across industries), and estimates of the true cost of bankruptcy vary greatly. (Estimates of between 5% (the Warner estimate) and 40% of total assets realized have been cited.) In any case, this is definitely an area which would benefit from a thorough quantitative analysis.

Agency Costs of Debt:

The most comprehensive paper on the topic of agency costs to a firm is that by Jensen and Meckling [8]. The authors identify various effects arising out of the fact that the interests of the bondholders of the firm are often different from, and sometimes antagonistic to, the interests of the stockholders of the firm and the managers of the firm. One of the costs involved is, of course, that of bankruptcy discussed above. A second cost is that of Bonding and Monitoring. Bondholders must apply restrictive clauses to the terms of their debt contracts in order to protect themselves against a variety of actions that could be taken by management, such as dividend policies which transfer all the wealth to the managers. The cost of these restrictive actions, or the cost implicit in these actions not being taken will be passed on by the bondholders to the owners of the firm. A third cost is the opportunity wealth loss caused by the impact of the debt on the investment decisions of the firm; inasmuch as upside gain accrues to shareholders, whereas some of the downside risk will be borne by the debtholders, an asymmetry results which may cause managers of a firm to opt for investments which have higher risk than other potential investments offereing the same return.

Although Jensen and Meckling's position is intuitively appealing, there are counter arguments to some of their assumptions (For example, it is unlikely that managers willingly court the risk of bankruptcy since many managers do not hold a diversified portfolio, but have a large proportion of their investment and human capital placed on the future of their company.), a further difficulty is that it is a complex task to attempt to quantify and thus test the variables which the authors suggest are influential in the manager's capital structure decision.

Options Costs of Debt :

One of the more powerful tools currently being used to extend the impact of modern financial theory is the theory of Options Pricing, as developed by Fischer Black and Myron Scholes [5]. By viewing the future growth opportunities of the firm as options for investment, the theory can be applied to the problem of optimal capital structure; Myers [15] demonstrates how the presence of growth opportunities could influence the debt-equity decision. By utilizing the Capital Asset Pricing Model, moreover, and various measures derived from it, it is empirically possible to test Myers' theory against the actual behaviour of firms to se whether, in the aggregate, their capital structure policies are in accordance with what the theory says they ought to be. The purpose of this thesis is to perform these tests, and in the light of the results of the tests to say something, both descriptively and normatively, about the capital structure decisions of the firm. Accordingly, the following chapter is devoted to a more extensive description of Myers' theory; this is followed by an analysis of what variables should be examined in order to test the theory.

A nagging question which inevitably arises when one considers any of the above costs of debt, and their impact on the capital structure decision of the managers of the firm, is that of causality. Given that finance theory is only just beginning to see that the above factors have an impact on the value of the firm, is it reasonable to suppose that corporate financial managers have known about these factors all along and have incorporated them into their financial decisions? Because if the financial officers do not know about these factors, then even if the factors do have an effect on the value of the firm, we can only say that there is a gap between the normative and the descriptive, and that there is an opportunity for corporations to make better financing decisions. In other words, the argument implicit in this paper, that finance theory must correspond at least approximately with what actually occurs in the real world if it is to make any sense, is incorrect.

Merton Miller[11] offers an interesting way out of this dillemna. He likens the corporate financial behaviour to human evolution, and suggests that on a 'survival of the fittest' principle, only those firms whose financial decisions correspond reasonably closely to the normative will survive corporate competition. He suggests that there exists a pool of 'neutral' responses, or heuristics, which firms use as rules of thumb when making their decisions; these heuristics serve as surrogates or approximations for the normative. If a response in this pool is harmful to the firm, then sooner or later it will vanish, eradicated by the law of natural selection. If the response becomes, through circumstance, beneficial to the firm, it will flourish and become more extensively used. If the response remains neutral, then it may continue to be used without affecting the fortunes of the firm one way or another. Thus, Miller suggests, there may be surrogate rules of thumb which are widely held by firms, which direct their behaviour toward the normative without those firms actually being aware of the implications of the normative. We will return to a discussion of this point, which we feel is crucial for the validity of our results.

CHAPTER 1

Options Costs of Debt

Myers[15] identifies a particular cost of debt which arises out of an asymmetry which can develop between the interests of shareholders and the interests of bondholders. The asymmetry originates from the existence of 'discretionary expenditures'; these are expenditures which the future income stream of the company depends upon, but wnich the firm may or may not actually pay out, depending on the developing state of nature. Myers gives a simple example of a one-period investment in a firm without any other assets, and suggests that the following scenario can develop:

1.) On the basis of the future investment opportunity, shareholders borrow D from the creditors. They promise to pay P at the end of the period, when the investment, I, will have yielded V(s), where 's' is the state of nature which will obtain at the end of the period. It will be seen that the debt is risky debt; that is, V(s) will not necessarily be so large that it will be sufficient to cover the promised payment, P.

2.) This debt, D, now disappears into the pockets of the shareholders, for all intents and purposes; it is not necessarily recoverable by the creditors.

3.) The shareholders now look at the future states of nature, their probability of occurence, and the size of V(s) in each of them. Let us first assume that the debt matures before the decision to invest I or not is made. Then if the actual value of V(s) is greater than I+P, the shareholders will make the investment, and pay P. If it is <u>less</u>, then the shareholders will bail out, and the creditors will take over and make the investment if the expected value of V(s) is greater than I. This is a clear-cut case; the payment P will have been priced in relation to D to reflect the perceived riskiness of the debt, and no asymmetry will exist.

4.) However, if the debt matures <u>after</u> the decision to invest has to be made, i.e. after the option to invest has expired, then if V(s) is less than I+P, the shareholders will not make the investment, but the creditors will no longer have the option of taking over the firm and making the investment, since the opportunity to do this has now passed. In the difference between the two cases outlined here, it can be seen that a cost must be borne by either the shareholders or by the creditors.

5.) It can be seen that, since the liklihood of V(s) falling within the critical space where the asymmetrical case occurs is a function of the size of P, the greater the size is of the risky debt that the firm issues, the larger the costs are which arise out of this asymmetry.

Thus Myers' theory can be seen to depend on four preconditions:

a.) The existence of a class of assets within the firm which we may refer to as 'growth options'.

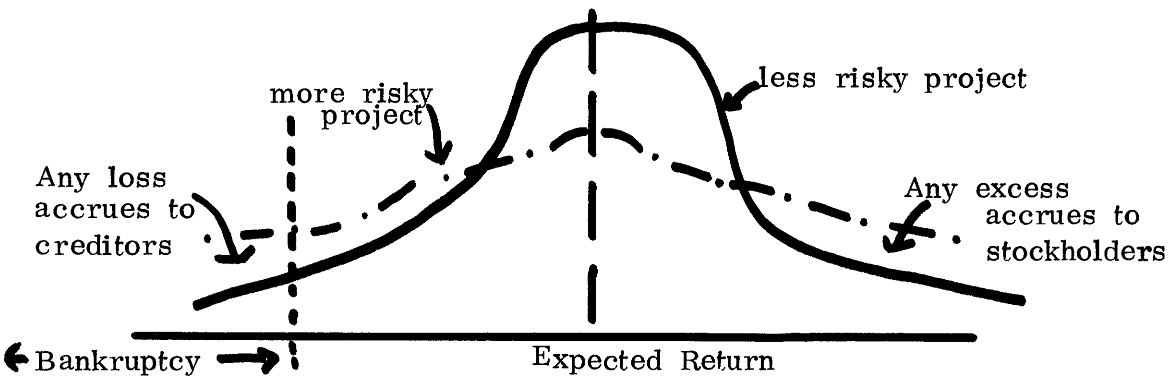
b.) The existence of 'risky debt', that is, debt which is raised on the expectation of the taking up of these options.

c.) The ability of shareholders to remove, through liberal dividend policy (or by limiting future equity issues), some of the proceeds of the issued debt.

d.) The existence of debt with a long enough maturity span for it to mature after the decision to take up the options or not has been made.

Halis [7] has shown that if there are dividend restrictions placed on the firm, requirement 3 is not fulfilled, and the cost therefore disappears. (This restriction does not force equity issues, however.)

However, a new cost, that of writing and implementing the restriction, has taken its place. Moreover, there still exists a cost, also identified by Jensen and Meckling, in the form of an asymmetry in the induced attitude to risk of the shareholders, compared to that of the creditors. Any excess gain arising out of the upside risk of the project will accrue to the shareholders; any loss from the downside will be borne by the creditors as illustrated below:



Thus the presence of risky debt will cause shareholders to chooseprojects with greater risk profiles than they would otherwise choose; this might result in taking projects with negative net present values--a cost which must be borne by the shareholders or creditors. (In any case, when the investment policy of a firm is not formulated on the basis of present values, a cost has been imposed on the organization.

The theory has been extended by Myers to the multiperiod case with a portfolio of assets; Myers further demonstrates that the presence of such debt at time t will not only cause an inappropriate strategy (in some states of nature) at that time t, but will also cause inappropriate strategies at t-1 and t+1. What, therefore, may we expect the behaviour of firms to be, in light of this theory? First, we may expect them to avoid taking on risky debt as opposed to debt that is covered by real assets. However, we may further note that no debt is entirely riskless. In any downturn of the economy, for example, the value of a firm's assets will plummet, while the size of the debt will remain constant. Hence, firms will view the major part of their debt as 'risky', although they would still be expected to view debt which is covered by the present value of their fixed assets as representing less of a cost than debt which is based on the present value of their growth opportunities. Thus two firms with the same assets but differing growth opportunities can be expected to take on different amounts of risky debt. Firms with greater growth opportunities should be expected to take on less debt than those with not so many growth opportunities. Further, firms with greater growth opportunities should take on debt with a shorter maturity than firms with less opportunities.

This thesis primarily sets out to test the first of these last two propositions. By quantifying the growth opportunities of different companies, it should be possible to examine whether companies' debt decisions are affected by the size of these opportunities relative to the value of the firm. Inasmuch however, as there will be many comapnies who do not order their capital structure in an optimum fashion, it will only be in the aggregate that such a trend will become visible.

One clear difference in growth opportunities exists between companies in different industries. It is also clear that this type of 'real option' is the type that closely corresponds with the requirements of Myers' theory; that is, if it is not taken up within a certain time, the fact that other companies within the same industry will have taken the option up and will have capitalized on it, will have removed the opportunity of that option from the company. It therefore seems possible to test the theory by examining whether different debt policies are adopted by different industries, and if so, whether these differences are a function of the presence of Present Value of Growth Opportunities.

CHAPTER 2

Model Specification and Testing

As stated in the introduction, the emphasis of this thesis is placed on the testing of Myers' theory of debt determination discussed in the preceeding chapter. In testing this theory, we have two major goals. First, we wish to see whether a statistically significant causal relationship exists between the level of growth opportunities open to the firm and the level of debt carried in the capital structure. In addition, we want to determine whether the Myers' theory does a better job of predicting actual debt levels than a more primitive theory: that is, that firm's borrow solely on the basis of the book value of their assets.

The initial step in testing the Myers theory is to set up a standard against which we can judge the predictive value of the theory. As mentioned above, we use the conventioanl wisdom, that firm's borrow a set fraction of their book value of assets, to determine this standard. [See Appendix A for a graphical depiction of this relationship.] In order to quantify this relationship, we ran a simple regression of the following specification:

$$Debt_i = a + b * Asset_i$$

where:

$Debt_i$ = Level of debt for industry i

$Asset_i$ = Level of assets for industry i

Results of this regression can be found in Appendix B . The most important statistic to be analyzed is the standard error of the regression, in this case 426.478 million dollars. This is our target value-- if the Myers' theory can lower the standard error, than it adds to our predictive capability.

It will be noted that each of our tests are run using industry aggregate data. We performed the tests in this manner because many firms arbitrarily set debt levels for what appear to be idiosyncratic reasons. Aggregating the firms into industry groups should help to test the general effects of the concepts considered without introducing systematic bias.

In testing the models, we selected five clearly defined industries which have at least ten firms involved solely in the activities of that industry. The five industries selected were:

a.) Textile Products

b.) Chemicals

c.) Electrical Switches & Controls

d.) Machine Tools

e.) Drugs

The individual firms selected were those which most closely resembled the others in that industry group in terms of production. (See Appendix C) Tne regressions were run using cross-sectional data for December,1975 -- the last time period for which all necessary data was available.

It is important to note that the level of debt to assets varies significantly between industry groups. (See Appendix D for a description of the Analysis of Variance.) This means that in aggregating into industry groups, we have not obscured significant counterbalancing behaviours by the firms within the industry groups. (See Appendix E for a description of the individual firm's debt levels.)

The first step in testing the Growth Options theory is to determine whether a statistically significant relationship exists between Present Value of Growth Opportunities(PVGO) and debt to asset ratios.

According to the Myers theory, we would expect the firm whose market value is chiefly the result of growth opportunities to finance less of its assets with debt than a firm with little growth potential but a high level of short term earnings. We have specified the following econometric model to test this:

$(D/A)_i = a + b * (\%PVGO)_i$

where:

$(D/A)_i$ = Book Value of Debt for Industry i divided by Book Value of Assets for Industry i (Book values were used because market values would induce correlation with the PVGO measure.)

$(\%PVGO)_i$ = Present Value of Growth Opportunities for Industry i divided by Market Value of Industry i

Without any strong prior belief about the exact functional relationship between growth opportunities and debt, we also test two alternative variations on the linear models described above:

1.) Quadratic Model (Model #2)

$$D/A = a + b * (\%PVGO)^2$$

2.) Multiplicative Model (Model #3)

$$D/A = a * (\%PVGO)^b$$

[Tested in a logarithmic form: $LOG(D/A) = a + b*LOG(\%PVGO)$]

It is clear that the definition of 'Present Value of Growth Opportunities' and their measurement will be central to our results. We have chosen to use the following identity in defining PVGO:

$$PVGO_i = MV_i - \quad E_{it} / (1 + k)^t$$

where:

$PVGO_i$ = PVGO for firm i

MV_i = Market Value for firm i

E_{it} = Earnings for firm i in time t from current Assets

t = Indicator for all future time periods

k = Cost of equity capital to the firm

The reasoning behind this identity is clear -- the market value of a firm is equal to the earnings expected from currently held assets plus the value of any earnings from future investment opportunities. Measuring the level of growth opportunities is less simple.

Producing detailed earnings forecasts for all fifty firms in our sample would be an impossible task and, we believe , that investors in the market do not attempt such accurate forecasting. It is more plausible that the market makers determine a 'sustainable' level of earnings when valuing a firm. We proxy this behaviour by calculating a normalized level of earnings for each firm in the sample. Recognizing the fact that the market will not forecast earnings solely on the basis of last period's earnings, but on the trend over time, calculating normalized earnings was accomplished with the aid of the following regression specification:

$$\text{Earnings}_i = a * (\text{Time})^b$$

where:

Earnings_i = Earnings for industry i

Time = Time trend

[This specification was tested using a logarithmic form which reduces to LOG(Earnings) = a + b * LOG(Time)]

This equation was estimated for each firm in the sample over a five year history (see Appendix G) and we take the fitted value for the most recent time period (1975) as our estimation of the normalized earnings.

Calculating 'k', the equity cost of capital for each firm is a second necessary step in measuring the PVGOs. We utilized the Capital Asset Pricing Model's Security Market Line to determine 'k'. We employed the formula:

$$k_i = z_i = B_i(z_m - R) + R$$

where:

k_i = equity cost of capital for firm i

z_i = expected return on equity for firm i

z_m = expected return on the market portfolio

R = risk-free rate

B_i = beta for firm i

In performing the above calculations (see Appendix G for the results.) we made use of the B estimations by Merrill Lynch and Co. (for December ,1975). We used the Ibbotsen-Sinquefield result of 8.6% as the risk premium (z_m - R) and the 90-day Treasury bill rate of 5.4% (for December, 1975) as the risk-free rate.

CHAPTER 3

Estimation Results

A summary of the three regression tests is shown in Figure 1 . (Complete results may be found in Appendix H)

Figure 1

Test Number	'a'	'b'	$\bar{R}$-Squared
1. Linear	.37501 (21.2566)	-.2613 (6.4155)	.9094
2. Quadratic	.34164 (47.5862)	-.3584 (11.9387)	.9725
3. Multiplicative	-1.61072 (14.0938)	-.2601 (3.02369)	.7113

[Numbers in parentheses are t-statistics]

The size and significance of the constant 'a' and the coefficient 'b' explain a great deal about the empirical reality of many of the theories mentioned in the introduction to this thesis. Figure 2 details the expected values of the two parameters to be estimated, given each of the theories discussed. (To insure that we have not just tested a coincidental industry phenomenon, we show in Appendix I , the results of Model #1 run for the firms with dummy variables for each industry.

As expected, the $\bar{R}$-squared is low, but the coefficient on PVGO is negative.)

Figure 2

Theory	Expected 'a'	Expected 'b'
Miller-Modigliani (1963)	1.0	insignificant
Asset Percentage	less than 1.0	insignificant
Myers' Growth Options	less than 1.0	less than 0
Merton Miller (1976)	unspecified	insignificant

If the original Modigliani-Miller theory were correct, we would expect every firm (ignoring behavioural influences) to completely leverage its balance sheet to make ultimate use of tax shields on interest payments. In this case, the constant term should approach 1.0, and the growth options term should be insignificant.

If the asset-percentage theory, used to set our standard, were actually correct, then we would expect the value of 'a' to approach the value of 'b' in the initial regression (Appendix B), and again, we would expect the value of 'b' to be insignificant.

Of course, if the Myers' theory is accurate, we expect that the value of 'b' will be significantly negative-- the firms with growth options representing a larger percentage of market value will tend to issue less debt. (In addition, we expect that the value of the constant will be less than one to include the other agency costs of debt and the Miller personal leverage theory.)

If Miller's latest theory were exclusively correct, than we would not expect either 'a' or 'b' to be significant -- there should be no systematic forces which influence the debt-equity decision.

It is important to note that in each of our tests, displayed in Figure 1, the values for 'a' and 'b' were as predicted by the Myers' theory as shown in Figure 2. (One must take the exponential of the equation for the Multiplicative test (using base 'e' since all logarithms were natural logarithms) in order to obtain the proper values.) In each case, the options term was quite significant and was negative in value. The empirical results were most encouraging using the Quadratic specification and least satisfactory in the multiplicative form.

Of course, at this point, we can not compare the results to the standard set by the Asset-percentage theory: these models forecast percentage of assets financed by debt, not the total debt issued by the industry. In order to test the predictive value of the equations, we must multiply the fitted values solved for by the three regressions by the value of assets for the industry, and run a simple regression of this 'fitted-debt level' versus the actual level of debt issued. The specification is:

$Debt_i = c * (Asset_i * Fit_i)$

where:

$Debt_i$ = Level of debt for industry i

$Asset_i$ = Level of Assets for industry i

Fit_i = Fitted value for Debt/Assets

This modified test was run for each of the three initial specifications of the original Myers' model and the results are shown in Figure 3.

Figure 3

Test Number	$\bar{R}$-Squared	Standard Deviation (in mil.)
1. Linear	.9996	62.4115
2. Quadratic	.9996	62.1324
3. Multiplicative	.9855	205.745

It is clear that in each case, the standard deviations are lower than the 426.478 milliond dollars resulting from the asset-percentage theory.

Of course, these tests have no value if instead of actually testing the Myers Options theory, we are instead testing another relationship which is coincidentally correlated with the PVGO theory. It is clear that the Assets-percentage theory was <u>not</u> borne out by our tests. Had the options term proved insignificant, we would have had to seriously consider the possibility that firms do borrow solely on the basis of their book value of assets.

A second theory we must consider involves the concept of interest coverage. It is theorized that firms will alter debt levels depending on the level of the interest coverage ratio (Earnings divided by Interest Payments). If testing of this proposition proved that this theory were correct, and if interest coverage ratios were correlated with growth option, than our testing has no <u>certain</u> value. We specified two separate models to test the interest coverage theory:

1.) $\Delta D_i / \Delta A_i = a + b * (E_i / I_i)$

where:

ΔD_i = Change in Debt for industry i (1975 minus 1974)

ΔA_i = Change in Assets for industry i (1975 minus 1974)

E_i = Earnings for industry i (in 1974)

I_i = Interest payments for industry i (in 1974)

2.) $(D/A)_i = a + b * (E_i/I_i)$

where:

$(D/A)_i$ = Debt to Asset ratio for industry i (in 1974)

If the interest coverage theory were to hold, we would expect that 'b' would be significant and positive -- as earnings relative to interest payments increased, the firm should be willing to issue more debt. The results, summarized in Figure 4, are shown in full in Appendix K . In neither case was the interest coverage term significant.

Two other theories of debt determination were tested. The first, detailed in Appendix L, assumes that debt is simply a function of earnings. The equation tested was:

$$(D/A)_i = a + b * (E_i/A_i)$$

The second debt theory tested states that firms with volatile earnings will tend to borrow less. The equation used to test this theory was:

$$(D/A)_i = a + b^* (SE_i/E_i)$$

where:

SE_i = Standard Error of the Normalized Earnings Equations

A summary of the results for these last two tests are shown in Figure 4. In neither case was the independent variable significant. (While the

Figure 4

Test Name	'b'	$\bar{R}$-Squared
Interest Coverage #1	-.0459 (.475619)	0.0
Interest Coverage #2	-.0114 (.892974)	0.0
Earnings	-1.532 (2.4529)	.5564
Volatility	.13202 (1.0023)	.2361

[Numbers in parehtheses are t-statistics]

coefficient 'b' is significant in the earnings test, it has the wrong sign-- we would expect a positive correlation.)

Conclusion

In the introduction, a system of theoretical forces and counter-forces was described which would impel a firm toward adopting a capital structure which could correspond to the structure firms typically do possess in the real world. Of these various factors, one was isolated which, it was felt, would reward empirical study. This concept, Myers' theory of Real Options, was then discussed in greater depth in the first chapter of this thesis. We then proceeded to describe the various tests which we designed to test whether the presence of real options in a firm's portfolio of assets affected, in the real world, the amount of debt in the balance sheet of the firm. The results of the test demonstrated that there was indeed a strong correlation between the two. An attempt to provide an alternative explanation, that is, that the correlation was an accidental result of coincidence between the real determinant-- the desire of management to keep interest payments below a certain fraction of earnings, and the size of the PVGO's of the firm-- proved to be a failure.

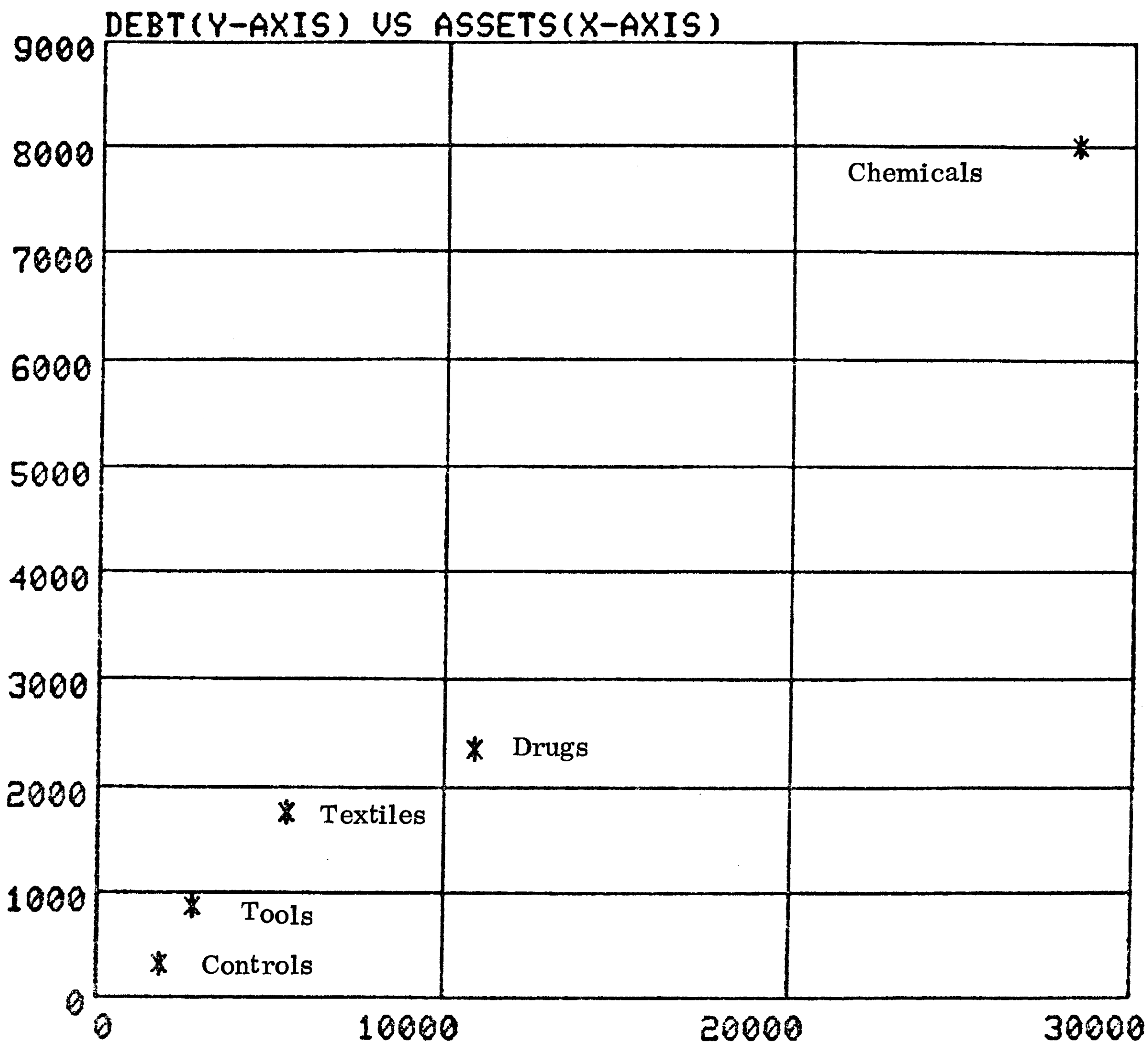
The results of the regressions (based, admittedly on a small sample) suggest that firms with no real options would tend to adopt a capital structure which approximates 35% of the book value of their assets. As Myers suggests, the concept of differentiation between real assets and real options leads one to hypothesize that firms will adopt a capital structure based on the book value of the assets of the firm, rather than on the market value of the firm. The mechanism whereby this has come about, in the absence of any formal realization by the managers of the firm of the implications of the presence of growth opportunities in the asset structure of the firm, is discussed in the last part of the introduction, in terms of Merton Miller's concept of a pool of heuristics which direct the financial decision--making behaviour of the firm's managers in the absence of any formally appreciated financial theory.

In other words, the managers of the firm, without any clear or well-defined reasons, base their debt decision on the book value of their assets; the reason that this particular piece of folklore has survived to determine the decisions of the managers is that, in practice, it has proved to have survival value.

Can we go further and find some similar heuristic which provides us with a similar explanation for the fact that firms with growth opportunities take on a smaller amount of debt? A possible solution may be found in an analysis of what happens to the price-earnings ratio of a firm when it has growth opportunities, and how this may effect the behaviour of the managers of the firm. In the description of the tests, we thoroughly explored the fact that as the growth opportunities of a firm increased, so did its price-eqrnings ratio. To the naive manager, it will appear that the stock of the firm is at an exceptionally 'good' level, in terms of its relation to the price of firms with similar earnings (but lower growth opportunities). Accordingly, if at any time the firm needs additional capital, it will do so by issuing equity, because the manager believes that it is advantageous to issue equity when the shares are so high priced. On the other hand, when shares appear 'undervalued'--i.e. when there are no future growth opportunities to raise the price of the stock-- the naive manager will decide on debt as the financing instrument of choice, since he does not wish to 'dilute his equity'. Modern financial theory, as represented by the Capital Asset Pricing Model, can clearly demonstrate the theoretical inappropriateness of this approach, but it is still a concept which determines the behaviour of many financial managers.

If, then, the tendency is to finance with equity when there are growth opportunities, and to finance with debt when there are not, it can be seen that once again we have found an operationally functional heuristic which, although it is based upon unsound principles, nevertheless acts as the practical doppelganger to a sound financial theory.

To suggest that this twinning of theoretical imperative with practical heuristic is actually what is occuring would amount to no more than speculation, were it not for the impressive correlation which we have found in our regression analses. In the light of the results, we can certainly go so far as to say that we have identified both a theoretical and a practical reason as to why firms behave in the way we observe.


DEBT(Y-AXIS) VS ASSETS(X-AXIS)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
10000
20000
30000
Chemicals
Drugs
Textiles
Tools
Controls

APPENDIX B

RESULTS OF ASSET-PERCENTAGE REGRESSION

DEBT = -54.7486 + .280452 * ASSET
(.201541) (14.3808)

Where:

DEBT : Nominal level of debt for the industry (in millions of dollars)

ASSET : Nominal level of assets for the industry (in millions of dollars)

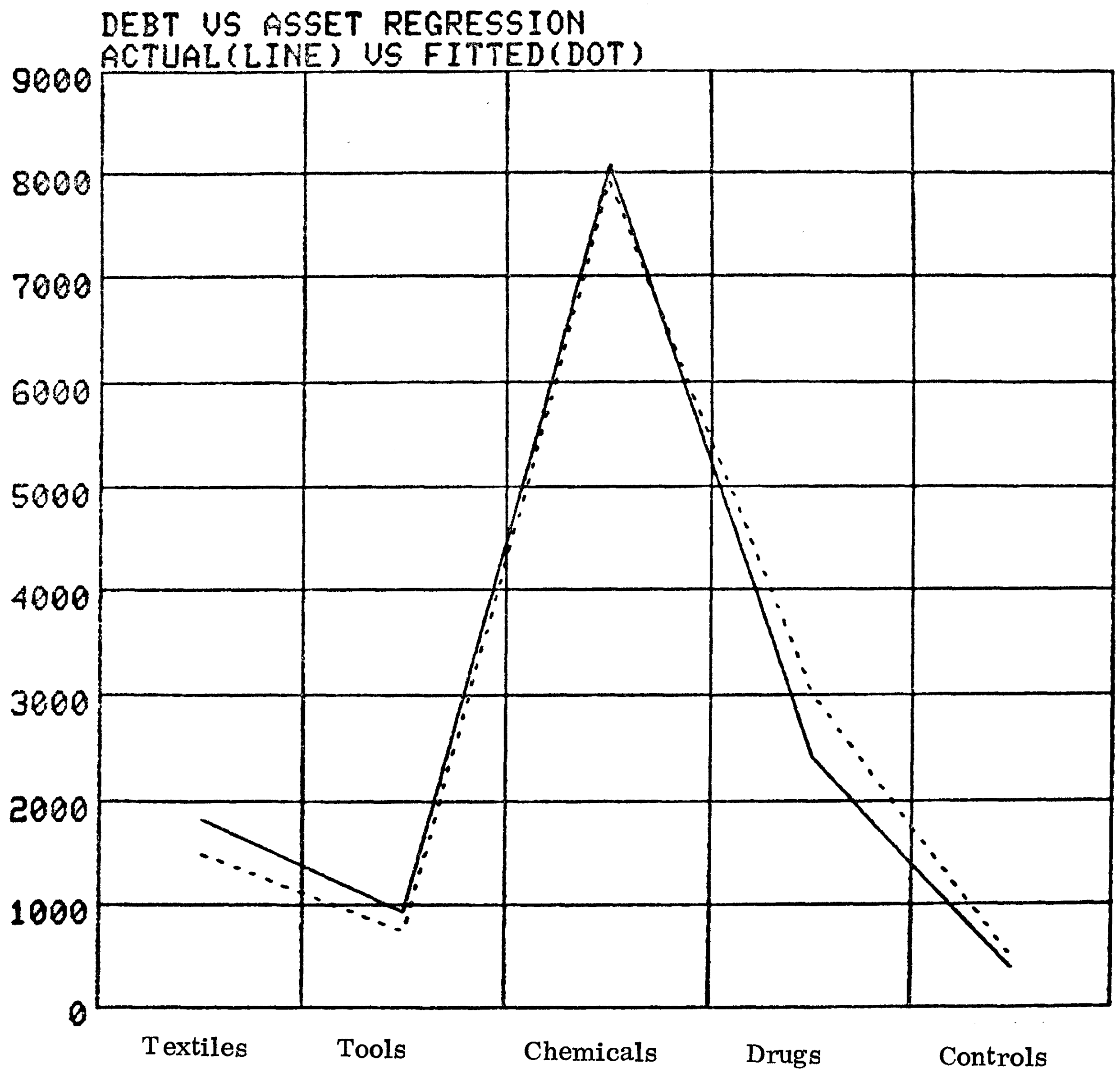
Summary Statistics

$\bar{R}$-Squared : .9809

Durbin-Watson : 1.4887

Standard Error : 426.478

[Numbers in parentheses are T-statictics for regression coefficients.]



DEBT VS ASSET REGRESSION
ACTUAL(LINE) VS FITTED(DOT)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Textiles
Tools
Chemicals
Drugs
Controls

APPENDIX C

Textile Products

Number	Company Name	Major Products
1.	Burlington Ind. Inc.	Fabrics, Knits, Hosiery
2.	Collins & Aikman	Fabrics for Apparel
3.	Cone Mills Corp.	Cotton Textiles, Corduroy
4.	Dan River Inc.	Fabrics for Apparel
5.	Fieldcrest Mills	Textile Products
6.	Lowenstein & Sons	Apparel Fabrics
7.	Springs Mills Inc.	Apparel Fabrics
8.	Stevens (JP) & Co.	Double knits, Hosiery
9.	United Merchants & Mfg.	Textiles
10.	West Point-Pepperell	Apparel Fabrics

Chemicals

Number	Company Name	Major Products
11.	Allied Chemical Co.	Basic Chemicals, Plastics
12.	Celanese Corp.	Chemicals, Plastics
13.	Dow Chemical	Chemicals, Fibers
14.	Dupont (EI) de Nem.	Chemicals, Fibers
15.	Grace (WR) & Co.	Specialty Chemicals
16.	Koppers Co. Inc.	Chemicals, Plastics
17.	Olin Corp.	Chemicals
18.	Rohm & Haas Co.	Plastics,Fibers
19.	Stauffer Chemical	Chemicals
20.	Union Carbide Corp.	Chemicals, Plastics

Electrical Switches & Controls

Number	Company Name	Major Products
21.	AMP Inc.	Electrical Connectors & Tools
22.	Burndy Corp.	Connectors & Tools
23.	Crouse-Hinds Co.	Controls
24.	Cutler-Hammer Inc.	Electrical Switching Equip.
25.	Johnson Controls	Elect. Control Systems
26.	Leeds & Northrup	Controls
27.	Ranco Inc.	Control Devices
28.	Robertshaw Controls	Automatic Controls
29.	Square D Co.	Switching & Control Equip.
30.	Thomas & Betts	Electrical Connectors

Machine Tools

Number	Company Name	Major Products
31.	Acme-Cleveland Corp.	Automatic Machine Tools
32.	Brown & Sharp Mfg. Co.	Machine Tools, Small Tools
33.	Carborundum Co.	Machine Tools
34.	Cincinnati Milacron Inc.	Large Machine Tools
35.	Giddings & Lewis Inc.	Machine Tools
36.	Kearney & Trecker Corp.	Machine Tools
37.	Norton Co.	Grinding Equip.
38.	Stanley Works	Electric Tools
39.	Sundstrand Corp.	Diversified Machine Tools
40.	Warner & Swasey Co.	Machine Tools

Drugs

Number	Company Name	Major Products
41.	Bristol-Myers Co.	Pharmaceuticals
42.	Pfizer Inc.	Drugs, Cosmetics
43.	Merck & Co.	Pharmaceuticals, Calgon
44.	Lilly (Eli) & Co.	Phamaceuticals, Eliz. Arden
45.	Abbott Laboratories	Pharmaceuticals
46.	Upjohn Co.	Pharmaceuticals
47.	Schering-Plough Corp.	Drugs, Cosmetics
48.	Searle (GD) & Co.	Pharmaceuticals
49.	Smithkline Corp.	Drugs, Cosmetics
50.	Baxter Travenol Labs	Pharmaceuticals

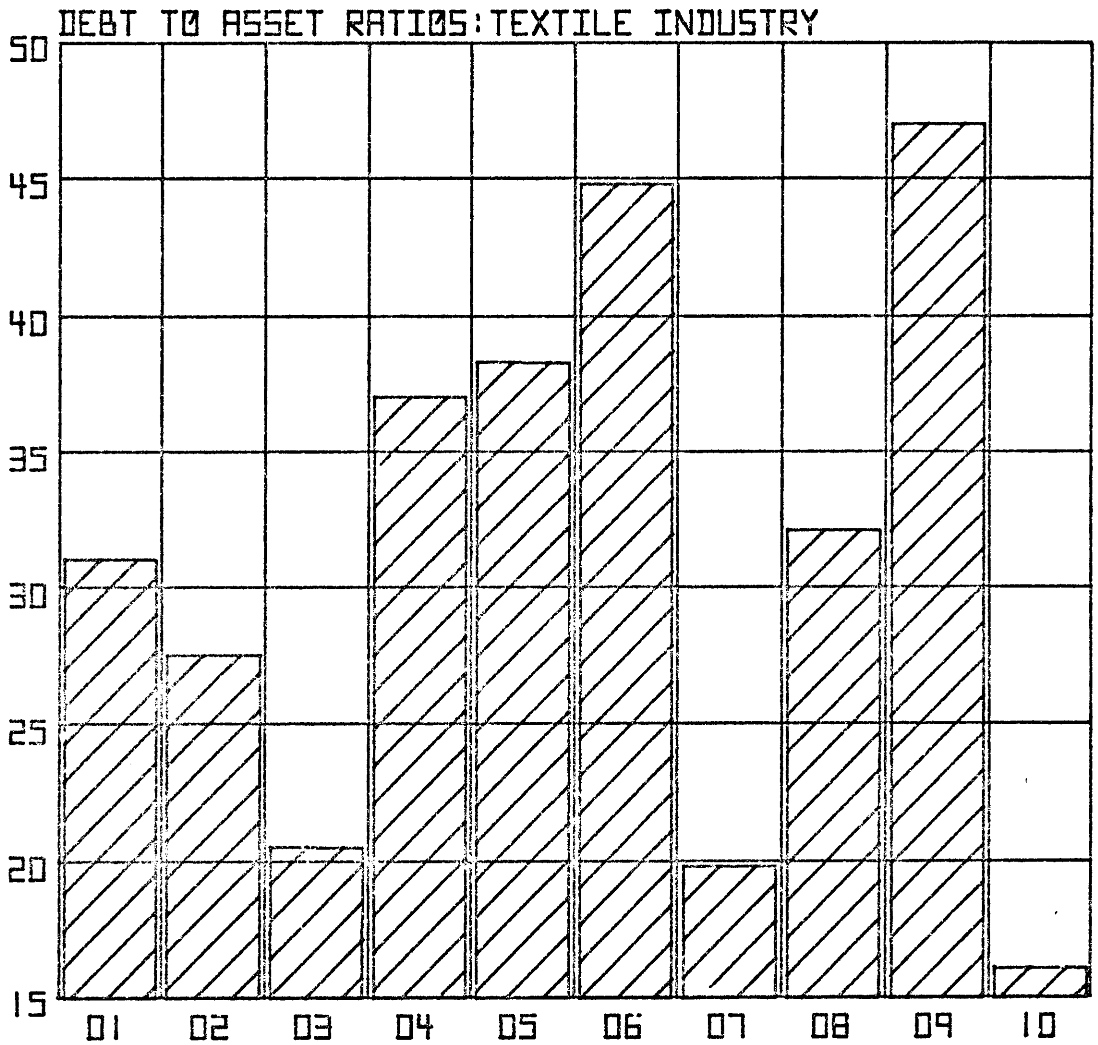
APPENDIX D

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squared Errors	Degrees of Freedom	Mean Squared Error	F Value
Between Industries	19.5	4	4.875	2.13
Within Industries	103.1	45	2.291	
Total	122.6	49		

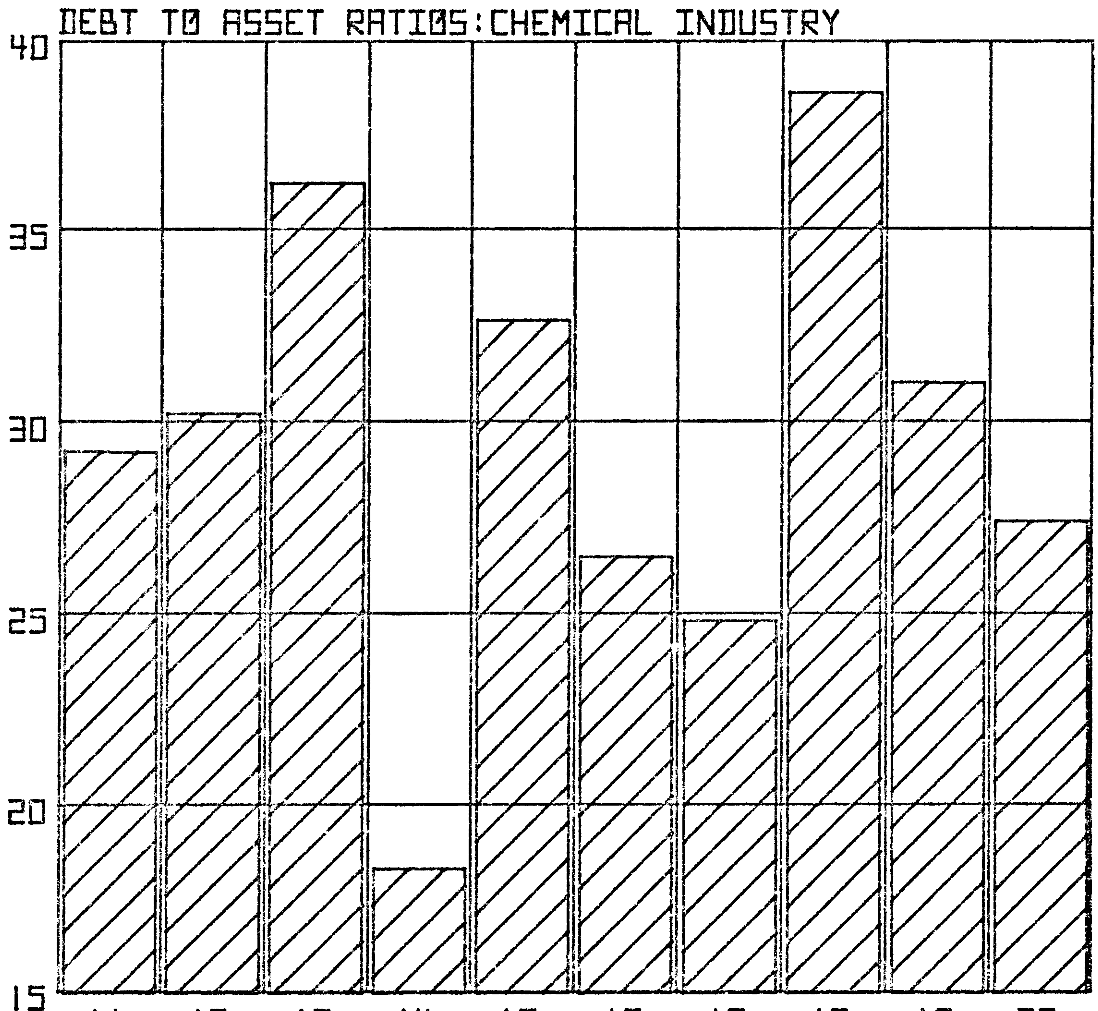
The result <u>is</u> significant with respect to the 90% confidence interval.

APPENDIX E

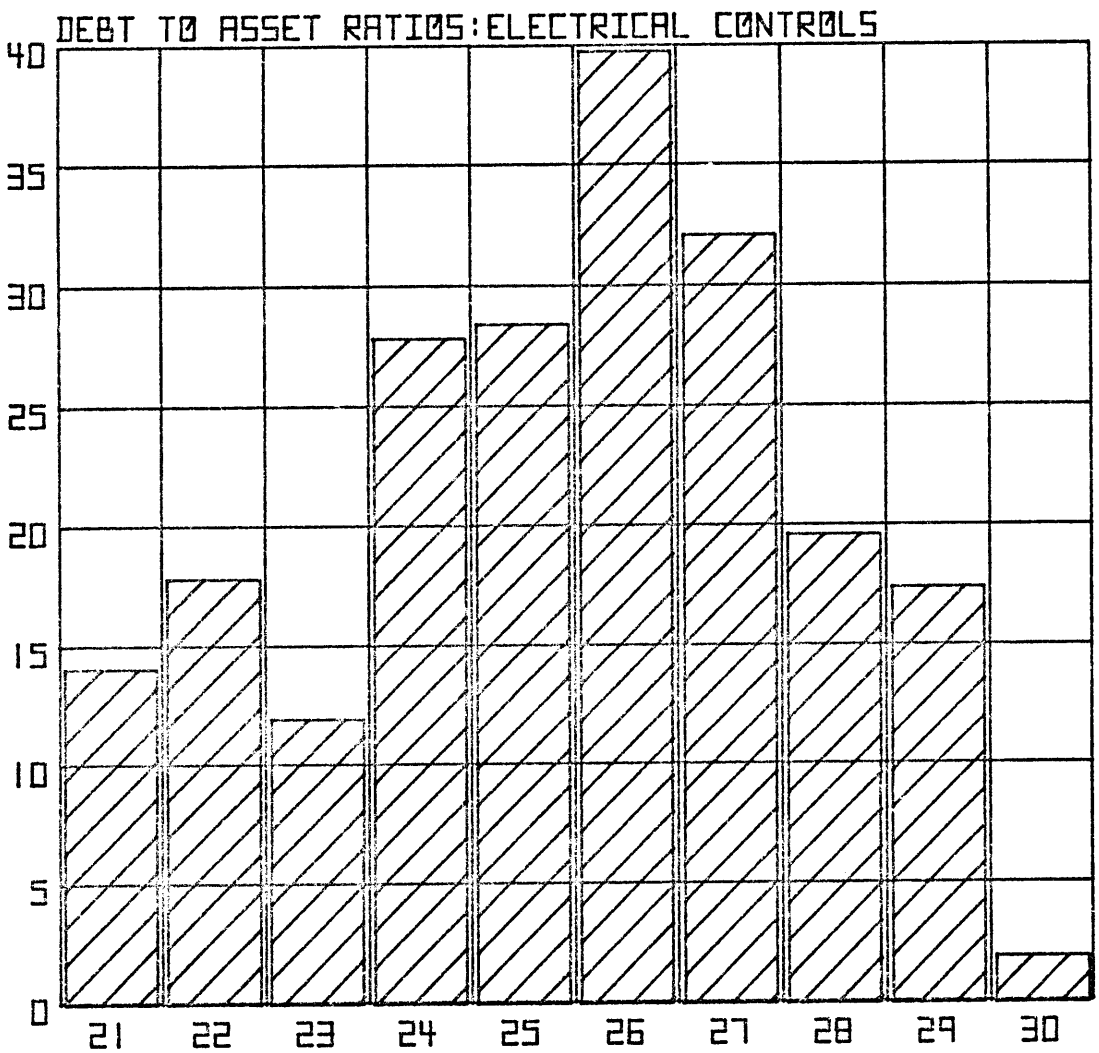


#	Company
1	Burlington Industries Inc.
2	Collins & Aikman Corp.
3	Cone Mills Corp.
4	Dan River Inc.
5	Fieldcrest Mills Inc.

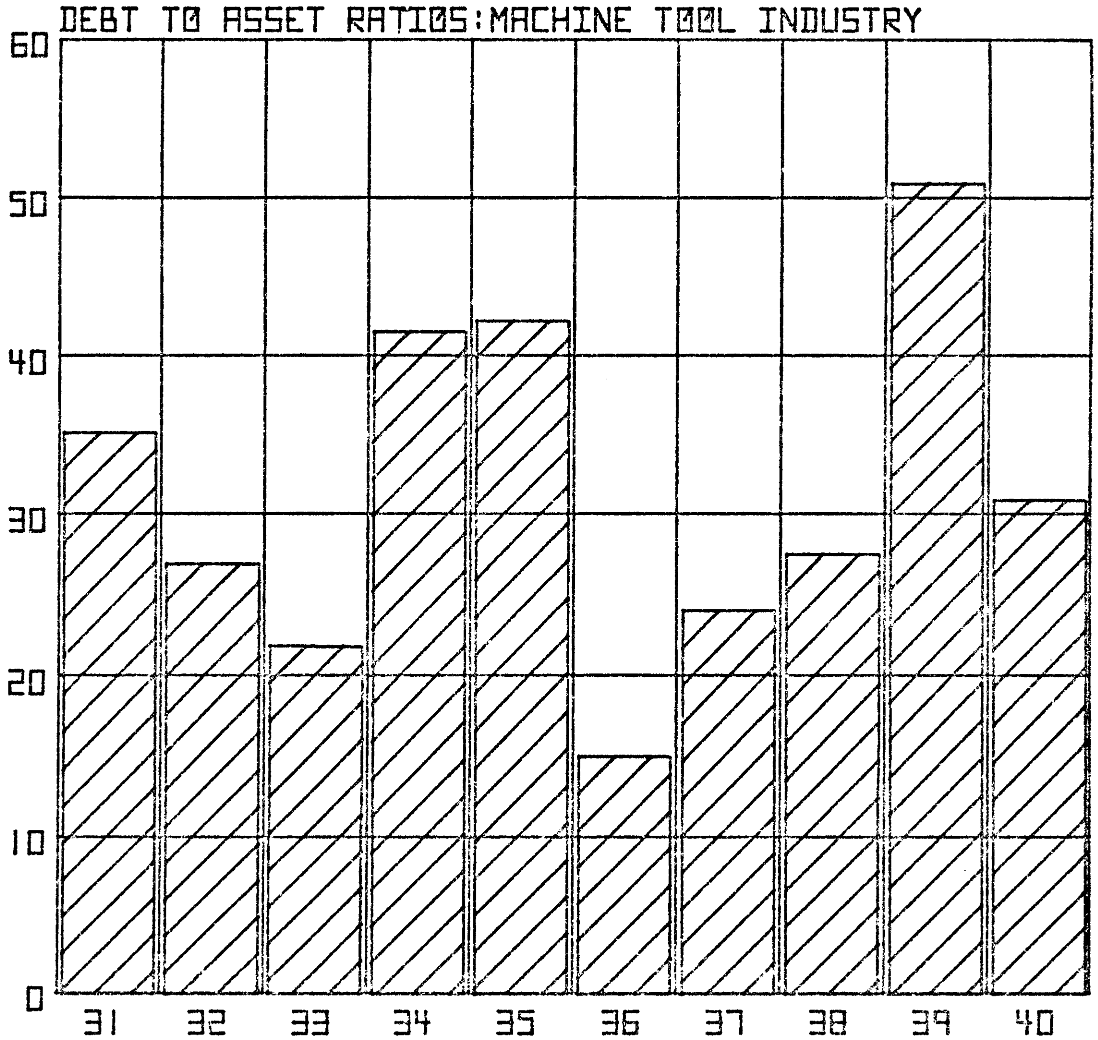
#	Company
6	Lowenstein (M) & Sons
7	Springs Mills Inc.
8	Stevens (J P) & Co.
9	United Merchants & Mfrs.
10	West Point-Pepperell Inc.



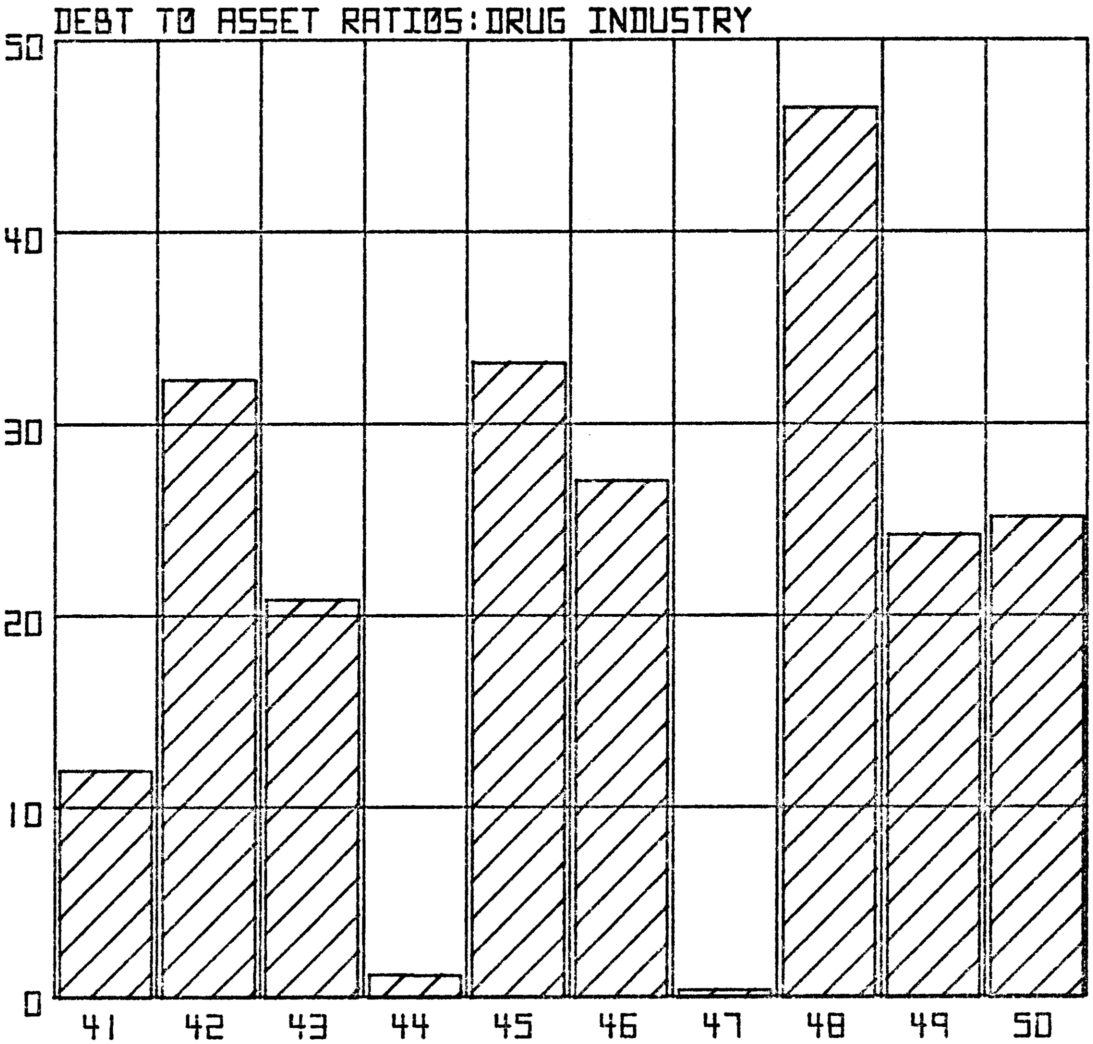
#	Company	#	Company
11	Allied Chemical Corp.	16	Koppers Co. Inc.
12	Celanese Corp.	17	Olin Corp.
13	Dow Chemical	18	Rohm & Haas Co.
14	Dupont (E I) de Nemours	19	Stauffer Chemical Co.
15	Grace (W R) & Co.	20	Union Carbide Corp.



#	Company	#	Company
21	AMP Inc.	26	Leeds & Northrup Co.
22	Burndy Corp.	27	Ranco Inc.
23	Crouse-Hinds Co.	28	Robertshaw Controls Co.
24	Cutler-Hammer Inc.	29	Square D Co.
25	Johnson Controls Inc.	30	Thomas & Betts Corp.

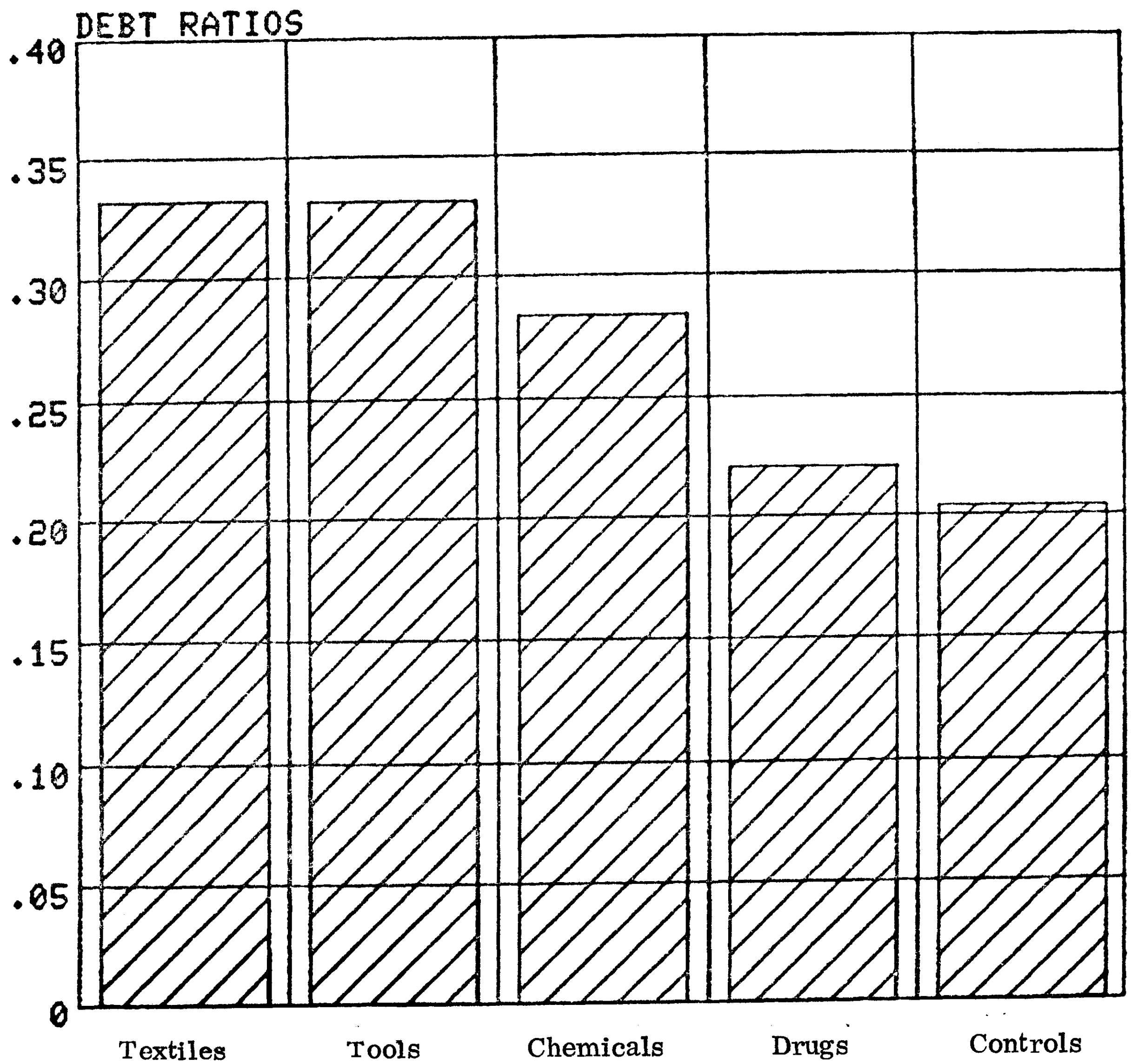


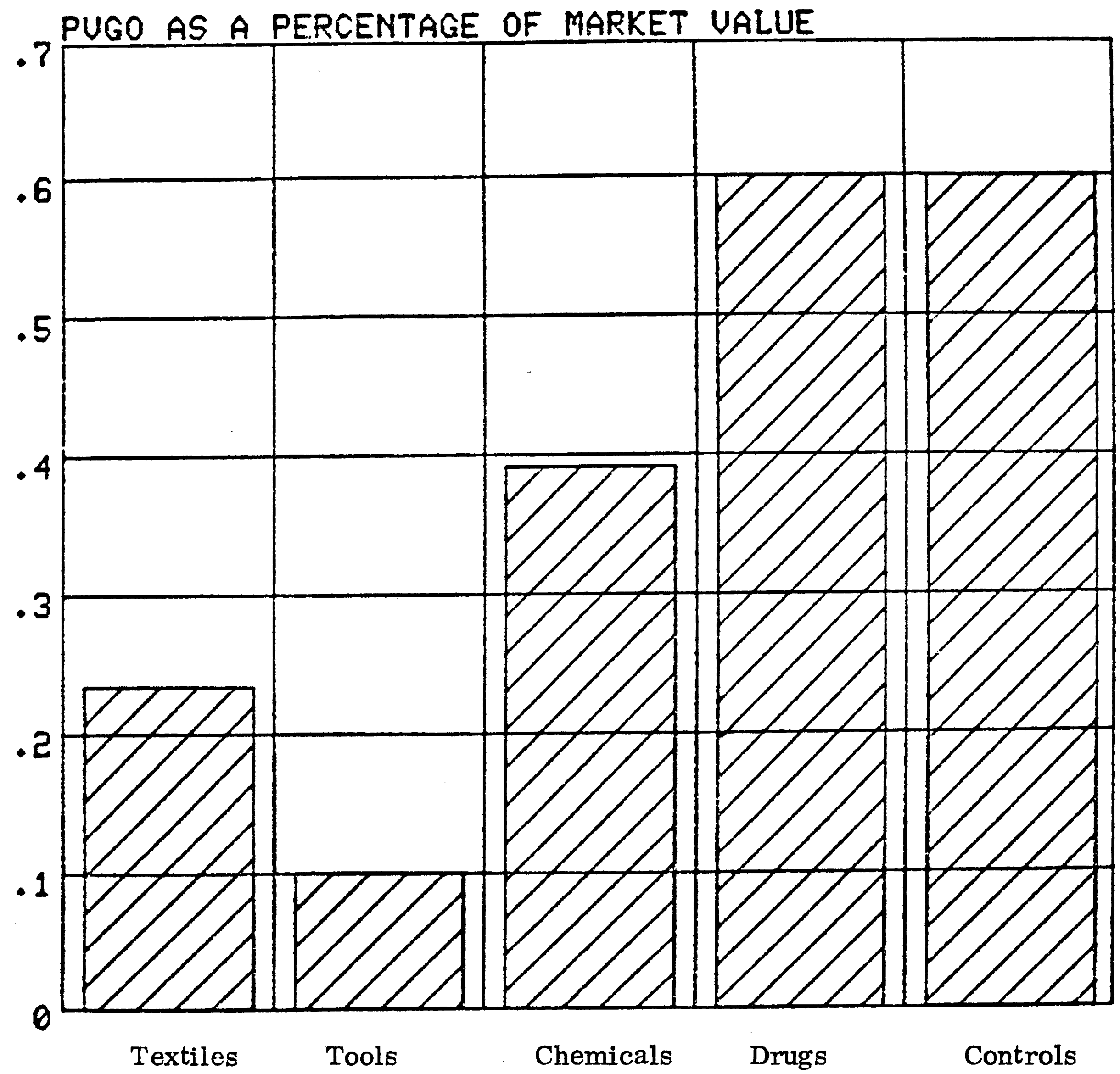
#	Company	#	Company
31	Acme-Cleveland Corp.	36	Kearney & Trecker Corp.
32	Brown & Sharp Mfg. Co.	37	Norton Co.
33	Carborundum Co.	38	Stanley Works
34	Cincinnati Milacron Inc.	39	Sundstrand Corp.
35	Giddings & Lewis Inc.	40	Warner & Swasey Co.



#	Company	#	Company
41	Bristol-Myers Co.	46	Upjohn Co.
42	Pfizer Inc.	47	Schering-Plough Corp.
43	Merck & Co.	48	Searle (G. D.) & Co.
44	Lilly (Eli) & Co.	49	Smithkline Corp.
45	Abbott Laboratories	50	Baxter Travenol Labs

APPENDIX F


DEBT RATIOS
.40
.35
.30
.25
.20
.15
.10
.05
0
Textiles
Tools
Chemicals
Drugs
Controls


PVGO AS A PERCENTAGE OF MARKET VALUE
.7
.6
.5
.4
.3
.2
.1
0
Textiles
Tools
Chemicals
Drugs
Controls

APPENDIX G

Company #	Company Name	Actual Earnings	Normalized Earnings	B	k	PVGO / Mkt. Value	Debt / Assets
1.	Burlington Ind.	39.77	71.46	1.18	15.55	.41	.31
2.	Collins-Aikman	18.37	12.67	1.38	17.27	.00	.275
3.	Cone Mills	24.24	22.00	.87	12.88	.00	.205
4.	Dan River	-2.95	3.63	.81	12.37	.28	.37
5.	Fieldcrest Mills	9.927	5.43	.94	13.48	.25	.383
6.	Lowenstein	-5.89	2.37	1.45	17.87	.65	.448
7.	Springs Mills	10.69	17.16	.63	10.82	.00	.198
8.	Stevens & Co.	19.90	37.04	1.01	14.09	.00	.321
9.	United Merch.	-18.65	3.52	.70	11.42	.55	.47
10.	West Point-P'll	19.76	25.86	1.02	14.17	.00	.161
Industry Total		115.17	201.14			.233	.332

Company #	Company Name	Actual Earnings	Normalized Earnings	B	k	PVGO / Mkt. Value	Debt / Assets
11.	Allied Chemical	116.20	144.90	1.03	14.26	.00	.292
12.	Celanese	50.00	71.06	.79	12.19	.04	.302
13.	Dow Chemical	615.70	672.90	1.25	16.15	.51	.362
14.	Dupont de Nem.	271.80	364.10	.91	13.23	.55	.183
15.	Grace & Co.	166.70	168.20	1.07	14.60	.00	.326
16.	Koppers	60.33	60.18	1.07	14.60	.05	.265
17.	Olin Corp.	59.41	61.72	.77	12.02	.00	.248
18.	Rohm & Haas	22.98	49.17	1.36	17.10	.61	.386
19.	Stauffer Chemical	98.71	100.70	.98	13.83	.21	.310
20.	Union Carbide	381.70	492.60	1.24	16.06	.18	.274
Industry Total		1843.53	2185.53			.392	.284

Company #	Company Name	Actual Earnings	Normalized Earnings	B	k	PVGO / Mkt. Value	Debt / Assets
21.	AMP Inc.	27.77	39.96	1.48	18.13	.77	.14
22.	Burndy Corp.	8.81	9.20	1.69	19.93	.50	.178
23.	Crouse-Hinds Co.	12.82	12.54	1.29	16.48	.10	.119
24.	Cutler-Hammer Inc.	13.94	16.08	1.49	18.21	.12	.278
25.	Johnson Controls	9.32	6.48	1.13	15.12	.08	.284
26.	Leeds & Northrup	4.19	3.04	1.24	16.06	.11	.397
27.	Ranco Inc.	-1.35	1.93	.62	10.73	.00	.321
28.	Robertshaw Controls	2.94	4.10	1.14	15.20	.48	.196
29.	Square D Co.	35.86	36.85	1.22	15.89	.53	.174
30.	Thomas & Betts	13.26	15.61	1.31	16.67	.64	.019
Industry Total		127.56	145.79			.60	.204

Company #	Company Name	Actual Earnings	Normalized Earnings	B	k	$\frac{\text{PVGO}}{\text{Mkt. Value}}$	$\frac{\text{Debt}}{\text{Assets}}$
31.	Acme-Cleveland	6.96	8.38	.98	13.83	.00	.351
32.	Brown & Sharp	-.39	1.47	1.17	15.46	.269	.269
33.	Carborundum	27.19	29.15	1.32	16.75	.084	.218
34.	Cincinnati Milacron	9.95	13.75	.93	13.40	.00	.415
35.	Giddings & Lewis	5.07	4.15	1.83	21.14	.019	.422
36.	Kearney & Trecker	5.70	2.85	2.40	26.04	.69	.150
37.	Norton Co.	20.89	25.43	.81	12.37	.00	.240
38.	Stanley Works	17.39	19.07	.97	13.74	.21	.275
39.	Sundstrand Corp.	21.97	24.42	1.95	22.17	.02	.509
40.	Warner & Swasey	6.02	9.19	1.37	17.18	.02	.309
Industry Totals		120.75	137.85			.10	.331

Company #	Company Name	Actual Earnings	Normalized Earnings	B	k	PVGO / Mkt. Value	Debt / Assets
41.	Bristol-Myers Co.	141.70	140.10	1.24	16.06	.60	.119
42.	Pfizer Inc.	147.70	150.30	1.17	15.46	.49	.323
43.	Merck & Co.	228.80	235.40	.95	13.57	.67	.208
44.	Lilly (Eli) & Co.	181.30	197.10	.99	13.91	.60	.012
45.	Abbott Laboratories	70.67	72.15	1.29	16.49	.61	.332
46.	Upjohn Co.	66.75	75.30	.42	9.01	.34	.270
47.	Schering-Plough	138.90	147.30	1.03	14.26	.63	.004
48.	Searle (GD) & Co.	80.54	84.61	1.25	16.15	.32	.464
49.	Smithkline Corp.	63.59	63.18	1.06	14.52	.50	.242
50.	Baxter Travenol	44.47	43.98	1.49	18.21	.81	.251
Industry Total		1164.42	1209.42			.60	.221

APPENDIX H

RESULTS OF MODEL # 1 REGRESSION

$$D/A = .375010 - .261325 * \%PVGO$$
$$(21.2566) \quad (6.41558)$$

Where:

D/A : Ratio of Book Value of Debt to Book Value of Assets for the industry

%PVGO : Ratio of Present Value of Growth Opportunities to Market Value of Equity for the industry

Summary Statistics

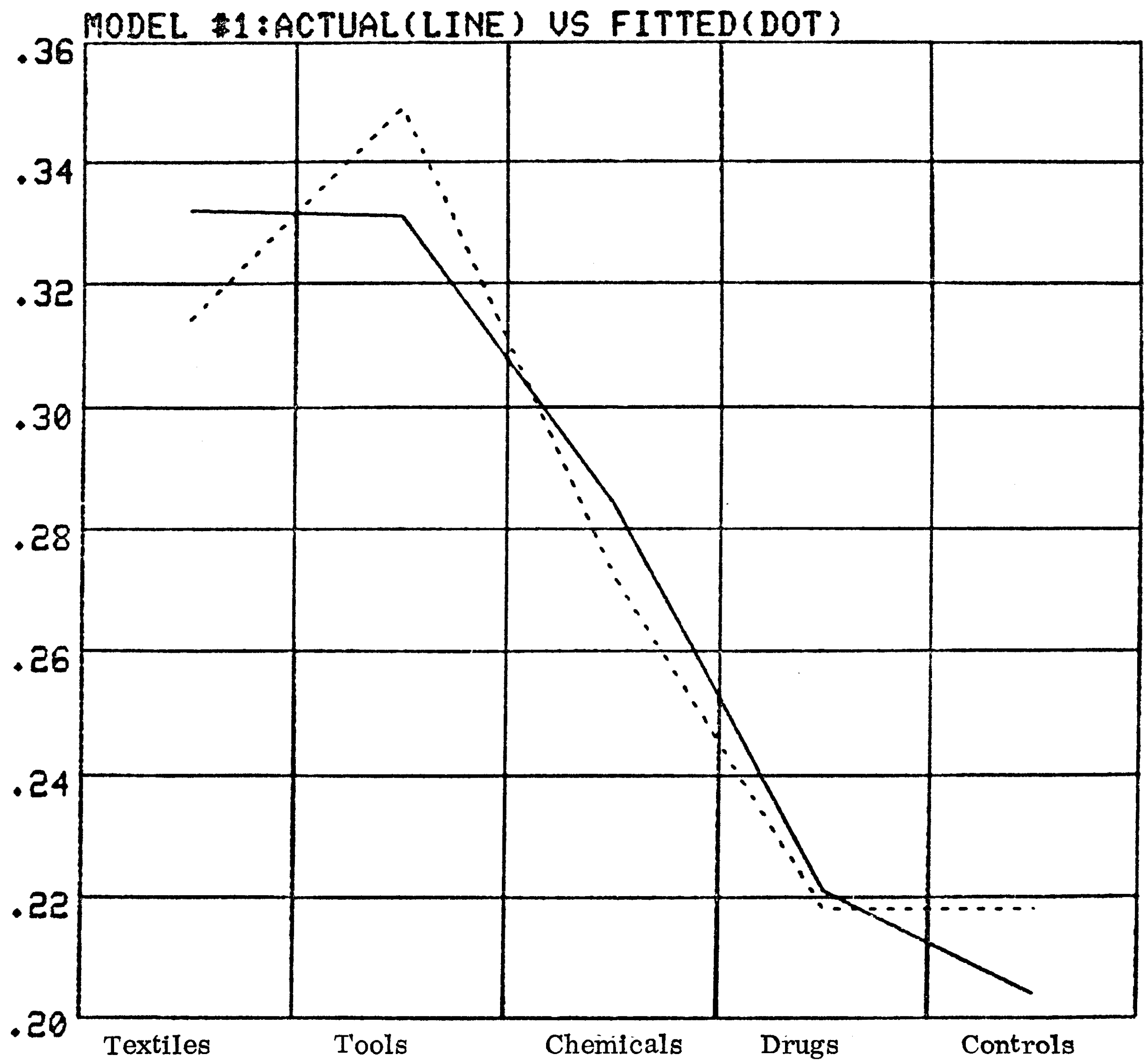
$\bar{R}$-Squared : .9094

Durbin-Watson : 1.1632

Standard Error : .0180712

Right-Hand Variable	Partial Correlation	Mean	Elasticity at Mean
%PVGO	-.965435	.385	-.366654

[Numbers in parentheses are T-statistics for regression coefficients]


MODEL #1:ACTUAL(LINE) VS FITTED(DOT)
.36
.34
.32
.30
.28
.26
.24
.22
.20
Textiles
Tools
Chemicals
Drugs
Controls

RESULTS OF MODEL # 2 REGRESSION

$$D/A = .341647 - .358477 * (\%PVGO)^2$$
$$\quad\quad (47.5862) \quad\quad (11.9387)$$

Where:

D/A : Ratio of Book Value of Debt to Book Value of Assets for the industry

%PVGO : Ratio of Present Value of Growth Opportunities to Market Value of Equity for the industry

Summary Statistics

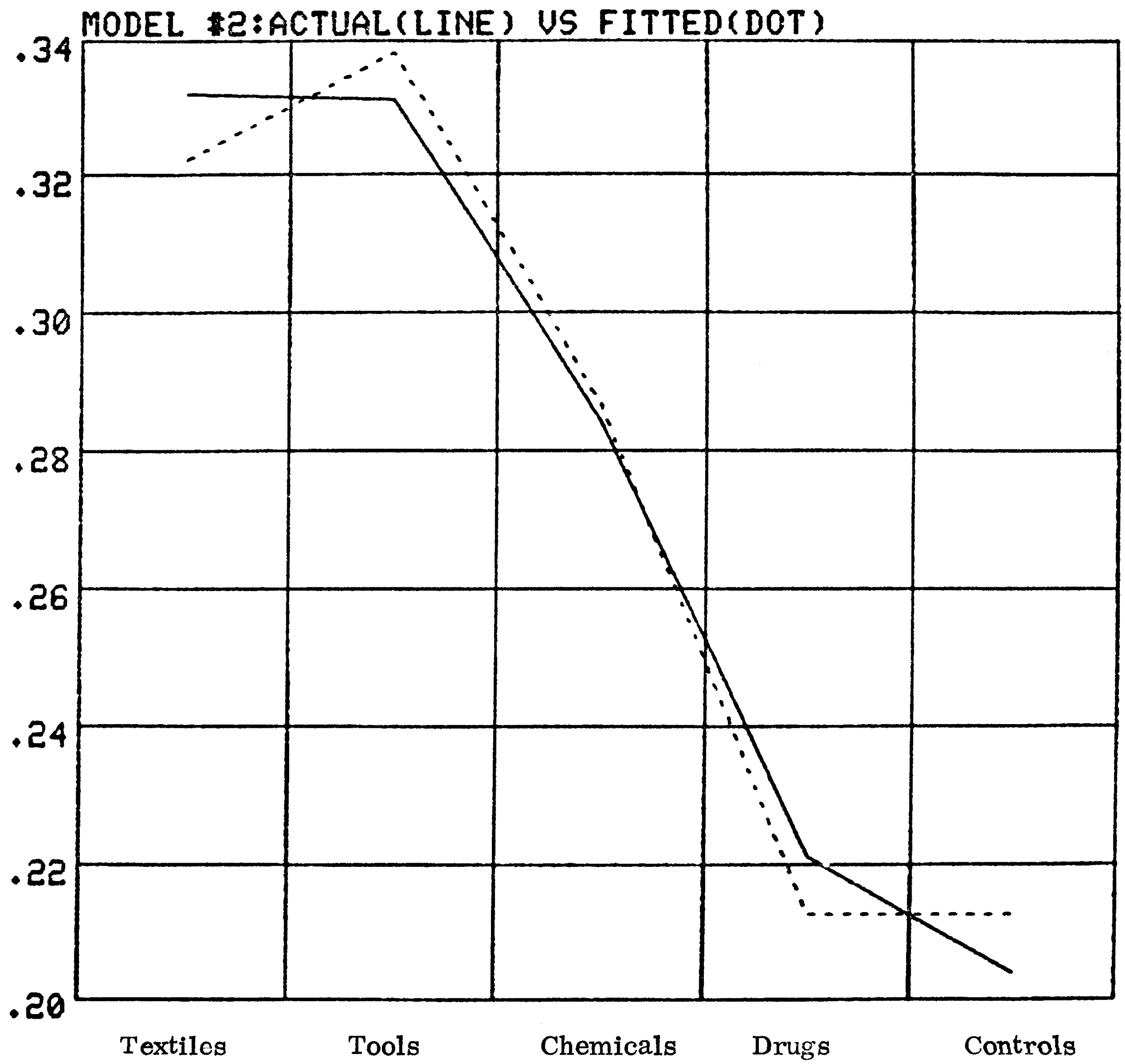
$\bar{R}$-Squared : .9725

Durbin-Watson : 1.4503

Standard Error : .0099545

Right-Hand Variable	Partial Correlation	Mean	Elasticity at Mean
$(\%PVGO)^2$	-.989639	.187591	-.245069

[Numbers in parentheses are T-statistics for regression coefficients.]



MODEL #2:ACTUAL(LINE) VS FITTED(DOT)
.34
.32
.30
.28
.26
.24
.22
.20
Textiles
Tools
Chemicals
Drugs
Controls

RESULTS OF MODEL # 3 REGRESSION

$$\text{LOG (D/A)} = \underset{(14.0938)}{-1.61072} - \underset{(3.02369)}{.260142} * \text{LOG(\%PVGO)}$$

Where:

D/A : Ratio of Book Value of Debt to Book Value of Assets for the industry

%PVGO : Ratio of Present Value of Growth Opportunities to Market Value of Equity for the industry

Summary Statistics (transformed into levels)

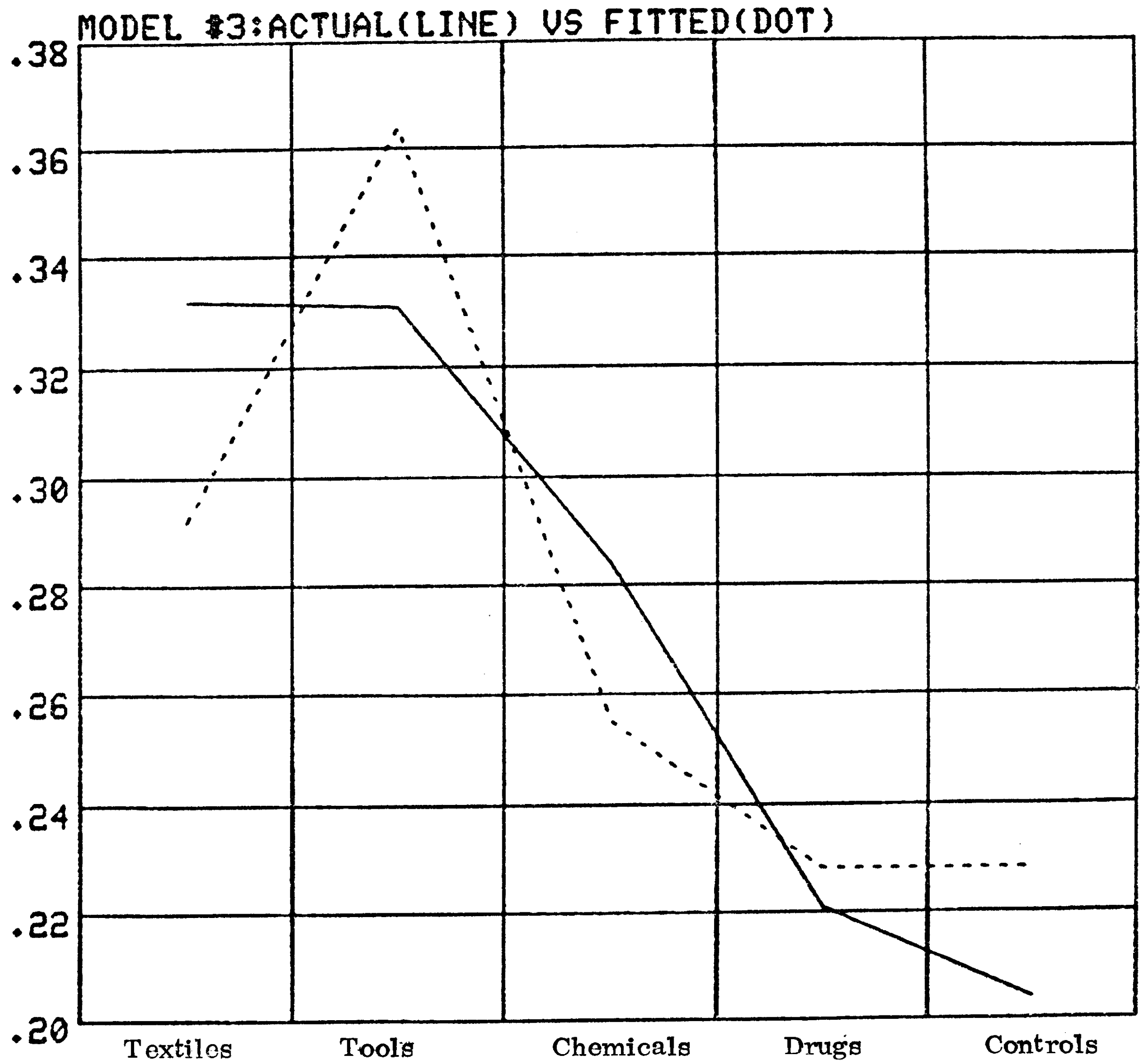
$\bar{R}$-Squared : .7113

Durbin-Watson : .8850

Standard Error : .0322619

Right-Hand Variable	Partial Correlation	Mean	Elasticity at Mean
LOG(%PVGO)	-.867720	-1.14349	-.226513

[Numbers in parentheses are T-statistics for regression coefficients.]


MODEL #3:ACTUAL(LINE) VS FITTED(DOT)
.38
.36
.34
.32
.30
.28
.26
.24
.22
.20
Textiles
Tools
Chemicals
Drugs
Controls

APPENDIX I

RESULTS OF INDIVIDUAL FIRM REGRESSION FOR MODEL #1

$$D/A = \underset{(5.16869)}{.266795} - \underset{(2.24855)}{.0795248}*(\%PVGO) + \underset{(1.19)}{.064}*X1 + \underset{(.835)}{.045}*X2 - \underset{(.583)}{.029}*X3 + \underset{(1.04)}{.059}*X4$$

Where:

D/A : Debt to Asset ratio for each firm

%PVGO : Ratio of Present Value of Growth Opportunities to Market Value for the firm

X1 : Dummy Variable for Textile Industry

X2 : Dummy Variable for Chemical Industry

X3 : Dummy Variable for Control Industry

X4 : Dummy Variable for Tool Industry

Summary Statistics

R-Squared : .0956

Durbin-Watson : 2.4136

Standard Error : .10849

[Numbers in parentheses are T-statistics for regression coefficients.]

APPENDIX J

RESULTS OF MODIFIED MODEL # 1 REGRESSION

$$\text{DEBT} = \underset{(139.063)}{1.038} * (\text{ASSET} * \text{FIT})$$

Where:

DEBT : Nominal level of debt for the industry (in millions of dollars)

ASSET : Nominal level of assets for the industry (in millions of dollars)

FIT : Fitted values for Model # 1

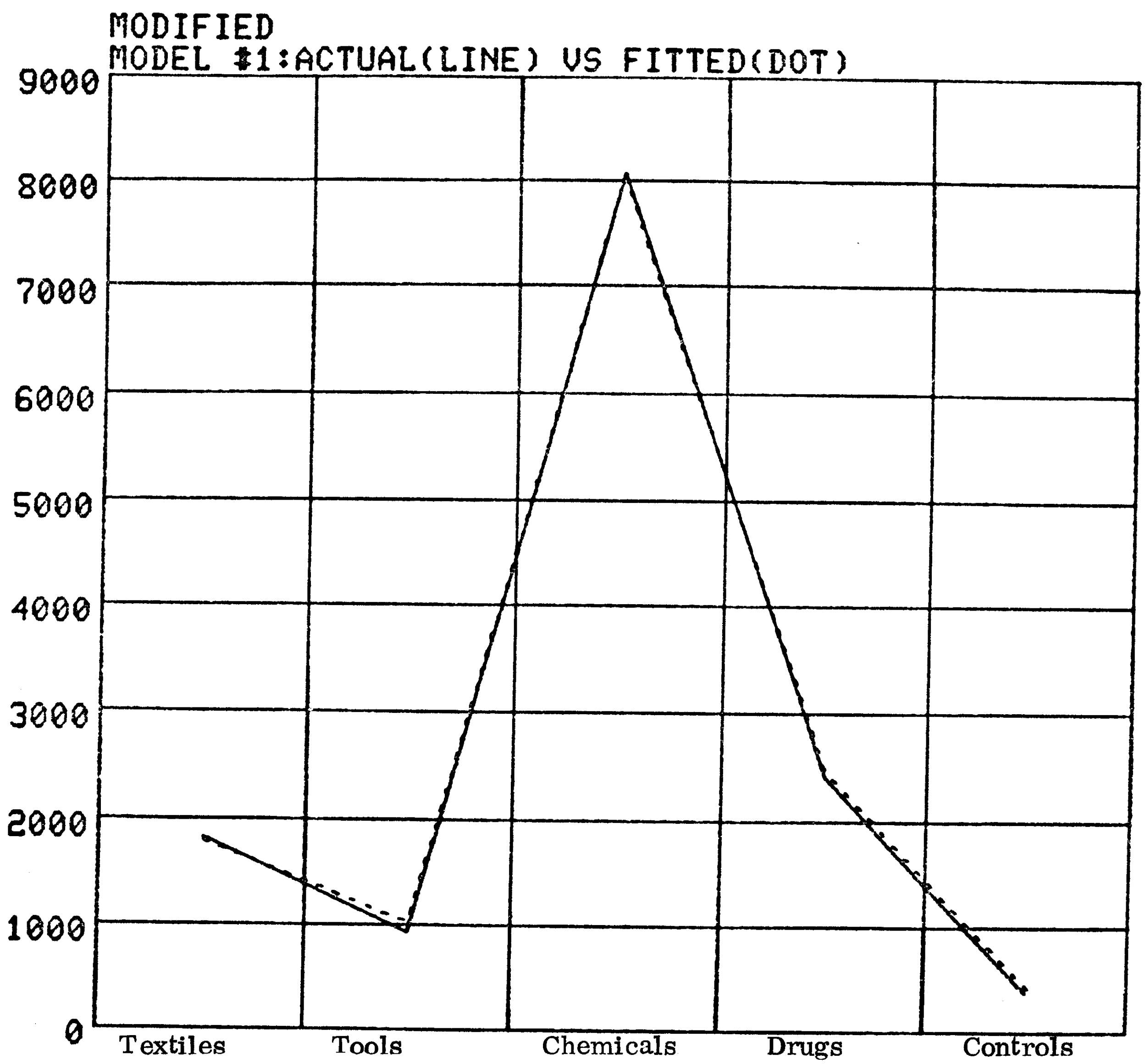
Summary Statistics

$\bar{R}$ - Squared : .9996

Durbin-Watson : .4738

Standard Error : 62.4115

[Numbers in parentheses are T-statistics for regression coefficients.]


MODIFIED
MODEL #1:ACTUAL(LINE) VS FITTED(DOT)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Textiles
Tools
Chemicals
Drugs
Controls

RESULTS OF MODIFIED MODEL # 2 REGRESSION

DEBT = .995328 * (ASSET * FIT)
(139,688)

Where:

DEBT : Nominal level of debt for industry (in millions of dollars)

ASSET : Nominal levels of assets for industry (in millions of dollars)

FIT : Fitted values for Model # 2

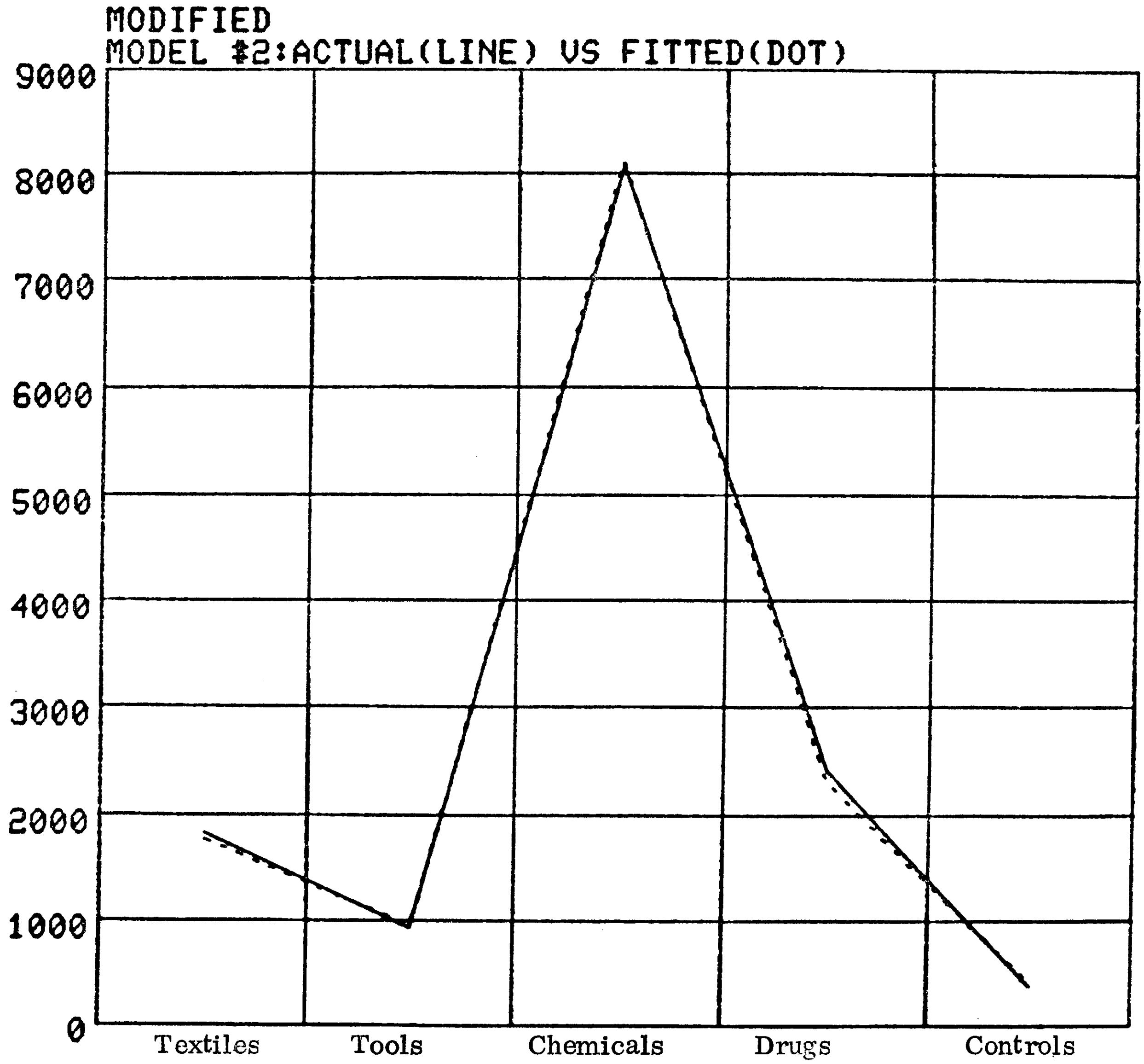
Summary Statistics

$\bar{R}$ - Squared : .9996

Durbin-Watson : 1.5412

Standard Error : 62.1324

[Numbers in parentheses are T-statistics for regression coefficients.]


MODIFIED
MODEL #2:ACTUAL(LINE) VS FITTED(DOT)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Textiles
Tools
Chemicals
Drugs
Controls

RESULTS OF MODIFIED MODEL # 3 REGRESSION

DEBT = 1.09555 * (ASSET * FIT)
(42.1408)

Where:

DEBT : Nominal level of debt for industry (in millions of dollars)

ASSET : Nominal level of assets for the industry (in millions of dollars)

FIT : Fitted values for Model # 3 (transformed to levels.)

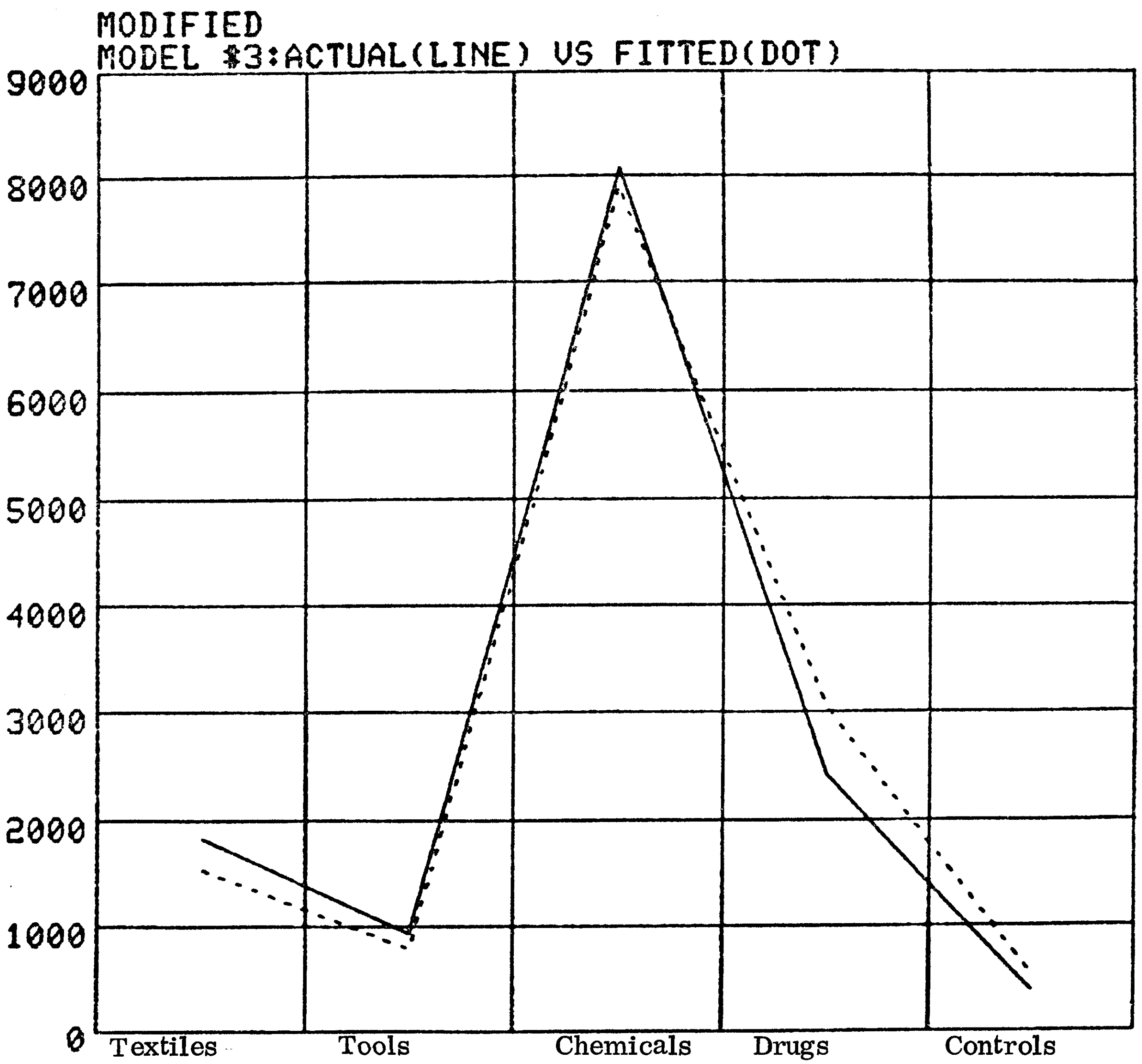
Summary Statistics

$\bar{R}$ - Squared : .9956

Durbin-Watson : .4614

Standard Error : 205.745

[Numbers in parentheses are T-statistics for regression coefficients.]


MODIFIED
MODEL $3:ACTUAL(LINE) VS FITTED(DOT)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Textiles
Tools
Chemicals
Drugs
Controls

APPENDIX K

RESULTS OF INTEREST-COVERAGE REGRESSION # 1

$$\Delta D/\Delta A = \underset{(1.87940)}{.679456} - \underset{(.475619)}{.0458884} * (E/I)$$

Where:

$\Delta D/\Delta A$: Change in Debt divided by Change in Assets for the industry (1975 minus 1974)

E/I : Ratio of Earnings to Interest Payments for the industry

Summary Statistics

$\bar{R}$ - Squared : 0.0

Durbin-Watson : .8115

Standard Error : .527887

[Numbers in parentheses are T-statistics for regression coefficients.]

RESULTS OF INTEREST-COVERAGE REGRESSION # 2

$$D/A = .309771 - .0114 * (E/I)$$
$$\quad (6.41946) \quad (.89297)$$

Where:

D/A : Debt to Asset ratio for the industry

E/I : Ratio of Earnings to Interest Payments for the industry

Summary Statistics

$\bar{R}$-Squared : 0.0

Durbin-Watson : 2.8309

Standard Error : .061625

[Numbers in parentheses are T-statistics for regression coefficients]

APPENDIX L

RESULTS OF DEBT VS EARNINGS MODEL

$$D/A = .367382 - 1.53219 * E/A$$
$$(8.76513) \quad (2.45292)$$

Where:

D/A : Ratio of Book Value of Assets to Book Value of Debt for the industry

E/A : Ratio of the Book Value of Earnings to Book Value of Assets for the industry

Summary Statistics

R-Squared : .5564

Durbin-Watson : 2.8466

Standard Error: .03999

[Numbers in parentheses are T-statistics for regression coefficients.]

APPENDIX M

RESULTS OF DEBT VS VOLATILITY MODEL

$$D/A = .23532 + .132028 * SE/E$$
$$\quad\quad (6.699) \quad\quad (1.0023)$$

Where:

D/A : Ratio of Book Value of Assets to Book Value of Debt for the industry

SE/E : Ratio of the Standard Error of the Normalized Earnings regressions (summed over firms) to Earnings for the industry

Summary Statistics

R-Squared	:	.2361
Durbin-Watson	:	3.4776
Standard Error	:	.052478

[Numbers in parentheses are T-statistics for regression coefficients.]

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